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Financial Constraints and Labor Management in Entrepreneurial Firms

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Abstract

We model the contrasting capital-labor decisions and work practices of financially constrained and unconstrained firms. We show that financially restricted firms use relatively more labor than capital because informed employees provide more efficient financing than uninformed capital suppliers. We demonstrate that constrained firms find it hard to attract new employees and thereby replace existing staff. This aligns owner-worker incentives and encourages workers to co-specialize with colleagues, so constrained firms grant more discretion to employees and more frequently produce in teams. Empirical tests on two data sets of small businesses confirm the central implications of the theory.

Introduction

Small entrepreneurial firms and large companies have very different labor management policies. One important distinction is that small firms are much more labor-intensive in their production processes. For example, data from the 1997 Economic Census show that the average sales-to-employee ratio for firm with 500 or more employees is \$212,288, while for firms with fewer than 500 employees the average ratio is \$136,917. A second disparity is that survey and anecdotal evidence consistently show that entrepreneurial work environments are more flexible, informal and cooperative.¹ What explains these different uses of labor in small and large firms? Is there a connection between small firms' heavy reliance on labor and their non-hierarchical, group-oriented modes of production? In this paper, we argue that it is the financially constrained status of many small firms that drives both their relatively high employment levels and their strategies of decentralized decision-making and production in teams.

We develop a model in which there are both constrained and unconstrained entrepreneurs. Financially restricted firms must seek vendor financing from their suppliers. We presume that the supplier of labor (i.e., a worker) learns about the firm in the course of production, while the supplier of capital (e.g., someone leasing equipment to the entrepreneur) does not receive information until production is complete. The worker's ability to learn in the course of performing his duties enables him to exploit the real option to quit the firm if the entrepreneur's quality is revealed to be low. Workers are thus willing to join risky new businesses, even without an initial compensatory payment, because they will remain only with successful ventures. Suppliers of capital do not learn the entrepreneur's quality as quickly as workers do, and hence can only rent out their assets to firms with the resources to offer some fee in advance. Constrained firms' inability to offer their suppliers cash up front thus leads them to make greater use of labor rather than capital in production.

We then demonstrate that financially restricted firms find it hard to attract new employees (and thereby replace existing staff), and hence current workers can expect to receive a larger share of future firm profits in these firms. This has two implications for optimal labor management. First, in constrained firms workers have incentives that are better aligned with the owner, so the entrepreneur is more likely to grant the employees discretion over project selection. Second, workers at constrained firms are less concerned with the replacement of both themselves and their colleagues, so they are more willing to invest in the coordination and co-specialization required

¹Examples include Wilkinson (1999) and "Nine to Five - No Comparison: Having worked for both large and small companies, These executives have come to the same conclusion: Small is better," *Wall Street Journal*, May 22, 1997, p. R.10.

when producing in teams.

Our theoretical predictions on the capital-labor decision and work practices of constrained and unconstrained firms are tested in two data sets of small firms. Consistent with the implications of the model, we find that, controlling for firm size, age and industry, financially restricted firms have lower capital-labor ratios, allow more employee autonomy and more frequently produce in groups. Our theory suggests, and our empirical work largely confirms, that financial constraints, independent of firm size or age, can have a substantial effect on the way a firm manages its employees.

The idea that a firm's capital structure can affect firm-employee relations has been the subject of a number of recent empirical papers. Hanka (1998) shows that debt-laden firms lay off employees more often and use more seasonal employees. In a study of firms experiencing short-term financial distress, Ofek (1993) finds that firms with high pre-distress levels of debt are more likely to discharge workers. Kang and Shivdasani (1997) show that restructurings in Japan lead to layoffs more frequently when the firm's main bank and other blockholders have larger ownership stakes. Bronars and Deere (1991) argue that firms issue debt to reduce the cash flows available to unions. The thrust of these papers is that firms with substantial debt facing severe financial constraints lay off workers more frequently. Our model incorporates this feature, but it also emphasizes that financially restricted firms find it difficult to hire new workers. Constrained firms are thus more likely to be forced due to a lack of resources to lay off workers, but are less likely to engage in discretionary dismissals. The optimal labor management of constrained firms, as described in this paper, takes this dichotomy into account.

The difficulty with which employees are replaced in constrained firms encourages workers to interest themselves in the long-term profits of the firm and to make investments in their relationships with other workers. These beneficial effects of financial constraints can help to offset the costs of lost flexibility and the risk of bankruptcy. One stream of the literature on financial market imperfections (Peek and Rosengren (2000), Cetorelli and Gambera (2001), Klein, Peek, and Rosengren (2002), and Burgess and Pande (2003)) has emphasized the damage that poorly functioning national or local credit markets can cause to investment and growth. Our model recognizes these costs, but suggests that when the gains from granting employees discretion or producing in teams are large, the relative disadvantage to being constrained may be small. A firm's inability to fire its employees can induce workers to make choices that benefit the entrepreneur.

Measuring the effects of financial constraints on a firm's employment and management strategies requires a reasonable proxy for having limited access to credit. Using data from the 1998

National Survey of Small Business, we analyze the owner characteristics that are associated with loan rejections and then consider the capital-labor ratios of firms that are more likely to have loan applications denied. We do not simply regress capital-labor ratios on whether a firm's application was denied, since firms with little capital to serve as collateral might be more likely to be rejected, thereby generating an endogenous relationship. Instead we show that local bank concentration, the owner's African-American or Hispanic status, the owner's net worth and the firm's credit score are all good predictors of bank loan rejection or acceptance and hence make for good instruments for financial constraints. We then show the instruments associated with bank loan rejection also predict low capital-labor ratios, as suggested by our theory. To test the implications of the theory for the discretion and teamwork policies of the firm, we make use of data from the 1996-1997 National Organizations Survey. Relying on the previously described results (and related evidence in Hannan (1997) and Berger, Rosen, and Udell (2001)), we proxy for financial constraints with the Herfindahl concentration of the local banking market, local home values and the ethnic composition of the workforce. We find that firms in concentrated banking markets and low-home-value areas are more likely to have workers involved in team production and to grant greater decision-making authority to lower-level employees. These results match the predictions of the theory.

Our theoretical analysis of the optimal utilization and organization of labor is related to the study of organization design. Harris and Raviv (2002), Dessein and Santos (2003), Vayanos (2003) and Garicano (2002) consider the optimal structure of hierarchies and coordination within firms. We differ from this research in that we take the structure of the firm as given, and examine instead how employment levels and discretion and teamwork policies vary with a firm's financial status. Our emphasis on the interrelationship between the financial constraints binding a firm and its employee management strategy distinguishes this paper from previous work.

Several previous studies have explored the effects of the financing environment on the success of entrepreneurial firms and evaluated the comparative advantages of bank and venture capital finance (Black and Strahan (2002), Black and Gilson (1998), Ueda (2004) and Inderst and Muller (2004)). While our theoretical model does analyze the conditions under which constrained firms are relatively advantaged, we do not examine the optimal source of financing for entrepreneurs; our central focus is on the optimal labor strategies for firms to undertake, given that they find it difficult to obtain credit. In essence, the model proposes recommendations about the best ways for constrained and unconstrained firms to manage their employees, and the empirical evidence we provide suggests that firms do to some extent adopt these strategies.

We find that financially constrained firms should have lower capital-labor ratios, which complements the literature showing that small firms are typically less capital intensive (Oi (1983), Kimuna (2001) and Dupuy and de Grip (2003)). Small firms are more likely constrained than their larger counterparts so, consistent with this work, our theory suggests that they employ less capital. In the empirical section we show that even among small firms, those that are more constrained use relatively more labor. Small firms are responsible for roughly 50 percent of U.S. nonfarm, private GDP (Headd (2000)), so their strategies for setting employment levels and choosing work practices have crucial implications for the overall allocation and organization of human and physical capital in the economy.

The rest of the paper is organized as follows. We introduce the basic model in Section 1 and provide results on the optimal capital-labor choices of financially constrained and unconstrained firms. In Section 2 we extend the model to provide an analysis of the effects of financial constraints on a firm's strategies in allocating decision-making power and organizing production in teams. Section 3 describes a series of empirical tests that support the central implications of the model. We conclude the paper in Section 4. Formal proofs of the results are given in the Appendix.

1 Theoretical Model

We model an entrepreneur with a new business idea. Production takes place over two periods, and it requires either labor or capital, which we will assume for simplicity to be perfect substitutes. The entrepreneur chooses the mode of production (labor or capital) at the beginning of the first period. The idea of the entrepreneur and the labor or capital are then used to generate output. Labor may be hired, but capital may be either purchased or rented (i.e., human capital is inalienable (Hart and Moore, 1994)). If the labor or capital input is hired, the supplier of the input acquires some bargaining power over the entrepreneur; we will assume that the output is not verifiable and that bargaining takes place over its division. If the capital is purchased, all output belongs to the entrepreneur.

Arrangements for second period production are made before the completion of first period production, but after some information has been revealed about the productivity of the various parties. The entrepreneur may fire the labor or cease renting the capital, and the suppliers of labor and capital may terminate their relationship with the entrepreneur. If both the entrepreneur and the owner of the necessary input choose to continue the relationship, then it is continued. Otherwise, each party must find a different match for the second period. At the conclusion of

second period production, the business is closed down and all assets have no further value.

The productiveness of the entrepreneur's idea is given by f . If labor is hired, the quality of the match between the labor and the idea is q . If capital is hired or purchased, the quality of the match between the capital and the idea is r . Total firm output π is given by

$$\pi(f, q, r) = \begin{cases} f + q & \text{if labor is hired} \\ f + r & \text{if capital is hired} \end{cases} \quad (1)$$

If labor is hired or capital is rented, then, in the course of the production process, the entrepreneur and the supplier of the selected input bargain over the non-verifiable output. Since both the input and the entrepreneur are necessary for production, we will assume that the entrepreneur receives a fraction $1 - \theta$ of the output, where $\theta \in (0, 1)$, with the remainder going to the input supplier (Binmore, Rubinstein and Wolinsky, 1986). Both labor and capital have opportunity costs, which we denote by $\epsilon > 0$ for labor and $\zeta > 0$ for capital. Any labor or capital not employed by the entrepreneur in a given period receives its opportunity cost as payoff that period. We denote the means of f , q and r by $\bar{f} = E[f]$, $\bar{q} = E[q]$ and $\bar{r} = E[r]$. We assume that $f \in [f_{min}, f_{max}]$, $q \in [q_{min}, q_{max}]$ and $r \in [r_{min}, r_{max}]$, where $f_{min} > 0$, $r_{min} > 0$ and $q_{min} > 0$. For convenience we assume that f , q and r have full support over these ranges, and for simplicity we set the discount rate to be zero. Capital may be purchased or sold for 2ζ before the first period and for ζ before the second period.

We distinguish between two types of entrepreneurs. Financially constrained entrepreneurs have no wealth with which to pay suppliers of capital or labor. Financially unconstrained entrepreneurs have limitless wealth at their disposal. A given entrepreneur is constrained with probability $\delta \in (0, 1)$.

We assume that the entrepreneurial venture is risky and, on average, not profitable for the suppliers of the inputs (see, for example, Hamilton (2000), Moskowitz and Vissing-Jorgensen (2002) and Audretsch (1991)).

Specifically, we have

Assumption A:

$$\theta (\bar{f} + \bar{q}) < \epsilon. \quad (2)$$

Assumption B:

$$\theta (\bar{f} + \bar{r}) < \zeta. \quad (3)$$

Even though in any given period the unconditional expected payoff to the supplier of labor or capital is less than his opportunity cost, we will show that under certain conditions a necessary input will nonetheless be supplied. This can occur for two reasons. First, the supplier in the first period has the power to remain with profitable firms and abandon unpromising ventures. This real option can generate sufficient expected profits to encourage supplier participation in the entrepreneurial firm. Second, unconstrained entrepreneurs can offer a retention payment (to an existing supplier) or a signing payment (to a new supplier) to induce the participation of a supplier in their firm.

In addition to the fact that labor cannot be purchased, a second important difference between labor and capital in the model is that the supplier of labor (i.e. a worker) is capable of learning about the firm in the course of production, while the supplier of capital (e.g. someone leasing a piece of machinery to the entrepreneur) does not receive information until production is complete. The worker's ability to learn in the course of performing his duties enables him to exploit the real option to separate from low quality entrepreneurs. Suppliers of capital lack this advantage.

Before the first period, the entrepreneur and the suppliers of labor and capital are equally ignorant of their specific qualities. In the course of the first period production, prior to the point at which second period arrangements must be made, however, f and either q or r (depending on whether labor or capital is hired) are revealed to the entrepreneur. If labor is hired, the worker also views f and q before making a decision about the second period. If, however, capital is hired, the supplier of capital only views f and r when first period production is complete, after second period arrangements have been finalized. The timing of the model is therefore as follows:

1. The entrepreneur hires either labor or capital.
2. The entrepreneur and labor (if hired) view f and q or r . First period production begins.
3. The entrepreneur may terminate his relationship with the supplier of labor or capital. The input supplier may also terminate the relationship.
4. If both parties choose to maintain the relationship, it continues into the second period. Otherwise, the entrepreneur may attempt to hire new labor or capital.
5. First period production ends and the output is divided.

Second period production is analogous, with the exception that no arrangements are made for future production.

The productiveness of the entrepreneur's idea persists over both periods, as does the quality of the labor or capital match. If new labor or capital is hired in step 4 above, then the quality of the new match is presumed to be independent of the quality of the previous match.

Outside suppliers of capital and labor do not observe any of the quality variables or the firm's output. They do, however, observe the age of the firm and whether any separations have occurred. Outsiders cannot distinguish between separations initiated by the entrepreneur and those initiated by the input supplier (Lane, Isaac and Stevens (1996)). Input suppliers will provide either labor or capital if their expected payoff (including retention or signing payment) from doing so exceeds their opportunity cost.

We presume that financial status is not initially known to outsiders, but that unconstrained entrepreneurs can demonstrate their status to the market by, for example, displaying a bank letter of credit. Constrained entrepreneurs, in contrast, cannot prove their status to the market since assets may be hidden or an apparently constrained shell company can be established by an entrepreneur who is actually wealthy. In all cases, however, the financial condition of the firm is learned by the workers in the course of their employment at the firm.² Financially unconstrained entrepreneurs may simply have large amounts of ready cash, or they may work in areas in which bank financing is easily available. For example, suppose that all entrepreneurs possess a valuable illiquid asset but no cash and that banks are the only entities capable of liquidating the asset. If the entrepreneur is located in an area with a healthy and competitive banking market, he will likely be financially unconstrained since a bank will probably lend him money for his venture secured against the illiquid asset. An entrepreneur in an area with a weak banking market is more likely to be constrained since it will be difficult for him to secure a loan. We will return to this discussion in our empirical analysis.

Since output is not verifiable, the entrepreneur cannot offer input suppliers a contract promising payment based on performance. A financially unconstrained entrepreneur, however, can offer a worker or machinery owner a fixed payment in exchange for supplying the firm, or he may purchase the machinery outright.

²We assume that this is part of the information gleaned by workers over time as they, for example, learn where the owner lives, etc. Alternatively, in a straightforward extension of the model, one can assume that unconstrained entrepreneurs can undertake certain profitable projects not available to the constrained, and that these projects are observed by workers.

1.1 The Capital-Labor Decision

We now consider differences in the capital-labor decisions of constrained and unconstrained entrepreneurs. We seek Perfect Bayesian Equilibria of the game described above. (All subsequent references to equilibria are to Perfect Bayesian equilibria.)

Result 1. *There is no equilibrium in which financially constrained entrepreneurs hire or buy capital. A necessary condition for the existence of an equilibrium in which financially constrained entrepreneurs hire labor is*

$$\theta(\bar{f} + \bar{q}) + E[\max\{\theta(q + f), \epsilon\}] \geq 2\epsilon. \quad (4)$$

A proof of Result 1 is given in the Appendix.

It is clear that the purchase of capital is outside the means of the constrained entrepreneur, but Result 1 makes clear that constrained firms cannot rent capital either. The intuition for the result is as follows. Suppose that firms could rent capital in both the first and second periods with no up front payment. After viewing the quality r of the first-period capital, entrepreneurs would retain high quality capital and replace low quality capital. The capital suppliers themselves would not observe the firm quality, and so cannot make an informed decision before arrangements are made for the second period. Thus, a firm seeking new capital will be regarded as having an average type \bar{f} (since replacement of capital is not an informative signal about firm quality), and suppliers of new capital will regard their likely match quality as \bar{r} . Assumption (3) shows that the one-period returns to capital are less than the reservation rental price, so no supplier will be willing to offer new capital to the firm in the second period, which contradicts our premise. We conclude that second-period capital can only be rented with some up front cost. In that case, however, constrained entrepreneurs who rent capital in the first period will always retain the capital for both periods. Assumption (3) then shows that first-period suppliers of capital will not earn their reservation payoffs over the two periods. It must therefore be that capital can only be rented with an up front charge, which implies that constrained entrepreneurs cannot rent capital in equilibrium.

Labor differs from capital in that the first-period employees can observe the firm's quality f and their own quality q before making second-period arrangements. If the sum of the firm and worker qualities is too low, then the employee will leave the firm. This real option to only remain with a

successful venture enhances the two-period payoff of labor hired in the first period from $2\theta(\bar{f} + \bar{q})$ to $\theta(\bar{f} + \bar{q}) + E[\max\{\theta(q + f), \epsilon\}]$, and if (4) holds, then constrained firms can hire labor with no up front signing payment.

Result 2 describes a range of equilibria for the capital-labor decision game

Result 2. *If in equilibrium financially constrained entrepreneurs hire labor, then financially unconstrained entrepreneurs either hire labor, rent capital or buy capital.*

i. If \bar{r} is sufficiently large, $\zeta - \theta(\bar{f} + \bar{r}) > 0$ is sufficiently small and (4) holds, then there is an equilibrium in which constrained entrepreneurs hire labor and unconstrained entrepreneurs either rent or buy capital.

ii. If \bar{r} is sufficiently large, $\zeta - \theta(\bar{f} + \bar{r}) > 0$ is sufficiently small and (4) does not hold, then there is an equilibrium in which constrained entrepreneurs do not produce and unconstrained entrepreneurs either rent or buy capital.

iii. If \bar{q} is sufficiently large, $\epsilon - \theta(\bar{f} + \bar{q}) > 0$ is sufficiently small and (4) holds, then there is an equilibrium in which both types of entrepreneur hire labor.

iv. If \bar{q} is sufficiently large, $\epsilon - \theta(\bar{f} + \bar{q}) > 0$ is sufficiently small and (4) does not hold, then there is an equilibrium in which constrained entrepreneurs do not produce and unconstrained entrepreneurs hire labor.

A proof of Result 2 is given in the Appendix.

The ability of workers to learn about a firm's prospects and hence remain only with successful ventures enables them to join risky new businesses, even without an initial compensatory payment. Suppliers of capital do not learn as quickly as workers do, and hence can only rent out their assets to firms with the ability to offer some fee in advance. The real option generated by the worker's learning about firm quality enables him to earn a payoff above his reservation value in a constrained firm, while the uninformed supplier of capital cannot. This is the intuition between the statement of Result 2 that unconstrained entrepreneurs may either hire labor or capital, with the choice governed by the relative payoffs and costs of the two inputs, while constrained entrepreneurs, whenever they produce, hire only labor.

Unconstrained entrepreneurs have greater resources and can always produce whenever constrained owners can. The three conditions in Result 2, part i. are that capital generates attractive gross returns relative to labor, the cost of renting capital is sufficiently small and labor is willing to work without a signing payment. In this case, unconstrained entrepreneurs prefer to rent or buy

capital, and constrained entrepreneurs are able to hire labor. If capital is rented, it must be with some initial charge. (Result 1 makes clear that constrained entrepreneurs cannot rent capital, even if capital offers a high payoff.)

In Result 2, part ii., capital is the preferred investment and labor can only be hired if some signing payment is offered. In this case, the unconstrained entrepreneur rents or buys capital and the constrained is unable to rent either labor or capital. If labor generates bigger payoffs than capital, and the cost of labor is not too high, then the unconstrained hire labor. The constrained hire labor if and only if it is possible to do without a signing payment.

While in practice the differences between the two entrepreneurs will not be quite as stark as depicted in the theoretical findings, the clear empirical implication of Results 1 and 2 is that constrained firms will rely more heavily on labor while unconstrained firms will make more use of capital. We will test this prediction in Section 3.

2 Labor Management: Teamwork and Discretion

We now introduce a more comprehensive model of labor production that allows for an analysis of group dynamics. We assume that labor production is completed by a group of workers, that, for simplicity, we will presume consists of two members. We will allow the entrepreneur to determine whether the workers produce separately or jointly. The entrepreneur also has the power to set the degree of discretion permitted his employees. As our focus in this section will be on the firm's labor policy, we will analyze the case in which both constrained and unconstrained entrepreneurs hire labor, not capital.³

We will now allow the firm-wide productivity f described above to be affected by the actions of the entrepreneur and the workers, so we refer instead to an initial firm-wide productivity f^0 . We denote by s_m the effective per-worker signing payment required by new prospective employees who observe that the firm experienced m separations in the previous period. The firm can always “fire” an existing employee and make a side arrangement to rehire him, so we must have $s_2 \geq s_1$, and employees are wealth-constrained which implies that $s_1 \geq 0$.

2.1 Teamwork

At the beginning of each period, the entrepreneur decides whether workers 1 and 2 produce as a team or as two distinct units. If the employees work jointly in a team, they are presented with the

³It is sufficient, for example, to assume that the conditions in Result 2 iii. hold.

option to exert effort at a cost of g^j . If both workers exert this effort, then the personal productivity of each worker i improves this period from q_i to $q_i + \lambda^j$. The gains persist into the second period only if both workers remain with the firm. If either worker fails to exert effort, no gains are realized. If the employees work separately, each is presented with the option to exert effort g^s . If a worker exerts this effort, then his own productivity permanently increases from q_i to $q_i + \lambda^s$, irrespective of the effort choice of the other worker. We assume that

$$g^j > \theta\lambda^j > \theta\lambda^s > g^s \geq 0 \quad (5)$$

and

$$2\theta\lambda^j > g^j. \quad (6)$$

The inequalities in (5) and (6) imply that it is costly for the employees to achieve coordination and co-specialization, but the rewards from doing so are substantial. Coordination may require, for example, that employees spend time communicating with each other, but brings the benefit of allowing each employee to learn from the other or focus on his comparative advantage. Effort exertion by workers in the teamwork setting will only be profitable to them when they expect to enjoy the benefits over both periods. The benefits may only be exploited within the firm, so they may be viewed as a form of organization capital (Chowdhry and Garmaise, 2004).

2.2 Discretion

The entrepreneur also determines the level of discretion enjoyed by the employees. We assume that an employee who is granted discretion can select the firm's project choice. Different projects vary in their benefits to the firm and in the private benefits they generate for the employee who selects them. An employee will choose the project that maximizes his own personal payoff, but, as in Aghion and Tirole (1997), the entrepreneur may nonetheless grant discretion since the employee has access to a wider menu of projects than the entrepreneur. Thus, in some cases, both the employee and the entrepreneur may benefit from the employee's discretion.

At the beginning of period one, a menu of project options $\{(f_k, b_k)\}_{k=1}^N$, ($N \geq 2$) is presented to the workers, where the f_k represent firm-wide benefits and the b_k describe private benefits to be enjoyed by both workers but not by the entrepreneur. The first option, $(f_1, b_1) = (f_D, b_D)$ is the default project option that is chosen when the entrepreneur does not grant discretion. A randomly selected employee \hat{i} attains a leadership role, and if discretion is granted, then employee \hat{i} chooses

the firm's project that period. If the firm only has one employee, that employee automatically assumes the leadership position.

The project option selected in the first period, which we label (f^{1*}, b^{1*}) , permanently changes the productivity of the firm and yields a benefit to the workers. The period one firm-wide productivity is now given by $F^1 = f^0 + f^{1*}$. The type of project selected by an employee can change the productivity of the firm by contributing to the physical or intellectual capital controlled by the entrepreneur. Project selection can also bring benefits to employees by, for example, allowing them to choose a more pleasant or less onerous task. For a given initial firm-wide productivity f^0 and personal qualities (q_1, q_2) of the workers, the total firm production in period one is given by

$$\pi^1(f^0, q_1, q_2, f^{1*}, b^{1*}) = 2(f^0 + f^{1*}) + q_1 + q_2. \quad (7)$$

Worker i 's first period payoff is given by

$$W_i^1(f^0, q_1, q_2, f^{1*}, b^{1*}) = \theta(f^0 + f^{1*} + q_i) + b^{1*}. \quad (8)$$

The worker who is not presented with the menu of project options realizes the same private benefits, but does not have control over the project choice.

The entrepreneur receives the residual cash flows

$$\pi_E^1(f^0, q_1, q_2, f^{1*}, b^{1*}) = (1 - \theta)(2(f^0 + f^{1*}) + q_1 + q_2). \quad (9)$$

The period two firm-wide productivity is given by $F^2 = f^0 + f^{1*} + f^{2*}$, and period two payoffs are analogous to those described above.

In each period, after viewing the menu of project options, the entrepreneur can elect to grant employee \hat{i} discretion to choose whichever option he pleases, or the entrepreneur can insist on the default project. The entrepreneur may not simply select the project option from the employee's menu that he most prefers; the full menu of options is only available to the worker himself, perhaps because it is linked to his human capital (Hart and Moore (1994)). The entrepreneur's power is limited to being able to preclude the worker from choosing any project other than the default project. (In essence, the entrepreneur possesses only a veto power.) Project options are presented in a similar way in the second period as well.

With the introduction of teamwork and discretion, the first-period timing in the model can now be given:

1. Two workers are hired. The initial firm productivity f^0 , worker qualities (q_1, q_2) , menu of project actions $\{(f_k, b_k)\}_{k=1}^N$ and worker leader \hat{i} are all revealed to the entrepreneur and the workers.
2. The entrepreneur selects the firm's teamwork and discretion policies.
3. First period production begins. The workers sequentially decide whether or not to exert effort. If discretion is granted, worker \hat{i} then chooses the project.
4. First period output is generated and divided between the entrepreneur and the workers.
5. The entrepreneur chooses which workers, if any, to retain. Workers may quit. The entrepreneur can hire up to two replacement workers.

The timing in the second period is analogous.

2.3 Results

2.3.1 Second period policies

We begin by analyzing the second period strategies of the entrepreneur and the workers. The second period teamwork and discretion decisions of the entrepreneur are straightforward. Inequality (5) shows that workers will not exert effort if production is organized in teams, and will exert effort if they produce separately, so teamwork is never adopted; the optimal second-period teamwork policy for both constrained and unconstrained entrepreneurs is to have the employees work separately. Given a set $\{f_k, b_k\}_{k=1}^N$ of prospective second-period projects, the second period choice (f^2, b^2) of the worker granted discretion will satisfy

$$\theta f^2 + b^2 \geq \theta f_k + b_k,$$

for all k . If $f^2 \geq f_D$, then discretion will be granted. Thus, the second period choice of f is given by $f^{2*} = \max\{f^2, f_D\}$. We define b^{2*} to be the second period choice of b . The optimal second-period discretion policy, as just described, is identical for both constrained and unconstrained entrepreneurs.

At the conclusion of the first period, given the second period teamwork and discretion policies just described, we can write the expected F^2 in the second period as

$$E[F^2] = f^0 + f^{1*} + E[f^{2*}].$$

All workers will exert effort in separate production, so λ^s will be added to the personal productivity of each worker.

The entrepreneur may choose to retain worker i at no cost if

$$\theta(E[F^2] + \lambda^s + q_i) + E[b^{2*}] - g^s \geq \epsilon, \quad (10)$$

because the worker will be willing to remain in the firm without any additional payment. If (10) does not hold, an unconstrained entrepreneur can retain the worker by paying a fixed retention payment $p_i = \epsilon - E[b^{2*}] + g^s - \theta(E[F^2] + \lambda^s + q_i)$, but the constrained entrepreneur cannot retain the worker. We will say that the worker enjoys strictly profitable retention when (10) holds with a strict inequality, since otherwise he only receives his reservation payoff ϵ . Retention is costless to the entrepreneur when (10) holds.

We define R_i to be the indicator function for the retention of worker i : $R_i(h, q_1, q_2) = 1$ if worker i is retained by the firm when total shared productivity $E[F^2] + \lambda^s$ is given by h and worker qualities are given by (q_1, q_2) , and $R_i(h, q_1, q_2) = 0$ otherwise. R_i^c and R_i^u are the indicator functions for the constrained and unconstrained firms, respectively.

Workers may always choose to quit and receive ϵ , so for a given first period firm-wide productivity improvement f^1 and worker qualities (q_1, q_2) , the expected second period payoff of worker i in a constrained firm is given by

$$\begin{aligned} W_i^{2,c}(f^1, q_1, q_2) = & R_i^c(f^0 + f^1 + E[f^{2*}] + \lambda^s, q_1, q_2) \max\{\theta(f^0 + f^1 + E[f^{2*}] + \lambda^s + q_i) + E[b^{2*}] - g^s, \epsilon\} \\ & + (1 - R_i^c(f^0 + f^1 + E[f^{2*}] + \lambda^s, q_1, q_2)) \epsilon. \end{aligned} \quad (11)$$

The formula for $W_i^{2,u}(f^1, q_1, q_2)$ is analogous, with unconstrained retention functions replacing the constrained ones above.

2.3.2 First period discretion policy

We now analyze the optimal first-period teamwork and discretion policies of constrained and unconstrained entrepreneurs. To choose the best policies, the entrepreneur must predict the actions of the workers. If the entrepreneur expects the workers to exert effort in a teamwork setting, then a teamwork policy will be optimal. Similarly, if the entrepreneur expects the leader worker to choose a project that yields large firm-wide benefits, then discretion will be granted. The workers' actions,

however, are partially determined by their own predictions about whether they will be retained by the entrepreneur at the end of the period. An analysis of optimal labor policies should therefore begin with a consideration of the retention policies of the two types of entrepreneurs.

A constrained entrepreneur is more likely to retain a worker than an unconstrained entrepreneur when the worker may be retained at no cost (i.e., (10) holds), because the signing cost s_m of hiring m new workers may exceed the financial capability of the constrained entrepreneur. In essence, the constrained entrepreneur's lack of wealth limits his ability to access the secondary labor market, since firing an employee sends a negative signal to the market, and the constrained entrepreneur may be unable to offer a sufficiently large signing payment to offset this signal. Conversely, when the worker may only be retained with a retention payment (i.e., (10) fails), the constrained entrepreneur cannot retain him, but the unconstrained entrepreneur may elect to do so. A worker only earns second-period rents, however, when (10) holds (with a strict inequality). Both a worker who is fired and a worker who is given a retention payment that makes him indifferent between remaining and quitting earn only their reservation value of ϵ . We conclude, therefore, that the worker enjoys strictly profitable retention only when (10) holds, and he is more likely to be retained by a constrained firm in that case. This idea is formalized in Lemma 1.

Lemma 1. *If retention is strictly profitable for the worker, then he is more likely to be retained by a constrained entrepreneur than by an unconstrained entrepreneur.*

A formal statement and proof of Lemma 1 are given in the Appendix.

In choosing one project over another, a worker with discretion will consider the marginal gains he enjoys from the different firm-wide and personal benefits. One can imagine that the worker's gains from firm-wide benefits might be uniformly high across projects in constrained firms (as suggested by Lemma 1), but that the marginal gain from choosing a project with high firm-wide benefits over a project with low firm-wide benefits might actually be higher in an unconstrained firm since by selecting the high firm-wide benefits project the worker might convince the unconstrained entrepreneur not to fire him.

To analyze this question, we begin with Lemma 2.

Lemma 2. *If retention is strictly profitable for the worker for a given project, choosing a different project with higher firm-wide benefits does not alter the likelihood that the worker will be retained.*

A formal statement and proof of Lemma 2 are given in the Appendix.

An increase in firm-wide productivity can induce the entrepreneur to retain a worker he would not have otherwise kept, if the increase changes the worker's retention from costly to costless. A constrained entrepreneur, for example, will only be able to retain a worker if (10) holds. Lemma 2 shows, however, that increasing firm-wide productivity has no effect on retention when the worker may already be retained at no cost. As firm-wide productivity rises, the firm's future output will increase, but a new worker can exploit this productivity as well as an existing worker, so the firm-wide gains do not change the entrepreneur's incentives to fire the current staff.

Lemmas 1 and 2 together show that an increase in firm-wide productivity yields greater benefits for workers in constrained firms, as is formalized in Result 3.

Result 3. *Workers in constrained firms benefit more from first-period firm-wide productivity improvements than do workers in unconstrained firms.*

Formally, for a given $f_y \geq f_x$,

$$W_i^{2,c}(f_y, q_1, q_2) - W_i^{2,c}(f_x, q_1, q_2) \geq W_i^{2,u}(f_y, q_1, q_2) - W_i^{2,u}(f_x, q_1, q_2).$$

A proof of Result 3 is given in the appendix.

The intuition for Result 3 may be understood as follows. If retention is strictly profitable, a firm-wide productivity improvement does not affect the retention decision (Lemma 2), and workers in constrained firms are more likely to benefit from the improvement since they are more likely to be retained (Lemma 1). If retention is not profitable, then workers in both constrained and unconstrained firms earn their reservation payoff ϵ . A firm-wide productivity improvement will yield benefits to a worker only if it causes him to be retained, and this is more likely to occur in a constrained firm (Lemma 1).

Result 3 suggests that constrained entrepreneurs should be more willing to grant discretion to their workers than unconstrained entrepreneurs. Workers at constrained firms are more likely to enjoy future benefits themselves from firm-wide productivity improvements, so they are more inclined to choose projects that benefit the firm, even at the cost of losing private benefits. Understanding the workers' incentives, constrained entrepreneurs will more often grant their employees discretion in project choice. We note that this analysis does not consider possible interactions between the choice of the firm's discretion and teamwork policies.

2.3.3 First period teamwork policy

We now turn to an analysis of teamwork. When the entrepreneur organizes production in teams, each worker must decide whether or not to exert effort. If both workers exert effort in the first period, each receives an immediate net benefit of $\theta\lambda^j - g^j < 0$, but if the workers remain with the firm in the second period, they each receive a total net benefit of $2\theta\lambda^j - g^j > 0$. If one worker does not exert effort, then neither receives any benefits. It is clear, then, that workers will exert effort only if both expect to remain with the firm for both periods.

Retention alone is not sufficient to induce the workers to exert effort in a teamwork setting. If his own retention is not profitable, a worker will garner no benefit from the second-period increase in his personal quality; he will continue to receive his reservation payoff ϵ . Thus for workers to exert effort when production is organized in teams, they must anticipate that they will be retained and that this retention will be strictly profitable.

Unconstrained entrepreneurs have a broader set of options available to them than do constrained entrepreneurs. Unconstrained entrepreneurs can fire workers and offer large signing payments to new employees or offer sizable retention payments to current employees, but these options are not available to constrained entrepreneurs. If retaining both employees is optimal for the unconstrained entrepreneur and retention is costless (and hence feasible for the constrained entrepreneur), retaining both workers must be optimal for the constrained entrepreneur, who has a smaller set of actions from which to choose. This idea is formalized in Lemma 3.

Lemma 3. *If retention is strictly profitable for both workers and the unconstrained entrepreneur retains them both, then the constrained entrepreneur will retain both workers.*

We argued above that workers will only exert effort if retention is profitable, and if both workers anticipate being retained. Lemma 3 can thus be used to show that if it is worthwhile for workers in a team to exert effort in an unconstrained firm, then workers in a team setting must also be willing to exert effort in an unconstrained firm.

Result 4. *If both workers in an unconstrained firm benefit from exerting effort in a teamwork setting, then both workers in a constrained firm also benefit from exerting effort in a teamwork setting.*

Formally, we let q_1 and q_2 be given. If for $i = 1, 2$

$$W_i^{2,u}(f, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,u}(f, q_1, q_2) \geq g^j - \theta\lambda^j, \quad (12)$$

then for $i = 1, 2$

$$W_i^{2,c}(f, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(f, q_1, q_2) \geq g^j - \theta\lambda^j. \quad (13)$$

Result 4 indicates that teamwork policies will be more successful in constrained firms than in unconstrained firms. Team production will only be adopted if the workers are expected to exert effort. The substantial initial effort required of a worker to coordinate with another employee will only be recouped if the worker expects to receive second-period rents from the firm arising from his improved personal productivity. As we argued earlier, constrained firms more often offer their employees these rents, and hence workers are more willing to invest in teamwork when working for financially restricted entrepreneurs. Constrained entrepreneurs are therefore more likely to choose team production.

2.3.4 First period joint policy decision

Results 3 and 4 essentially analyze the choice of an optimal teamwork policy in a univariate manner, neglecting interactions between the teamwork and discretion policies. We now examine the cross-effects from the two decisions to find the optimal first period policy.

The central distinction between the incentives of workers in constrained and unconstrained firms is generated by their different second period payoffs. We begin by exploring the impact of effort exertion and project selection decisions on the likelihood of retention and future payoffs.

Lemma 4. *An increase in his personal productivity makes it more likely that a worker will be retained in the second period.*

A formal statement and proof of Lemma 4 is given in the Appendix.

When a worker increases his personal productivity by, for example, exerting effort along with his colleague in a teamwork setting, he increases his firm-specific human capital. This makes him more valuable to the firm and hence he is more likely to be retained. Since his productivity within the firm has increased and he is more likely to be retained, his expected second period payoff increases.

Lemma 5. *An increase in firm-wide productivity makes it more likely that a worker will be retained in the second period.*

A formal statement and proof of Lemma 5 is given in the Appendix.

If the worker, through judicious project selection, increases the firm-wide productivity, then the second period production will improve. The entrepreneur can enjoy the improved productivity in the worker's absence, but the relative benefits from hiring a new worker do not increase. In addition, the higher firm-wide productivity may make it possible for a constrained firm to retain a worker whose retention would have been prohibitively costly at a lower productivity level. Even if the entrepreneur's retention decision is unchanged by the increase in firm productivity, a worker who is retained will benefit from higher output.

Result 5. *Firm-wide productivity improvements and personal productivity gains generate complementary benefits for workers.*

Formally, for a given $f_y \geq f_x$ and $\lambda \geq 0$

$$W_i^{2,c}(f_y, q_1 + \lambda, q_2 + \lambda) - W_i^{2,c}(f_x, q_1 + \lambda, q_2 + \lambda) \geq W_i^{2,c}(f_y, q_1, q_2) - W_i^{2,c}(f_x, q_1, q_2).$$

A proof of Result 5 is given in the Appendix.

For workers employed at the firm within a given period, both firm-wide and individual productivities enter the production function linearly, as detailed in (8). The complementarity described in Result 5 arises from the effect of retention on worker utilities. Workers' second-period payoffs are unaffected by their individual and firm-wide productivities if they are not retained, but rise linearly in productivity if productivity is sufficient to induce retention. Moreover, Lemma 2 guarantees that there will be no jump in a worker's payoff at the point at which the entrepreneur switches from firing to retaining him. This implies that workers' payoffs are convex in each type of productivity.

Lemma 4 shows that retention is more likely at higher levels of personal productivity. An increase in firm-wide productivity is therefore more beneficial to a worker when his personal productivity is high, since he is more likely to be retained when he has a better personal quality and retained workers enjoy firm-level gains for two periods rather than one. Lemma 5 shows in a similar manner that an increase in personal productivity is more useful to a worker when firm-wide productivity is high. These two effects generate the complementarity described in Result 5.

The intuition underlying Result 5 is quite broad. An increase in a worker's firm-specific human capital is most useful when he expects the firm to survive. Firms with greater firm-wide productivity are the likeliest candidates for survival. Similarly, an increase in the firm's productivity is most

valuable to a worker when the worker expects to be retained. High quality workers are more likely to be retained. These positive interactions between personal and firm-wide productivities underly Result 5.

Result 6 describes the optimal discretion and teamwork policies of constrained and unconstrained entrepreneurs.

Result 6. *For a given initial firm productivity f^0 , worker qualities (q_1, q_2) , menu of project actions $\{(f_k, b_k)\}_{k=1}^N$, effort costs (g^s, g^j) and personal productivity improvements (λ^s, λ^j) , an entrepreneur will select first-period discretion and teamwork policies in the following way:*

i. If it is an equilibrium policy for the unconstrained entrepreneur to select discretion but not teamwork, then it is an equilibrium policy for the constrained entrepreneur to select either discretion with teamwork or discretion without teamwork.

ii. If it is an equilibrium policy for the unconstrained entrepreneur to select teamwork but not discretion, then it is an equilibrium policy for the constrained entrepreneur to select either teamwork with discretion or teamwork without discretion.

iii. If it is an equilibrium policy for the unconstrained entrepreneur to select teamwork and discretion, then it is an equilibrium policy for the constrained entrepreneur to select teamwork and discretion.

A proof of Result 6 is given in the Appendix.

The intuition underlying Result 6 is that for the univariate discretion and teamwork decisions, constrained entrepreneurs are more likely to grant discretion (Result 3) and organize production in teams (Result 4). There may cross-effects from one decision on the other, but Result 5 guarantees that an affirmative decision on either policy by the constrained entrepreneur has a positive feedback onto the other policy. (That is, choosing discretion makes teamwork more appealing, and vice versa.) The conclusion then follows that the constrained firm is more likely to adopt both (or either) teamwork and discretion.

For example, if an unconstrained entrepreneur selects a discretion policy, Result 3 indicates that granting discretion should also be appealing to a constrained entrepreneur, since workers at a constrained firm are more likely to select a project that yields substantial firm-wide benefits. The analysis, though, is somewhat complicated by the joint nature of the decision problem facing the entrepreneur. In some circumstances, as indicated by Result 4, teamwork will be attractive to the constrained entrepreneur but not to the unconstrained owner. One might imagine that it

is possible for the unconstrained entrepreneur to choose discretion but not teamwork, and for the constrained entrepreneur to select teamwork but not discretion. Result 5, however, shows that this will not happen. When the constrained entrepreneur selects teamwork, his workers will generate large personal productivity gains. (The entrepreneur would not choose teamwork if he did not expect the workers to exert effort.) Result 5 indicates that firm-wide productivity benefits are more useful to workers in this case, so the incentives of the leading worker in picking projects are even more aligned with those of the entrepreneur in a teamwork setting. We conclude that the constrained entrepreneur will also choose a discretion policy, either with or without teamwork.

Analogously, if an unconstrained entrepreneur chooses a teamwork policy, Result 4 shows that a teamwork policy will also be attractive to a constrained entrepreneur. Result 5 guarantees that even if the constrained entrepreneur wishes to allow discretion, he will still choose teamwork production as well, due to the complementarities between personal and firm-wide improvements. A similar analysis shows that if an unconstrained entrepreneur chooses both teamwork and discretion, then the constrained entrepreneur will favor discretion and teamwork as well.

The clear empirical implication of Result 6 is that firms owned by constrained entrepreneurs should be more likely to grant their employees significant autonomy and should more frequently produce in groups. In section 3 we consider some evidence on these predictions.

2.3.5 Relative Payoffs to Constrained and Unconstrained Entrepreneurs

Result 6 shows that constrained entrepreneurs more frequently adopt discretion and teamwork policies than unconstrained entrepreneurs. Since these policies are only selected by the entrepreneur when he benefits from doing so, it is clear that constrained firms realize some benefits from their status. The fact that it is difficult for constrained entrepreneurs to hire new employees (and hence replace existing employees) encourages current workers to invest in co-specializing with other workers in team production and induces them to select projects that benefit the firm. Nonetheless, it is the case that unconstrained entrepreneurs gain from being able to more easily replace lower quality workers. Result 7 provides conditions under which the benefits to constrained status exceed the costs.

Result 7. *If the worker leader is of only marginally less than average quality and the gains from team production and worker project selection are large, then constrained entrepreneurs have a higher two-period expected payoff than unconstrained entrepreneurs.*

A formal statement and proof of Result 7 is given in the Appendix.

When the worker leader has a quality that is only somewhat below average, the benefits from replacing him are small. The worker will expect, however, that an unconstrained entrepreneur will choose to discharge him. In anticipation of his future dismissal, the worker leader will prefer projects that give him immediate large personal benefits over those generating gains for the firm. He will also refuse to invest in coordination if production is in teams. The constrained entrepreneur, by contrast, will be unable to fire the worker leader. Since he expects to be retained by the constrained firm, the worker will choose projects that benefit the firm and exert effort in team production. This can create substantial value for the constrained firm.

One might ask whether unconstrained firms could not simply hide their status from workers in order to enjoy the higher constrained firm payoffs in the cases described in Result 7. We assume here that the financial status of an entrepreneur cannot be concealed from workers in the course of their performing their functions. For example, one could alter the model to include some additional benefits that accrue only to unconstrained firms (e.g. they may have access to a broader set of projects). In order to realize these benefits, unconstrained entrepreneurs must reveal their status. The thrust of Result 7 is not to argue that entrepreneurs are better off if they are financially constrained, but rather to suggest that the relative benefits of being financially restricted are greatest when current employees are only slightly sub-par (perhaps because there is little variation in worker quality) and teamwork and employee discretion yield large gains.

3 Empirical Tests

In this section we test the central implications of our model. Result 2 suggests that constrained entrepreneurs will make relatively greater use of labor in production while unconstrained entrepreneurs will rely more heavily on capital. Using data on owner characteristics and balance sheets of small businesses, we find evidence in support of this hypothesis. Result 6 shows that constrained firms will grant their employees discretion and organize production in teams more often than unconstrained firms. We employ a survey of organizational practices to test this prediction, and we present a series of empirical findings that are consistent with the theoretical result.

We make use of two different data sets in our tests. To test the implication of Result 2 linking financial constraints to the firm's capital-labor decision, we draw on the 1998 National Survey of Small Business Finance (NSSBF) conducted by the Board of Governors of the Federal Reserve System. This survey, which has been used by a number of researchers (e.g. Petersen and Rajan (2002) and Moskowitz and Vissing-Jorgensen (2002)) collects information on owner demographics,

financing characteristics, balance sheets and other attributes of small businesses (which are defined to be firms with fewer than 500 employees). To test the predictions of Result 6 about organizational practices, we employ the 1996-1997 National Organizations Survey (Kalleberg, Knoke and Marsden, 1996-1997). The National Organizations Survey (NOS) gathers data from U.S. work establishments on their formal structures, internal labor markets and use of hierarchies. We use only the NOS data for small, for-profit firms. We focus our tests of both Results 2 and 6 on smaller firms since the issues highlighted in the model, in particular individual employee contributions that have a significant effect on firm-wide outcomes, large risk of bankruptcy and asymmetric information about the firm's financial status and quality, are most germane in smaller firms. In addition, our proxies for financially constrained status are most appropriate for small firms.

3.1 Capital-labor ratios

We begin with a discussion of the NSSBF data. There 3,561 U.S. firms in the data set. As a measure of the firm's capital-labor ratio, we calculate $\log\left(1 + \frac{\text{value of assets}}{\text{number of employees}}\right)$. The value of assets includes capital that is rented in the form of capitalized leases or secured with collateralized loans but excludes operating leases. Seven firms report negative asset levels and we exclude these firms from consideration. We seek a measure of whether or not the firm is financially constrained, and the NSSBF data provide several plausible proxies. Survey respondents indicate whether their most recent loan application was rejected and whether they have applied for a loan in the last three years. They also supply characteristics of the owner, such as net wealth (including the value of his home but excluding the value of the firm), ethnicity, gender and education (on a 1-7 scale). Firm characteristics including sales revenue, age, the Dun and Bradstreet credit score (a 1-5 scale) and location in an MSA (Metropolitan Statistical Area) are detailed. Firms in which the owner had a judgement rendered against him in the last three years or in which either the firm or owner has declared bankruptcy in the last seven years are separately identified. Last, an index from one to three describes the commercial bank deposit Herfindahl index of the firm's MSA (if it is in an MSA) or county. (The firm's location, however, is not revealed.) The Herfindahl index is available for all firms but one, which is excluded. Summary statistics including means (all variables) and medians and standard deviations (all non-binary variables) are given in Panel A of Table 1.

To test Result 2, we will regress firms' capital-labor ratios on proxies for financial constraints, but we first need a set of reasonable proxies. A clear indication of financially constrained status is that a firm's loan application is denied. One strategy for testing Result 2 is to regress capital-labor

ratios directly on this measure of financial constraints, namely whether the firm had its most recent loan application declined. It is reasonable to consider, however, that firms with small capital-labor ratios may have very few assets with which to secure a loan, and that this lack of collateral may cause their loan applications to be denied, rather than the converse. That is, the relationship between a loan denial and a low capital-labor ratio may be endogenous. We will therefore seek instruments for loan denial and use these instruments as measures of financial constraints.⁴ In addition, it may be the prospect of having a future loan request denied, rather than the actual denial itself, that weighs heaviest on most constrained firms.

In the first column of Table 2 we report results from regressing a dummy variable for whether the firm's most recent loan application was rejected on a set of owner and firm characteristics. The estimation is via binary logistic regression (Logit), with t -statistics reported in parentheses using robust "sandwich" (White) standard errors. We find that firms are significantly more likely to be denied a loan in concentrated local banking markets, which is consistent with the evidence in Hannan (1997) and Berger, Rosen, and Udell (2001) that concentrated markets are less competitive. Less wealthy owners, African Americans and Hispanics are more likely to have their loan applications rejected, as are owner with recent judgments against them. Firms or owners who have declared bankruptcy in the past seven years are also less likely to receive financing. Firms with greater sales and better Dun and Bradstreet credit scores (unsurprisingly) are more likely to receive a loan, as are firms not located in an MSA. Additional regressors with coefficients unreported for brevity include a constant, industry dummies at the 2-digit SIC level, the log of one plus the owner's experience in managing a business, the log of the owner's age, a dummy for whether the firm is managed by the owner and a dummy for a family-owned firm.

A second approach is to seek proxies for constrained status from an analysis of whether or not firms made any loan applications in the last three years, but this regression is less straightforward to interpret. Constrained firms may be so unlikely to receive financing that they are discouraged from applying. In this case, not having applied for a loan would suggest constrained status. It is also possible, however, that unconstrained firms may have sufficient internal capital or long-term loans such that they need not apply for new debt. Then it would be the unconstrained firms that do not apply. It may also be the case that filing a loan application is relatively low cost, so that it is done by both constrained and unconstrained firms.

⁴A direct regression of capital-labor ratios on whether the most recent loan application was denied yields a negative and significant ($t=-3.00$) coefficient, as predicted by Result 2, but we find that the instrumented results offer the clearest interpretation.

Having made loan applications may thus not provide a completely clear indication of a firm's status, but, nonetheless, in column 2 of Table 2 we report the results from regressing whether the firm has applied for a loan on the same set of owner and firm characteristics as in the first regression. The estimation is via Logit with robust standard errors. The evidence here is mixed. African-Americans, Hispanics, owners with recent judgements against them and firms with low credit scores are all less likely to apply for a loan, perhaps because they are discouraged from doing so. Firms with greater sales, however, are also less likely to apply for a loan, probably because they are less in need of external financing. Banking market concentration, owner's net worth and whether the firm or owner has recently declared bankruptcy have no effect on the likelihood of a loan application. Overall, both the theoretical and empirical arguments for using the loan-application-was-made variable are unclear, and we will not make use of this measure to gauge a firm's financial constraints.

Result 2 implies that financially constrained firms will have low capital-labor ratios, and we now test this hypothesis. In the third column of Table 2 we regress firms' capital-labor ratios (the log of one plus the ratio of assets to employees) on the firm and owner characteristics described earlier. The regression method is OLS and the reported standard errors are robust. The first regression supplied a set of proxies for financial constraints: location in a concentrated banking market, low net worth, African-American and Hispanic ethnicities, recent bankruptcies or judgements, low credit scores and small sales are all indicative of financially constrained status. Result 2 predicts that these variables should be associated with low capital-labor ratios, and the regression detailed in column 3 broadly supports this assertion. Firms in banking markets with high Herfindahls, and firms with less wealthy owners, African-American owners, low credit scores and low sales all have significantly lower capital-labor ratios, as predicted. The coefficients on Hispanic ethnicity, recent bankruptcies and recent judgements, however, are insignificant. (The NSSBF does not provide detailed firm locations or physical capital or labor market variables, so the regressions do not include measures of physical capital or labor productivity or costs.) Overall, these empirical findings are strong evidence in favor of Result 2. It is hard to think of reasons that banking market concentration, for example, should affect capital-labor ratios, outside of an indirect effect through the medium of financing constraints. Financial constraints appear to have a strong influence on firms' capital-labor ratios.

In column four of Table 2 we repeat the previous regression, but include only those firms that applied for a loan in the last three years. Our financial constraints proxies are generated from this

restricted data set (in the first regression), and it is possible that our measures of constrained status are only appropriate for firms that actually apply for loans. (For example, the concentration of the local banking market may have no effect on the set of firms that do not require outside financing.) The results from this regression are quite similar to those in the regression using all firms. Local banking market concentration, low net worth, African-American ethnicity, poor credit scores and small sales are all associated with lower capital-labor ratios. The mean asset-employee ratio is \$61,737. A one-standard-deviation increase in banking concentration decreases the asset-employee ratio by \$4,781 when all other variables are evaluated at their medians.

In column five of Table 2 we conduct a two-stage least squares regression of capital-labor ratios on whether the most recent loan was declined. We instrument for loan denial with local banking market concentration, the log of the owner's net worth, the owner's education, gender and ethnicity, recent bankruptcies and judgements and the firm's credit score. The first stage regression is OLS, as recommended by Angrist (2000). Consistent with the previous results, we find that financially constrained firms (i.e, those whose loan applications were declined) have reduced capital-labor ratios. The t-statistic on loan denial is -4.63 (calculated with robust standard errors). The empirical findings in Table 2 together provide a variety of evidence in favor of Result 2's prediction linking financial constraints to lower capital-labor ratios.

3.2 Discretion and Teamwork

The NOS data provide variables that allow us to test the predictions of Result 6 that financially constrained firms will grant their employees greater discretion and organize production more frequently in teams. There are 1,002 organizations in the NOS database, of which 710 are for-profit. We include only for-profit firms that are not branches, subsidiaries nor franchises, and that have no more than 500 employees. We exclude non-profits since the division of surplus profits is an essential part of the model, and it not clear how this would apply, for example, in a charitable foundation. We are interested in firms that determine their own labor management policies, so we exclude subsidiary divisions of larger companies, and, as we argued earlier, the implications of the model are most appropriate for small firms so we exclude large organizations. (In addition, our financial constraints proxy is more suitable for small firms.) These exclusions, and the requirements that the firm's age, sales and address be given, leave us with 230 firms.

We use the firm's address and the FDIC Summary of Deposits to construct a measure of the competitiveness of the local banking market. Specifically, we calculate the commercial bank deposit

Herfindahl of the firm's MSA (if it is in an MSA) or county (otherwise) in 1996 and label this variable Bank Herf. We use Bank Herf as a measure of a firm's financial constraints. The results in Table 2 indicate that local banking market concentration is an effective and, from the individual firm's perspective, plausibly exogenous proxy for financially constrained status. A similar approach is adopted in Hannan (1997) and Berger, Rosen, and Udell (2001). (The owner demographic and credit score variables we employed in Table 2 are not available in the NOS data.) Small firms, in particular, are especially likely to borrow from local banks and, hence, are more affected by the competitiveness of the local banking market (Petersen and Rajan, 2002).

To proxy for the wealth of the owner, we make use of the location of the firm. Using 2000 census data, we calculate the median home value in the 5-digit zip code (specifically, the zip code tabulation area (ZCTA)) in which the firm is located. (If the 5-digit ZCTA is unavailable, we use the 3-digit ZCTA.) The NOS data also provides information on the fraction of the firm's employees who are white. In Table 2 we show that wealthier owners and African-American and Hispanic owners are more likely to be constrained. While the local median home value and the ethnic composition of the firm's workforce are imperfect measures of the owner's own wealth and ethnicity, they do serve as not unreasonable proxies.

Our empirical strategy is to regress various measures of teamwork and discretion on the banking market concentration, median home value and ethnic composition of the workforce variables to test the implications of Result 6. The work practices of the core employees of the firm (as defined by the survey respondents) are the subject of our study, rather than, for example, the practices of the clerical staff, since it is the efforts of the core employees that are most linked to the firm's production. We will use the the number of employees in the firm, the fraction of employees who are women, firm sales, a dummy indicating whether the firm is located in an MSA and the the MSA population as controls in our regressions. The number of employees and sales are included as controls for firm size, since larger firms are likely to have different work practices, and the MSA and MSA population variables are included since it is plausible that firms in cities (or large cities) might have different organizational forms from firms in rural areas. Means, medians and standard deviations for these variables and the dependent variables detailed below are reported in Panel B of Table 1.

In the first column of Table 3 we describe the results from regressing a dummy variable indicating whether employees are involved in work teams when they do their job on the concentration of the local banking market, the log of local median home values, the fraction of employees who are

women, the fraction of employees who are white, the log of one plus the number of employees in the firm, the log of one plus firm sales, a dummy indicating whether the firm is located in an MSA and the log of the MSA population. Additional regressors with coefficients unreported for brevity include a constant, industry dummies at the 2-digit SIC level and dummies for sole proprietorships, partnerships, headquarters and presence of a union in the firm. The estimation is via Logit, with robust standard errors that account for clustering at the local-banking-market level. (Clustering at the zip code level yields very similar results.)

Result 6 predicts that financially constrained firms will produce more often in teams, and this prediction finds support in the regression results. Firms located in concentrated banking markets are significantly more likely to have their core employees involved in work teams ($t=2.26$). Firms located in zip codes with higher home values are less likely to have work teams ($t=-1.70$). These two results are consistent with Result 6. The coefficient on the fraction of white workers is insignificant. A one-standard-deviation increase in banking concentration increases the probability of work teams by 6.8% when the other variables are evaluated at their medians, while a one-standard-deviation increase in median home values reduces the probability of teams by 6.5%.

The second implication of Result 6 is that constrained firms will grant their employees greater discretion. To test this prediction, we construct a variable measuring the level at which decisions are made in a firm. The NOS provides data on who within the firm makes the final decision in the following eight areas: new employee hiring, the use of subcontractors, the use of temporary workers, worker evaluation, product or service improvement, worker schedules, production targets and the provision of training programs. For each area the respondent indicates if the decision is made by the head of the organization (to which we assign a score of four), a middle manager (three), a supervisor (two) or someone below (one). For each firm we then average the scores across all the areas for which data is available. We denote this variable as the locus of authority within the firm. In firms with a high locus of authority, most decisions are made by the owner or senior managers and little discretion is granted to employees. In firms with low scores on the locus of authority measure, discretion and final-decision-making power reside more often with lower-level workers.

In the second column of Table 3 we report results from regressing the locus of authority variable on banking market concentration, log of median home values, fraction of white employees and the same set of controls as in the first regression. Estimation is by OLS and robust standard errors are reported. Consistent with Result 6, we find a significant negative coefficient ($t=-1.84$) on banking concentration and a significant positive ($t=1.98$) coefficient on log of median home values:

discretion (decision-making authority) is more often vested in lower-level employees in financially constrained firms. The coefficient on fraction of white employees is again insignificant. A one-standard-deviation increase in bank concentration reduces the locus of authority by 0.066 (2.0% of the mean), while a one-standard-deviation increase in $\log(\text{median home values})$ increases the locus of authority by 0.077 (2.3% of the mean).

The results for the bank concentration and median home value variables provide evidence in favor of Result 6, but the fraction of white employees coefficient was insignificant in both tests. This may be due to the fact that there are likely very few minority-owned businesses in the NOS sample. The NSSBF deliberately over-weights the representation of minority-owned firms in order to facilitate inferences about such firms, while the NOS does not. Using weights appropriate for the entire sample of U.S. small businesses (and hence for the NOS), the NSSBF data indicate that only 4.1% of small business owners are African-American, while 5.5% are Hispanic. These small fractions and the high proportions of white employees described in Table 1 suggest that it may be difficult to find minority-owner effects in the NOS.

The two regression results described thus far do, however, lend empirical support to Result 6. A counter-hypothesis, however, is that, for some unspecified reason, firms in concentrated banking markets or in low-home-value areas simply adopt progressive work practices. The relationships between financial constraints and teamwork and discretion detailed above would thus not be attributable to the mechanism described in the model but to some unknown other association between banking market concentrations and the organization of firms. To analyze this alternate premise, we consider a variable from the NOS data set that describes whether firms offer drug or alcohol abuse programs to employees. This is a typical progressive work practice, but the theoretical model in this paper makes no prediction linking this particular practice to firms' financially constrained status. Constrained firms in the model adopt discretion and production in teams because workers in these firms capture larger second period rents and hence their incentives make such policies efficient. It is not the case in the model that constrained firms offer a more nurturing environment to their employees.

To test the counter-hypothesis we regress the drug/alcohol-programs variable on banking market Herfindahls and the standard set of controls. The dependent variable is binary, so estimation is by logit and the results are reported in column three of Table 3. We find no association between the likelihood firms offer a drug or alcohol abuse program and either banking market concentration, log of median home values or fraction of white employees, suggesting that the alternate hypothesis

of progressive work practices in high-Herfindahl or low-home-value markets is not supported by the data.

Taken together, these findings provide support for the theoretical predictions of Result 6 and indicate that work organization practices vary substantially between constrained and unconstrained firms.

4 Conclusion

In this paper we develop a model of the optimal labor management strategies of financially constrained and unconstrained firms. We demonstrate that constrained firms will have lower capital-labor ratios and will more frequently produce in teams and grant decision-making authority to lower-level workers. Empirical tests on two data sets of small businesses confirm the central predictions of the model and suggest that firm-employee relations can be affected considerably by the extent of the firm's financial resources.

The model suggests that firms that undergo a shift in their financial status will simultaneously alter their labor management policies. For example, the advent of new sizable venture capital or bank financing should lead a firm to institute a more formal hierarchy structure that concentrates decision-making power in the hands of senior managers. This may lead to a "professionalization" (Hellman and Puri (2002)) of the way the firm conducts business that derives simply from the firm's new access to financing and that is independent of any actions or guidance on the part of the source of capital. Similarly, post-IPO firms should experience a significant change in their use, for example, of teamwork.

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Appendix

Proof of Result 1.

We first consider a financially constrained entrepreneur. Suppose, for a contradiction, that there is an equilibrium in which this entrepreneur hires capital in the first period. First suppose that the unconstrained entrepreneur demonstrates his status or does not rent capital with probability one. Then any constrained renter of capital will be immediately identified as constrained. We begin by showing that the constrained entrepreneur will retain the supplier of capital after first period production with probability one. It cannot be that the supplier of capital quits with probability one, since then (3) would show that this supplier would not supply the entrepreneur in period 1. So for any outcome of f and r , the supplier of capital chooses to remain with positive probability $p_s > 0$. (Recall that the supplier of capital cannot condition his strategy on f and r , since he does not view them until after making a decision.)

Suppose that for any given f and r with some positive probability the entrepreneur fires the supplier of capital. It must then be that with some positive probability there is a supplier of capital willing to rent to the entrepreneur in the second period or else the entrepreneur would do strictly better to retain the first period supplier of capital. This implies that if a separation is viewed by the market, there is a probability $p_c > 0$ that new capital is supplied.

For any f and r , the entrepreneur's payoff from retention is $(1 - \theta)(f + r)$ and his payoff from firing the capital and attempting to rehire is $(1 - \theta)(p_c(f + \bar{r}))$. In equilibrium, the entrepreneur will choose to fire if and only if

$$(1 - \theta)(f + r) < (1 - \theta)p_c(f + \bar{r}),$$

i.e. $r < p_c\bar{r} - (1 - p_c)f$. We define $D(f) = \min\{r_{max}, p_c\bar{r} - (1 - p_c)f\}$, a decreasing function of f . Separation can arise from either quitting or firing. We denote the densities and cumulative distribution functions of f , r and q by h_f , h_r and h_q , H_f, H_r and H_q , respectively. We have

$$E[f|separation] = \frac{p_s \int_{f_{min}}^{f_{max}} \int_{r_{min}}^{D(f)} h_r(r) dr (f) h_f(f) df + (1 - p_s)\bar{f}}{p_s \int_{f_{min}}^{f_{max}} \int_{r_{min}}^{D(f)} h_r(r) dr h_f(f) df + (1 - p_s)} \quad (14)$$

We note that

$$\frac{\int_{f_{min}}^{f_{max}} \int_{r_{min}}^{D(f)} h_r(r) dr (f) h_f(f) df}{\int_{f_{min}}^{f_{max}} \int_{r_{min}}^{D(f)} h_r(r) dr h_f(f) df} = \frac{\int_{f_{min}}^{f_{max}} H_r(D(f))(f) h_f(f) df}{\int_{f_{min}}^{f_{max}} H_r(D(f)) h_f(f) df} \leq \bar{f},$$

since $\hat{h}_f(f) = \frac{H_r(D(f)) h_f(f)}{\int_{f_{min}}^{f_{max}} H_r(D(f)) h_f(f) df}$ is a probability density function for f , and it is dominated by h_e in the sense of the monotone likelihood ratio property and hence has a lower mean. (It is clear that $\frac{\hat{h}_f(f)}{h_f(f)} = \frac{H_r(D(f))}{\int_{f_{min}}^{f_{max}} H_r(D(f)) h_f(f) df}$ is decreasing, since D is decreasing.) We conclude from (14) that

$$E[f|separation] \leq \bar{f}.$$

No new capital will consent to join the firm since the expected payoff from doing so is

$$\theta(\bar{r} + E[f|separation]) \leq \theta(\bar{r} + \bar{f}) < \zeta.$$

This contradicts our earlier assumption. We conclude that with probability one the entrepreneur retains the first period supplier of capital. The two period payoff to the first period supplier of capital is given by

$$\theta(\bar{f} + \bar{r})(1 + p_s) + (1 - p_s)\zeta < 2\zeta.$$

We conclude that no supplier of capital will be willing to provide capital in the first period.

Now suppose that with positive probability the unconstrained entrepreneur chooses both to not demonstrate his status and to rent capital in the first period. An alternative strategy for the unconstrained entrepreneur is to purchase capital in the first period, and thereafter retain the capital, abandon the project, rent new capital or purchase new capital, precisely as in the candidate equilibrium.

The analysis above shows that a first period supplier of capital will receive an expected payoff of less than 2ζ when renting to a constrained entrepreneur, but capital may be still be rented if the expected payoff to renting to an unidentified unconstrained entrepreneur exceeds 2ζ . We denote the period i payoff to the first-period supplier of capital by C^i . The second period payoff to any newly hired capital is denoted \hat{C}^2 . Since the alternative strategy adopts the same retention policy as the candidate equilibrium strategy, the total firm payoffs are identical under the two. We will compare the costs to the unconstrained entrepreneur of procuring capital under the two strategies.

Three events may occur at the end of period one. The entrepreneur may retain the first-period supplier of capital (event A_1). The total payment to the supplier is $C^1 + C^2$ under the candidate equilibrium, and 2ζ under the alternative strategy. If the first-period supplier is fired and no new capital is hired (event A_2), the payment to the supplier is C^1 in the candidate equilibrium and ζ under the alternate strategy. If the first-period supplier is fired and new capital is hired at cost \hat{C}^2 (event A_3), the total cost is $C^1 + \hat{C}^2$ in the candidate equilibrium and $\zeta + \hat{C}^2$ under the alternative strategy.

The first-period capital supplier receives $C^1 + C^2$ in event A_1 and $C^1 + \zeta$ in events A_2 and A_3 . Since the payoff to this supplier must exceed 2ζ in equilibrium, we have

$$E[C^1] + E[C^2 I_{A_1}] + \zeta(E[I_{A_2} + I_{A_3}]) > 2\zeta.$$

This implies that

$$E[C^1] + E[C^2 I_{A_1}] + E[\hat{C}^2 I_{A_3}] > \zeta + \zeta E[I_{A_1}] + E[\hat{C}^2 I_{A_3}]. \quad (15)$$

The left side of (15) is the cost incurred by the unconstrained entrepreneur in the candidate equilibrium, and the right side is the cost he incurs under the alternate strategy. Since the alternate strategy yields the same firm payoffs at a lower cost, the candidate equilibrium cannot, in fact, be an equilibrium.

Similar analysis shows that the constrained entrepreneur cannot in equilibrium rent capital only in the second period. We now show that condition (4) is necessary for the existence of an equilibrium in which financially constrained entrepreneurs hire labor. If in equilibrium labor is hired by the constrained entrepreneur in the first period, the worker will quit if

$$\theta(f + q) < \epsilon.$$

We denote the probability that new labor can be hired without any up front cost by p_l . The entrepreneur will fire the worker if

$$(f + q) < p_l(f + \bar{q}).$$

Separation thus occurs for

$$q < \max\left\{\frac{\epsilon}{\theta} - f, p_l(f + \bar{q}) - f\right\} := D_1(f),$$

where the equality is a definition and D_1 is a decreasing function. We thus have

$$E[f|separation] = \frac{\int_{f_{min}}^{f_{max}} \int_{q_{min}}^{D_1(f)} h_q(q) dq (f) h_f(f) df}{\int_{f_{min}}^{f_{max}} \int_{q_{min}}^{D_1(f)} h_q(q) dq h_f(f) df}. \quad (16)$$

As above, this shows that after separation no new labor will be supplied to the constrained entrepreneur. Since no new labor can be hired in period two, the first period worker will remain with the constrained firm if and only if $\theta(q + f) \geq \epsilon$ (i.e. if it is in his own interest to do so). The two period expected payoff to a worker hired by a constrained entrepreneur in the first period is

$$\theta(\bar{f} + \bar{q}) + \theta E[\max\{q + f, \frac{\epsilon}{\theta}\}] \geq 2\theta(\bar{f} + \bar{q}).$$

If

$$\theta(\bar{f} + \bar{q}) + \theta E[\max\{q + f, \frac{\epsilon}{\theta}\}] \geq 2\epsilon, \quad (17)$$

it is an equilibrium for a worker to join the firm in period 1, quit if $\theta(q + f) < \epsilon$ and remain otherwise. The entrepreneur never fires the worker. A worker at an unconstrained firm may be separated from the firm against his will (the entrepreneur may be willing to pay a signing fee to new labor), so the payoff to such a worker is less than the payoff to a worker at a constrained firm. Condition (17) is thus necessary and sufficient for the existence of an equilibrium in which labor is hired, since if it fails the worker will not agree to join the firm.

Proof of Result 2.

If the constrained entrepreneur hires labor in equilibrium, then he makes strictly positive profits (since $(1 - \theta)(\bar{f} + \bar{q}) > 0$ and the constrained entrepreneur makes no fixed payments to the worker). The unconstrained entrepreneur can always achieve the payoff of the constrained entrepreneur by mimicking the constrained entrepreneur's strategy. Since a strictly positive payoff is available, the unconstrained entrepreneur must engage in some type of production in equilibrium.

We now suppose that the conditions in part i. hold. We assume

$$\bar{r} > \max\left\{2\bar{q}, \frac{\theta f_{min}}{1 - \theta} + \bar{q}, \zeta + 2(1 - \theta)\bar{q}\right\} \quad (18)$$

and

$$\zeta - \theta(\bar{f} + \bar{r}) \in (0, \min\{\epsilon - \theta(\bar{f} + \bar{q}), \theta\bar{f}\}). \quad (19)$$

We propose the following candidate equilibrium. Unconstrained entrepreneurs hire capital in the first period and keep it if and only if $r \geq \bar{r}$. Otherwise, the existing capital is sold and new capital is purchased. Constrained entrepreneurs hire labor in the first period. Constrained entrepreneurs never fire, and labor remains with the firm if and only if $\theta(q + f) \geq \epsilon$. All off-equilibrium path bids from the entrepreneur are assumed to come from constrained entrepreneurs in the first period and from entrepreneurs with $f = f_{min}$ in the second period.

We now confirm that the above describes an equilibrium. We first consider the actions of the unconstrained entrepreneur. In the proof of Result 1 we showed that capital can be more cheaply bought by the unconstrained entrepreneur than rented in the first period. The off equilibrium path beliefs show that capital will be bought, not rented, in the second period as well. Condition (18) shows that the entrepreneur does better to follow his equilibrium strategy rather than not producing.

If the entrepreneur hires labor in the first period, his expected first-period payoff is $(1 - \theta)(\bar{f} + \bar{q})$. The entrepreneur may either retain the labor or hire new capital or labor in the second period. If labor is retained and $\theta(f + q) > \epsilon$, then no retention payment is needed. If $(f + q) \in [\epsilon, \frac{\epsilon}{\theta}]$, a retention payment of $k_l = \epsilon - \theta(f + q)$ will be required. The entrepreneur will never retain the labor if $(f + q) < \epsilon$, since he could only do so at a loss. This gives a net payoff to the entrepreneur choosing retention of

$$\text{Max}\{\text{Min}\{f + q - \epsilon, (1 - \theta)(f + q)\}, 0\}.$$

In the second period, the off-equilibrium belief of labor is that any bid for new labor comes from $f = f_{min}$. Thus only signing payments $s \geq \epsilon - \theta\bar{q} - \theta f_{min}$ would be accepted. The expected payoff from hiring new labor is $(1 - \theta)(f + \bar{q}) - (\epsilon - \theta\bar{q} - \theta f_{min})$. The two-period expected payoff to the entrepreneur hiring labor is thus

$$\begin{aligned} & (1 - \theta)(\bar{f} + \bar{q}) + E[\text{Max}\{(1 - \theta)f + \bar{q} - \epsilon + \theta f_{min}, \text{Min}\{f + q - \epsilon, (1 - \theta)(f + q)\}\}] \\ & \leq (1 - \theta)(\bar{f} + \bar{q}) + E[\text{Max}\{(1 - \theta)f + \bar{r} - \zeta, (1 - \theta)(f + q)\}] \\ & \leq 2(1 - \theta)(\bar{f} + \bar{q}) + \bar{r} - \zeta \\ & \leq 2(\bar{f} + \bar{r} - \zeta) \\ & \leq (2\bar{f} + \bar{r} - \zeta) + E[\text{Max}\{\bar{r} - \zeta, r - \zeta\}], \end{aligned}$$

where, the last term is the expected payoff from selecting capital in the first period. The first inequality follows from (18) and (19), the third from (18), and the second and fourth follow from routine algebra. This establishes that the unconstrained entrepreneur will hire capital.

The constrained entrepreneur cannot purchase capital, and the beliefs off the equilibrium path guarantee that an up front payment will be required for renting capital, so that is not an option either. Condition (4) shows that the constrained entrepreneur can hire labor. This verifies the candidate equilibrium.

For part ii., it is clear that it is optimal for the unconstrained entrepreneur to adopt the strategy described in part i., while the proof of Result 1 shows that the constrained entrepreneur cannot hire labor or capital.

We now suppose the conditions in part iii. are met. The necessary conditions are

$$\bar{q} > \text{Max}\{\epsilon, \frac{\theta f_{min}}{1 - \theta} + \bar{r}, 2\bar{r}, \frac{\theta\bar{f} + \bar{r} - \frac{\zeta}{2}}{1 - \theta}\}, \quad (20)$$

$$\epsilon - \theta(\bar{f} + \bar{q}) < \zeta - \theta(\bar{f} + \bar{r}), \quad (21)$$

and

$$\epsilon - \theta(\bar{f} + \bar{q}) \in [0, E \text{max}\{\epsilon, \theta(f + q)I_{(1-\theta)q \geq \bar{q} - \epsilon + \theta f_{min}}\} - \epsilon]. \quad (22)$$

Condition (22) implies (4).

We propose the following candidate equilibrium. Unconstrained entrepreneurs hire labor at no cost in the first period. The retention payment to first period labor is $k_l = \text{Max}\{\epsilon - \theta(f + q), 0\}$ and the signing payment to new second period labor is $s = \epsilon - \theta\bar{q} - \theta f_{min}$. First period labor is retained by unconstrained entrepreneurs if and only if $\text{Min}\{f + q - \epsilon, (1 - \theta)(f + q)\} \geq (1 - \theta)f + \bar{q} - \epsilon + \theta f_{min}$; otherwise new labor is hired. The strategy of the constrained entrepreneur is as in the equilibrium in part i. Unconstrained entrepreneurs do not reveal their status. All off-equilibrium path bids from the entrepreneur are assumed to come from constrained entrepreneurs in the first period and from entrepreneurs with $f = f_{min}$ in the second period. The proof that this is an equilibrium is analogous to that given above.

For part iv., the necessary conditions are (20) and (21), and the equilibrium strategies are as in part iii., except that first-period labor is offered a signing bonus in the amount of

$$2\epsilon - \theta(\bar{f} + \bar{q}) - E \max\{\epsilon, \theta(f + q)I_{(1-\theta)q \geq \bar{q} - \epsilon + \theta f_{min}}\} > 0.$$

The unconstrained cannot make this payment and thus do not produce.

Proofs of Lemma 1, Lemma 2 and Result 3.

We define $e_x = f^0 + f_x + E[f^{2*}] + \lambda^s$, $e_y = f^0 + f_y + E[f^{2*}] + \lambda^s$ and $\eta = E[b^{2*}] - g^s$. We define $q_{max} = \max\{q_1, q_2\}$ and let $e \in \{e_x, e_y\}$ be given. The entrepreneur at the end of the first period has potentially five actions from which to choose:

1. σ_a - retain both employees:

$$\pi_E(e, q_1, q_2, \sigma_a) = \min\{(1 - \theta)(e + q_1), e + q_1 - \epsilon + \eta\} + \min\{(1 - \theta)(e + q_2), e + q_2 - \epsilon + \eta\}.$$

2. σ_b - retain one employee, fire one employee and leave his position open:

$$\pi_E(e, q_1, q_2, \sigma_b) = \min\{(1 - \theta)(e + q_{max}), e + q_{max} - \epsilon + \eta\}.$$

3. σ_c - retain one employee, fire one employee and hire one new employee:

$$\pi_E(e, q_1, q_2, \sigma_c) = \min\{(1 - \theta)(e + q_{max}), e + q_{max} - \epsilon + \eta\} + (1 - \theta)(e + \bar{q}) - s_1.$$

4. σ_d - fire both employees and hire none:

$$\pi_E(e, q_1, q_2, \sigma_d) = 0.$$

5. σ_e - fire both employees and hire two new employees:

$$\pi_E(e, q_1, q_2, \sigma_e) = 2(1 - \theta)(e + \bar{q}) - 2s_2.$$

(Firing both employees and rehiring one is dominated by either σ_d or σ_e .)

The separation costs may be different for constrained and unconstrained entrepreneurs, but since only unconstrained entrepreneurs can demonstrate their status, in equilibrium these costs will always be weakly lower for the unconstrained. We will presume that the costs are the same for notational simplicity, but the results continue to hold if the unconstrained have lower costs (i.e. the results hold for both pooling and separating equilibria in the second period labor market).

A constrained entrepreneur can only retain worker i if $\theta(e + q_i) \geq \epsilon - \eta$ (since he cannot make a retention payment), and he may only fire m employee(s) if $s_m = 0$ (since he cannot pay signing payments).

Lemma 1. *If $\theta(e + q_i) > \epsilon - \eta$ then $R_i^c(e, q_1, q_2) \geq R_i^u(e, q_1, q_2)$.*

Proof of Lemma 1: If $\theta(e + q_i) > \epsilon - \eta$ then action σ_b is available to both types of entrepreneur. Action σ_d is dominated by action σ_b . We set $v = 3 - i$. We consider three cases:

Case i: $\theta(e + q_v) \geq \epsilon - \eta$. Action σ_a is available to both types of entrepreneur. If $s_2 = s_1 = 0$ then constrained and unconstrained entrepreneurs have the same set of actions and will make the same choice. If $s_2 > 0$ or $s_1 > 0$, the unconstrained entrepreneur has additional options (either σ_e or both σ_c and σ_e), but these actions both involve weakly less retention than σ_a or σ_b . We conclude that the constrained entrepreneur retains worker i whenever the unconstrained entrepreneur does.

Case ii: $\theta(e + q_v) < \epsilon - \eta$ and $e + q_v - \epsilon + \eta < 0$. In this case action σ_a is only available to the unconstrained entrepreneur, but it is dominated by action σ_b . The analysis in case i. applies here as well.

Case iii: $\theta(e + q_v) < \epsilon - \eta$ and $e + q_v - \epsilon + \eta \geq 0$. The unconstrained entrepreneur may select σ_a , but not the constrained entrepreneur. Worker i is retained under actions σ_a , σ_b and σ_c . If the constrained entrepreneur does not choose σ_e or the unconstrained entrepreneur does choose σ_e , the lemma holds. Suppose the constrained entrepreneur chooses σ_e and the unconstrained does not. This implies that $s_2 = 0$, hence $s_1 = 0$ and the constrained entrepreneur therefore prefers σ_e to σ_c . This implies that $(1 - \theta)(e + \bar{q}) \geq \min\{(1 - \theta)(e + q_{max}), e + q_{max} - \epsilon + \eta\}$, hence the unconstrained entrepreneur must strictly prefer σ_e to σ_a, σ_b and σ_c , which is a contradiction. This proves Lemma 1.

Lemma 2. *If $\theta(e_x + q_i) > \epsilon - \eta$ then for all $e_y \geq e_x$:*

$$R_i^u(e_x, q_1, q_2) = R_i^u(e_y, q_1, q_2)$$

and

$$R_i^c(e_x, q_1, q_2) = R_i^c(e_y, q_1, q_2).$$

Proof of Lemma 2:

Without loss of generality, we set $i = 1$. Action σ_b is available to both types of entrepreneur.

If $\theta(e_x + q_2) \geq \epsilon - \eta$ then action σ_a is available and dominates actions σ_b and σ_d for both entrepreneurial types. If $s_1 = 0$ and $s_2 = 0$ then actions σ_c and σ_e , respectively, are available to the constrained entrepreneur. We also have

$$\begin{aligned} \pi_E(e_y, q_1, q_2, \sigma_a) - \pi_E(e_x, q_1, q_2, \sigma_a) &= \pi_E(e_y, q_1, q_2, \sigma_c) - \pi_E(e_x, q_1, q_2, \sigma_c) \\ &= \pi_E(e_y, q_1, q_2, \sigma_e) - \pi_E(e_x, q_1, q_2, \sigma_e) = 2(1 - \theta)(e_y - e_x). \end{aligned}$$

We conclude that the retention policies of both the constrained and unconstrained entrepreneurs are unchanged by the shift in e .

If $\theta(e_x + q_2) < \epsilon - \eta$ then action σ_d is dominated by σ_b . We note that

$$\begin{aligned} \pi_E(e_y, q_1, q_2, \sigma_a) - \pi_E(e_x, q_1, q_2, \sigma_a) &\geq 2(1 - \theta)(e_y - e_x) \\ \pi_E(e_y, q_1, q_2, \sigma_c) - \pi_E(e_x, q_1, q_2, \sigma_c) &= \pi_E(e_y, q_1, q_2, \sigma_e) - \pi_E(e_x, q_1, q_2, \sigma_e) \\ &> \pi_E(e_y, q_1, q_2, \sigma_b) - \pi_E(e_x, q_1, q_2, \sigma_b), \end{aligned} \tag{23}$$

If the entrepreneur is unconstrained, therefore, if either σ_a or σ_c is optimal under $e = e_x$, worker 1 will be retained under $e = e_y$ as well. If σ_b is optimal, it must be that $(1 - \theta)(e_x + \bar{q}) \leq s_1$ and hence

$$\pi_E(e_x, q_1, q_2, \sigma_c) \geq \pi_E(e_x, q_1, q_2, \sigma_e).$$

Equation (23) shows that

$$\pi_E(e_y, q_1, q_2, \sigma_c) \geq \pi_E(e_y, q_1, q_2, \sigma_e),$$

so worker 1 is retained under $e = e_y$ as well.

If σ_e is optimal under e_x , (23) shows that σ_e will continue to dominate σ_b and σ_c for $e = e_y$. The fact that σ_e dominates σ_c under $e = e_x$ shows that

$$(1 - \theta)(e_x + \bar{q}) - s_2 \geq (1 - \theta)(e_x + q_1) \geq (1 - \theta)(e_x + q_2),$$

so we conclude that σ_e dominates σ_a under $e = e_y$. We conclude in this case as well that the retention of worker 1 by the unconstrained entrepreneur is identical for $e = e_x$ and $e = e_y$.

If the entrepreneur is constrained, action σ_a is not available. If $s_1 > 0$, then action σ_b is optimal for both $e = e_x$ and $e = e_y$. If $s_1 = 0$ then σ_c dominates σ_b , and (23) shows that whichever of σ_c and σ_e is optimal for $e = e_x$ will remain optimal for $e = e_y$. This proves Lemma 2.

Proof of Result 3.

To prove the result, we proceed by an analysis of cases. We will suppose without loss of generality that $i = 1$.

i. Suppose $\theta(e_x + q_1) \leq \epsilon - \eta$.

In this case

$$W_i^{2,c}(f_x, q_1, q_2) = W_i^{2,u}(f_x, q_1, q_2) = \epsilon.$$

If $\theta(e_y + q_1) \leq \epsilon - \eta$ then

$$W_i^{2,c}(f_y, q_1, q_2) = W_i^{2,u}(f_y, q_1, q_2) = \epsilon,$$

and the result is proved. If $\theta(e_y + q_1) > \epsilon - \eta$, Lemma 1 shows that

$$W_i^{2,c}(f_y, q_1, q_2) \geq W_i^{2,u}(f_y, q_1, q_2),$$

and the result is proved.

ii. Suppose $\theta(e_x + q_1) > \epsilon - \eta$.

We have

$$\begin{aligned}
& W_i^{2,c}(f_y, q_1, q_2) - W_i^{2,c}(f_x, q_1, q_2) \\
&= R_i^c(e_x, q_1, q_2)(\max\{\theta(e_y + q_i) + \eta, \epsilon\} - \max\{\theta(e_x + q_i) + \eta, \epsilon\}) \\
&\geq R_i^u(e_x, q_1, q_2)(\max\{\theta(e_y + q_i) + \eta, \epsilon\} - \max\{\theta(e_x + q_i) + \eta, \epsilon\}) \\
&= W_i^{2,u}(f_y, q_1, q_2) - W_i^{2,u}(f_x, q_1, q_2),
\end{aligned}$$

where the inequality follows from Lemma 1 and the equalities from Lemma 2. This concludes the proof of Result 3.

Proofs of Lemma 3 and Result 4.

We define $e = f^0 + f + E[f^{2*}] + \lambda^s$ and $\eta = E[b^{2*}] - g^s$.

Lemma 3. For any (\hat{q}_1, \hat{q}_2) , if $R_i^{2,u}(e, \hat{q}_1, \hat{q}_2) = 1$ and $\theta(e + \hat{q}_i) > \epsilon - \eta$ for $i = 1, 2$ then $R_i^{2,c}(e, \hat{q}_1, \hat{q}_2) = 1$ for $i = 1, 2$.

Proof of Lemma 3. Under the conditions of the lemma, action σ_a is available to both types of entrepreneurs and dominates all the actions available to the unconstrained entrepreneur. It must therefore be that action σ_a dominates the smaller set of actions available to the constrained entrepreneur.

Proof of Result 4.

First suppose that $\theta(e + q_i + \lambda^j) \leq \epsilon - \eta$ for $i = 1$ or 2 . This implies that $\theta(e + q_i) \leq \epsilon - \eta$, hence

$$W_i^{2,u}(e, q_1 + \lambda^j, q_2 + \lambda^j) = \epsilon = W_i^{2,u}(e, q_1, q_2).$$

Inequality (5) shows that (12) fails and the result holds.

Now suppose that $\theta(e + q_i + \lambda^j) > \epsilon - \eta$ for $i = 1, 2$. If $R_i^{2,u}(e, q_1 + \lambda^j, q_2 + \lambda^j) = 0$ for $i = 1$ or $i = 2$, then

$$W_i^{2,u}(e, q_1 + \lambda^j, q_2 + \lambda^j) = \epsilon \leq W_i^{2,u}(e, q_1, q_2),$$

so (12) must fail.

We have shown that

$$R_i^{2,u}(e, q_1 + \lambda^j, q_2 + \lambda^j) = 1 \tag{24}$$

and

$$\theta(e + q_i + \lambda^j) > \epsilon - \eta \tag{25}$$

for $i = 1, 2$ is a necessary implication of (12). Lemma 3 shows that (24) and (25) imply that $R_i^{2,c}(e, q_1 + \lambda^j, q_2 + \lambda^j) = 1$ for $i = 1, 2$.

Since $\theta(e + q_i + \lambda^j) > \epsilon - \eta$, $W_i^{2,c}(e, q_1 + \lambda^j, q_2 + \lambda^j) = \theta(e + q_i + \lambda^j) + \eta$ and $W_i^{2,u}(e, q_1 + \lambda^j, q_2 + \lambda^j) = \theta(e + q_i + \lambda^j) + \eta$.

If $\theta(e + q_i) \leq \epsilon - \eta$ then $W_i^{2,c}(e, q_1, q_2) = \epsilon$ and $W_i^{2,u}(e, q_1, q_2) = \epsilon$, (13) must hold and the result is proved.

Suppose $\theta(e + q_i) > \epsilon - \eta$. This implies that

$$\begin{aligned}
W_i^{2,c}(e, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(e, q_1, q_2) &\geq \theta(e + q_i + \lambda^j) + \eta - \theta(e + q_i) - \eta \\
&\geq g^j - \theta\lambda^j,
\end{aligned}$$

where the final inequality follows from (6). This shows that (13) holds. This concludes the proof of Result 4.

Proofs of Lemma 4, Lemma 5 and Result 5.

We define e_y, e_x and η as in the proof of Result 3. We let $e \in \{e_x, e_y\}$ be given.

Lemma 4. For any (q_1, q_2) , $R_i^c(e, q_1 + \lambda, q_2 + \lambda) \geq R_i^c(e, q_1, q_2)$ and hence $W_i^{2,c}(f, q_1 + \lambda, q_2 + \lambda) \geq W_i^{2,c}(f, q_1, q_2)$.

Proof of Lemma 4: We note that

$$\begin{aligned}
& \pi_E(e_x, q_1 + \lambda, q_2 + \lambda, \sigma_a) - \pi_E(e_x, q_1, q_2, \sigma_a) \geq \\
& \pi_E(e_x, q_1 + \lambda, q_2 + \lambda, \sigma_b) - \pi_E(e_x, q_1, q_2, \sigma_b) = \pi_E(e_x, q_1 + \lambda, q_2 + \lambda, \sigma_c) - \pi_E(e_x, q_1, q_2, \sigma_c) \\
& \geq \pi_E(e_x, q_1 + \lambda, q_2 + \lambda, \sigma_d) - \pi_E(e_x, q_1, q_2, \sigma_d) = \pi_E(e_x, q_1 + \lambda, q_2 + \lambda, \sigma_e) - \pi_E(e_x, q_1, q_2, \sigma_e).
\end{aligned} \tag{26}$$

Thus, if σ_a is optimal and both workers are retained when qualities are (q_1, q_2) , then σ_a is optimal when qualities are $(q_1 + \lambda, q_2 + \lambda)$. If either σ_b or σ_c is optimal and worker i is retained for qualities (q_1, q_2) , then at least 1 employee is retained for qualities $(q_1 + \lambda, q_2 + \lambda)$. Since adding λ to each worker quality does not induce a change in the rank ordering of worker qualities, worker i will also be retained for qualities $(q_1 + \lambda, q_2 + \lambda)$. We note that this proof applies to the unconstrained firm as well.

Lemma 5. For any given $f_y \geq f_x$ and (q_1, q_2) , $R_i^c(e_y, q_1, q_2) \geq R_i^c(e_x, q_1, q_2)$ and hence $W_i^{2,c}(f_y, q_1, q_2) \geq W_i^{2,c}(f_x, q_1, q_2)$.

Proof of Lemma 5: We have

$$\begin{aligned} \pi_E(e_y, q_1, q_2, \sigma_a) - \pi_E(e_x, q_1, q_2, \sigma_a) &\geq \pi_E(e_y, q_1, q_2, \sigma_c) - \pi_E(e_x, q_1, q_2, \sigma_c) \\ &\geq \pi_E(e_y, q_1, q_2, \sigma_e) - \pi_E(e_x, q_1, q_2, \sigma_e) \end{aligned}$$

and

$$\begin{aligned} \pi_E(e_y, q_1, q_2, \sigma_c) - \pi_E(e_x, q_1, q_2, \sigma_c) &\geq \pi_E(e_y, q_1, q_2, \sigma_b) - \pi_E(e_x, q_1, q_2, \sigma_b) \\ &\pi_E(e_y, q_1, q_2, \sigma_d) - \pi_E(e_x, q_1, q_2, \sigma_d). \end{aligned}$$

If $R_i^c(e_x, q_1, q_2) = 1$, then either σ_a , σ_b or σ_c must be optimal. If σ_a is optimal at $e = e_x$, then it is optimal at $e = e_y$. If σ_c is optimal at $e = e_x$, then either σ_a or σ_c is optimal at $e = e_y$. If σ_b is optimal at $e = e_x$, it must be that $(1 - \theta)(e_x + \bar{q}) \leq s_1$ and hence $\pi_E(e_x, q_1, q_2, \sigma_c) \geq \pi_E(e_x, q_1, q_2, \sigma_e)$, so σ_c dominates σ_e under $e = e_y$. In all cases, worker i is retained for $e = e_y$.

Proof of Result 5

Without loss of generality, we set $i = 1$.

Case I: $\theta(e_x + q_1) \leq \epsilon - \eta$. This implies that $W_1^{2,c}(f_x, q_1, q_2) = \epsilon$.

If $\theta(e_y + q_1) \leq \epsilon - \eta$, then

$$W_1^{2,c}(f_y, q_1 + \lambda, q_2 + \lambda) - W_1^{2,c}(f_x, q_1 + \lambda, q_2 + \lambda) \geq 0 = W_1^{2,c}(f_y, q_1, q_2) - W_1^{2,c}(f_x, q_1, q_2),$$

where the inequality follows from Lemma 5.

We now suppose that $\theta(e_y + q_1) > \epsilon - \eta$. If $\theta(e_x + q_1 + \lambda) \leq \epsilon - \eta$ or $R_1^{2,c}(e_x, q_1 + \lambda, q_2 + \lambda) = 0$, then $W_1^{2,c}(f_x, q_1 + \lambda, q_2 + \lambda) = \epsilon$, and the result holds by Lemma 4.

If $\theta(e_x + q_1 + \lambda) > \epsilon - \eta$ and $R_1^{2,c}(e_x, q_1 + \lambda, q_2 + \lambda) = 1$, then

$$\begin{aligned} W_1^{2,c}(f_y, q_1 + \lambda, q_2 + \lambda) - W_1^{2,c}(f_x, q_1 + \lambda, q_2 + \lambda) &= \theta(e_y - e_x) \geq \\ &\theta(e_y + q_1) + \eta - \epsilon \geq W_1^{2,c}(f_y, q_1, q_2) - W_1^{2,c}(f_x, q_1, q_2). \end{aligned}$$

Case II: $\theta(e_x + q_1) > \epsilon - \eta$.

We have

$$\begin{aligned} &W_1^{2,c}(f_y, q_1 + \lambda, q_2 + \lambda) - W_1^{2,c}(f_x, q_1 + \lambda, q_2 + \lambda) \\ &= R_1^c(e_x, q_1 + \lambda, q_2 + \lambda)(\theta(e_y + q_1 + \lambda) - \theta(e_x + q_1 + \lambda)) \\ &\geq R_1^c(e_x, q_1, q_2)(\theta(e_y + q_1) - \theta(e_x + q_1)) \\ &= W_1^{2,c}(f_y, q_1, q_2) - W_1^{2,c}(f_x, q_1, q_2), \end{aligned}$$

where the equalities follow from Lemma 2 and the inequality from Lemma 4.

Proof of Result 6.

Case i. We first consider the unconstrained firm. We denote the equilibrium project choice of the worker with discretion (worker \hat{i}) by (f_u^*, b_u^*) . By not allowing discretion, the entrepreneur could set $f^1 = f_D$ (the default option) in the second period. Since the entrepreneur's first period payoff is strictly increasing in f^1 and his second period

payoff is weakly increasing in f^1 , it must be that $f_u^* \geq f_D$. Since worker \hat{i} chooses $f^1 = f_u^*$, it must then be that for any $f_k \leq f_u^*$

$$W_i^{2,u}(f_u^*, q_1, q_2) + \theta(f_u^* + q_i) + b_u^* \geq W_i^{2,u}(f_k, q_1, q_2) + \theta(f_k + q_i) + b_k. \quad (27)$$

Result 3 and (27) show that

$$W_i^{2,c}(f_u^*, q_1, q_2) + \theta(f_u^* + q_i) + b_u^* \geq W_i^{2,c}(f_k, q_1, q_2) + \theta(f_k + q_i) + b_k.$$

This implies that if the constrained entrepreneur does not choose teamwork, allowing discretion leads worker \hat{i} to choose $f_c^* \geq f_u^* \geq f_D$. We conclude that the constrained entrepreneur will prefer discretion with no teamwork to a policy of no discretion and no teamwork.

We now assume that the constrained entrepreneur selects a policy of teamwork and no discretion. Since workers always exert effort in a separate production environment and generate increased production of $\lambda^s > 0$ in the first period and weakly greater production in the second period, an entrepreneur will only select teamwork if both workers exert effort in the teamwork setting. That is,

$$W_i^{2,c}(f_D, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(f_D, q_1, q_2) \geq g^j - \theta\lambda^j \quad (28)$$

must hold for $i = 1, 2$. Suppose the constrained entrepreneur allows discretion in addition to teamwork. We denote the productivity of the project choice of worker \hat{i} when both workers exert effort by f_c^* and the productivity of his choice if either worker does not exert effort by \hat{f}_c^* . Result 5, Result 3 and (27) show that $f_c^* \geq \hat{f}_c^* \geq f_u^* \geq f_D$. The second worker to exert effort will do so if and only if the first worker does, since

$$\begin{aligned} & W_i^{2,c}(f_c^*, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(\hat{f}_c^*, q_1, q_2) \\ & \geq W_i^{2,c}(f_c^*, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(f_c^*, q_1, q_2) \\ & \geq W_i^{2,c}(f_D, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(f_D, q_1, q_2) \geq g^j - \theta\lambda^j, \end{aligned}$$

where the first inequality follows from Lemma 5, the second from Result 5 and the third from (28). A similar argument shows that the first worker will choose to exert effort. This implies that allowing discretion and teamwork will result in effort exertion by both workers. A policy of teamwork and discretion thus yields the constrained entrepreneur

$$\begin{aligned} & (1 - \theta)(2f_c^* + q_1 + q_2 + 2\lambda^j) + \pi_E^{2,c}(f^0 + f_c^* + E[f^{2*}], q_1 + \lambda^j, q_2 + \lambda^j) \\ & > (1 - \theta)(2\hat{f}_c^* + q_1 + q_2 + 2\lambda^s) + \pi_E^{2,c}(f^0 + \hat{f}_c^* + E[f^{2*}], q_1 + \lambda^s, q_2 + \lambda^s), \end{aligned}$$

where the second term is the entrepreneur's payoff from a policy of discretion alone. We conclude that teamwork and cooperation dominates teamwork alone.

Case ii. In this case, Result 4 shows that the constrained entrepreneur prefers teamwork and no discretion to a policy of neither teamwork nor discretion. We now consider a policy on the part of the constrained entrepreneur of allowing discretion but not teamwork. We denote by f_y the f^1 selected by worker \hat{i} under this policy. It must that $f_y \geq f_D$, or else this policy would be dominated by allowing neither discretion nor teamwork. We now consider a policy of teamwork and discretion on the part of the constrained entrepreneur. We denote by f_z the f^1 selected by worker \hat{i} at a constrained firm under a policy of teamwork and discretion if both workers exert effort. We label \hat{f}_z the discretion choice of worker \hat{i} if either worker does not exert effort. By Result 5, $f_z \geq \hat{f}_z$ and $f_z \geq f_y$.

The second worker to exert effort will do so if and only if the first worker does, since

$$\begin{aligned} & W_i^{2,c}(f_z, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(\hat{f}_z, q_1 + \lambda^j, q_2 + \lambda^j) \\ & \geq W_i^{2,u}(f_D, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,u}(f_D, q_1 + \lambda^j, q_2 + \lambda^j) \geq g^j - \theta\lambda^j, \end{aligned}$$

where the first inequality follows from Lemma 5, Result 5 and Result 3, and the second inequality follows from the fact that the unconstrained entrepreneur prefers teamwork and no discretion to a policy of neither teamwork nor discretion. A similar argument shows that the first worker will choose to exert effort. This implies that allowing

discretion and teamwork will result in effort exertion by both workers and a higher choice of f^1 than discretion alone. We conclude that teamwork and cooperation dominates discretion alone.

Case iii. If it is an optimal strategy for the unconstrained entrepreneur to select a policy of discretion and teamwork, it must be that both workers exert effort in the unconstrained firm. We denote by f_u the equilibrium f^1 selected by worker \hat{i} . For $i \in \{1, 2\}$

$$W_i^{2,u}(f_u, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,u}(f_u, q_1, q_2) \geq g^j - \theta\lambda^j. \quad (29)$$

Suppose the constrained entrepreneur selects a policy of discretion and teamwork. We denote by f_z and \hat{f}_z the f^1 choices of worker \hat{i} if both workers exert effort and if at least one worker does not exert effort, respectively. By Result 3, $f_z \geq f_u$, and by Result 5, $f_z \geq \hat{f}_z$.

If the first worker exerts effort, the benefit from effort exertion for the second worker is given by

$$\begin{aligned} & W_i^{2,c}(f_z, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(\hat{f}_z, q_1, q_2) \\ & \geq W_i^{2,c}(f_u, q_1 + \lambda^j, q_2 + \lambda^j) - W_i^{2,c}(f_u, q_1, q_2), \end{aligned}$$

where the inequality follows from Lemma 5 and Result 5. Result 4 shows that the second worker exerts effort if and only the first worker invests. A similar argument shows that the first worker will exert effort. We conclude that both workers will exert effort.

Suppose that $f_u < f_D$. If this is true, the unconstrained entrepreneur would do strictly better to choose teamwork and no discretion, unless the workers would not exert effort given that policy choice. We define $e_D = f^0 + f_D + E[f^{2*}] + \lambda^s$. Lemma 2, (24) and (25) show that

$$W_i^{2,u}(f_D, q_1 + \lambda^j, q_2 + \lambda^j) = \theta(e_D + q_i + \lambda^j) + \eta.$$

It must that $W_i^{2,u}(f_D, q_1, q_2) \leq \epsilon$ or $W_i^{2,u}(f_D, q_1, q_2) \leq \theta(e_D + q_i) + \eta$. In the former case, (29) shows that workers would exert effort given a no discretion policy. In the latter case, the same conclusion follows from the fact that $\theta\lambda^j > g^j - \theta\lambda^j$. It must therefore be that $f_u \geq f_D$. Result 5 then shows that a discretion and teamwork policy will yield the constrained entrepreneur the highest choice of f^1 . Let \hat{f}^1 and $\hat{\lambda}$ denote the equilibrium f^1 and λ choices under any other policy. We have shown that $f_z \geq \hat{f}^1$ and in all cases $\lambda^j \geq \hat{\lambda}$, so a policy of discretion and teamwork must be optimal for the constrained entrepreneur.

Proof of Result 7.

Result 7. Denote the worker leader by \hat{i} , the second worker by v and suppose the following conditions hold:

$$q_v > \bar{q} > q_i + \frac{s_1}{1 - \theta} + \lambda^j, \quad (30)$$

$$f_1 + q_i > \epsilon \quad (31)$$

and for $k \geq 2$

$$b_1 - b_k > \theta(f_k - f_1) > 0. \quad (32)$$

We also assume that $s_1 > 0$. For sufficiently large f_k ($k \geq 2$) and λ^j satisfying (30), (31) and (32),

$$\pi_E^{1,c}(f^0 + f^{1*,c}, q_1, q_2) + E \pi_E^{2,c} \geq \pi_E^{1,u}(f^0 + f^{1*,u}, q_1, q_2) + E \pi_E^{2,u}.$$

Under conditions (30), (31) and (32), the unconstrained entrepreneur will always fire worker \hat{i} , so teamwork is never adopted and (32) implies that the (f_1, b_1) project is selected. The two-period expected payoff to the unconstrained entrepreneur is given by

$$(1 - \theta)(2(f^0 + f_1) + 2\lambda^s + q_i + q_v) + (1 - \theta)(2(f^0 + f_1 + f^{2*}) + 3\lambda^s + q_v + \bar{q}) - s_1.$$

Since $s_1 > 0$, (31) shows that the constrained entrepreneur will retain both employees. The constrained firm will therefore produce in teams. If there exists a $k \geq 2$ such that $b_1 + \theta f_1 < b_k + 2\theta f_k$, then the constrained entrepreneur will choose discretion and the selected projected $(b^{1*,c}, f^{1*,c})$ will satisfy $f^{1*,c} > f_1$. We assume that λ^j is sufficiently large that

$$\lambda^j - \lambda^s > \frac{\bar{q} - q_i - \lambda^j}{3} - \frac{s_1}{3(1-\theta)}. \quad (33)$$

The two-period payoff of the constrained entrepreneur is

$$(1-\theta)(2(f^0 + f^{1*,c}) + 2\lambda^j + q_i + q_2) + (1-\theta)(2(f^0 + f^{1*,c} + f^{2*}) + 2\lambda^j + 2\lambda^s + q_i + q_v).$$

The result follows from (33).

Table 1: Summary Statistics

Panel A: National Survey of Small Business Finance variable distribution characteristics						
			Std			
Non-binary variables	Mean	Median	Dev	Binary variables	Mean	
Employees	25.5	5	54.52	MSA	0.78	
Sales	3,436,004	250,000	14,993,484	Female	0.22	
Assets	1,463,454	95,756	5,330,001	African-American	0.08	
Bank Herf Index	2.47	3	0.59	Hispanic	0.07	
Net Worth	934,107	275,000	360,603	Bankrupt	0.02	
Firm Age	14.45	11	12.12	Judgement	0.04	
DBscore	3.03	3	1.04	Applied for a loan	0.27	
Education	4.65	6	1.96	Applied for a loan and rejected	0.05	

Panel B: National Organizations Survey variable distribution characteristics						
			Std			
Non-binary variables	Mean	Median	Dev	Binary variables	Mean	
Employees	56.09	18	92.28	MSA	0.78	
Sales	204,265,514	5,000,000	439,369,605	Work in teams	0.49	
Bank Herf	0.1975	0.1794	0.0910	Drug/Alcohol Programs	0.28	
Median Home Value	132,244	102,550	90,165			
Firm Age	26.99	19	25.02			
Women % Employees	0.41	0.38	0.31			
White % Employees	0.80	0.95	0.28			
MSA Population	1,373,848	513,117	2,065,382			
Locus of Authority	3.36	3.375	0.53			

Panel A reports means (all variables), medians and standard deviations (all non-binary variables) for each variable in the 1998 National Survey of Small Business Finance. Assets, employees, sales, firm age and DBscore (Dun and Bradstreet credit score on a 1-5 scale) are measured at the firm level. Net worth (excluding the value of the firm), education (on a 1-7 scale), gender and ethnicity are given for the firm's primary owner. Bankrupt is a dummy for whether the firm or its owner has declared bankruptcy in the last 7 years, and Judgement is a dummy for whether the owner has had any judgements rendered against him in the last 3 years. MSA is a dummy for whether the firm is located in a Metropolitan Statistical Area, and Bank Herf Index is a measure (from 1 to 3) of the deposit concentration of the local MSA or county commercial bank market. Applied for a loan is a dummy for whether the firm made one or more loan applications in the past 3 years, and Applied for a loan and rejected is a dummy for whether the firm's most recent loan application (if any) was rejected. Panel B reports means (all variables), medians and standard deviations (all non-binary variables) for each variable in the 1996-1997 National Organizations Survey. Employees, sales and firm age are measured at the firm level. MSA is a dummy for whether the firm is located in a Metropolitan Statistical Area, MSA population is the population of the MSA if the firm is in one and Bank Herf is the deposit concentration of the local MSA or county commercial bank market. Median home value gives the median home value in the zip code in which the firm is located. Women % employees and White % employees describe the gender and ethnic composition of the firm's workforce. Work in teams is a dummy variable for whether employees are involved in work teams, locus of authority describes the the level of the corporate hierarchy at which decisions on hiring, production, training and evaluation are made and drug/alcohol programs is a dummy variable for whether the firm offers drug or alcohol abuse programs to employees.

Table 2: Financial Constraints and the Capital-Labor Decision

Dependent Variable # Obs.	Loan application rejected? 960	Made an application? 3553	Capital-Labor Ratio 3553	Capital-Labor Ratio 960	Capital-Labor Ratio 960
Bank Herf Index	0.546** (2.73)	-0.060 (-0.83)	-0.105* (-1.87)	-0.230** (-2.55)	
Log(net worth)	-0.131** (-3.07)	0.003 (0.17)	0.123** (6.11)	0.151** (3.97)	
Education	-0.048 (-0.76)	0.007 (0.28)	0.041** (2.25)	0.034 (1.18)	
Female	0.317 (1.12)	0.036 (0.33)	-0.193** (-2.25)	-0.297** (-1.98)	
African-American	1.516** (4.81)	-0.510** (-3.31)	-0.241* (-1.76)	-0.662** (-2.47)	
Hispanic	1.312** (4.02)	-0.280* (-1.79)	0.057 (0.48)	-0.006 (-0.03)	
Bankrupt	2.560** (4.00)	0.009 (0.03)	-0.078 (-0.35)	-0.207 (-0.53)	
Judgement	2.015** (4.95)	-0.367* (-1.76)	-0.191 (-1.03)	-0.534 (-1.43)	
DBscore	-0.166* (-1.68)	0.132** (3.30)	0.060** (2.25)	0.079* (1.89)	
Log(1+sales)	-0.216** (-3.28)	-0.240** (-8.59)	0.252** (11.39)	0.147** (3.35)	0.128** (2.87)
Log(1+firm age)	-0.183 (-0.94)	0.266** (4.05)	0.062 (1.07)	0.119 (1.20)	0.083 (0.79)
MSA?	0.583** (2.01)	0.311** (3.00)	-0.208** (-2.64)	-0.153 (-1.25)	0.076 (0.60)
Fin. Constr. (Inst.)					-2.279** (-4.63)
Estimation Method	<i>Logit</i>	<i>Logit</i>	<i>OLS</i>	<i>OLS</i>	<i>2SLS</i>
Sample	Loan Applicants	All Firms	All Firms	Loan Applicants	Loan Applicants

Results from the regressions of whether the firm had a loan application declined in the last 3 years (first column), whether the firm applied for a loan in the last 3 years (second column), and the log of one plus the ratio of assets to employees (third through fifth columns) on measures of financial constraints. The regressors with reported coefficients are an index of the local banking market Herfindahl measure, the log of one plus the firm owner's net worth, a ranking of the firm owner's education, dummies for the firm owner being female, African-American or Hispanic, a dummy for whether the firm or its owner has declared bankruptcy in the last 7 years, a dummy for whether the owner has had any judgements rendered against him in the last 3 years, the firm's credit score as obtained from Dun and Bradstreet, the log of one plus annual sales, the log of one plus firm age, a dummy for the location of the firm within an MSA (Metropolitan Statistical Area) and an instrumented estimate of the probability of the firm's having a loan application declined. Additional regressors with coefficients unreported for brevity include a constant, industry dummies at the 2-digit SIC level, the log of one plus the owner's experience in managing a business, the log of the owner's age, a dummy for whether the firm is managed by the owner and a dummy for a family-owned firm. The data source is the 1998 National Survey of Small Business Finance. The regressions are estimated via binary logistic regression (Logit), ordinary least squares (OLS), or two-stage least squares (2SLS), as described, with *t*-statistics reported in parentheses using robust "sandwich" standard errors.

*,** Indicates significance at the 10% and 5% levels, respectively.

Table 3: Financial Constraints and Work Organization

Dependent Variable	Work in teams?	Locus of authority	Drug/Alcohol Programs?
<i># Obs.</i>	<i>230</i>	<i>229</i>	<i>225</i>
Bank Herf	7.68** (2.26)	-0.73* (-1.84)	-0.25 (-0.06)
Log(median home value)	-0.83* (-1.70)	0.14** (1.98)	0.10 (0.16)
Women % Employees	0.70 (0.81)	0.04 (0.35)	0.48 (0.36)
White % Employees	0.73 (0.85)	0.02 (0.22)	0.93 (0.87)
Log(1+employees)	0.54** (2.29)	-0.17** (-5.91)	0.98** (3.50)
Log(1+sales)	-0.33 (-1.04)	0.01 (0.64)	0.21 (0.62)
Log(1+firm age)	-0.08 (-0.86)	-0.05 (-1.12)	-0.03 (-0.29)
MSA?	-4.06 (-1.26)	-0.01 (-0.02)	-0.38 (-0.12)
log(MSA population)	0.45* (1.82)	-0.02 (-0.60)	0.10 (0.41)
Estimation Method	<i>Logit</i>	<i>OLS</i>	<i>Logit</i>
<i># of Clusters</i>	<i>169</i>	<i>169</i>	<i>166</i>

Results from the regressions of organizational work practices on the local banking market deposit Herfindahl measure, the log of the median home value of the zip code in which the firm is located, the fraction of the firm's employees who are women, the fraction of the firm's employees who are white, the log of one plus the number of employees, the log of one plus annual sales, the log of one plus firm age, a dummy for the location of the firm within an MSA (Metropolitan Statistical Area) and the log of the population of the MSA if the firm is within an MSA. Additional regressors include a constant, industry dummies at the 2-digit SIC level and dummies for sole proprietorships, partnerships, headquarters and presence of a union. The dependent variables are whether employees are involved in work teams (first column), the level of authority at which decisions on hiring, production, training and evaluation are made (second column) and whether the firm offers drug or alcohol abuse programs to its employees (third column). The data source is the 1996-1997 National Organizations Survey. The regressions are estimated via binary logistic regression (Logit) or ordinary least squares (OLS), as described, with *t*-statistics reported in parentheses using White (1982)-corrected standard errors that account for group-wise clustering at the local-banking-market level. The coefficients on the constant and dummy terms are not reported for brevity.

*,** Indicates significance at the 10% and 5% levels, respectively.