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Fighting for Talent: Risk-Taking, Corporate Volatility, and Organizational Change

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Abstract

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Keywords: Financial Development, Spin-offs, Sorting, Organizations, Markets

JEL Classifications: L2, G3

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Abstract

We show that the availability of finance affects firms not only through financial markets, but also through the labor market. In our model, talented workers care for realizing their ideas because this can increase their lifetime income, but they also wish to be insured against income risk. Large firms are less likely to default and thus offer a safer income stream than small firms. But having assets, reputation or future cash flows of other projects at stake, large firms investigate new ideas more thoroughly than small firms. This investigation produces valuable but noisy information about the success probability of ideas. For this reason, large firms are more likely to reject good ideas than small firms. Workers thus face a trade-off between better insurance and lower probability of realizing their own ideas. If access to consumer credit increases, talented workers become less averse to the income risk of working in small firms and start spurning large firms. We show that this increases small firms' profit volatility and may induce large firms to create spin-offs. We also provide empirical evidence consistent with the implications of our theory.

Keywords: Occupational choice, spin-offs, sorting in labor markets, organizations and markets, financial development

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I Introduction

The nature of the firm has changed substantially in the last decade. Asset-intensive, highly vertically integrated firms with tight control over their employees have become old-fashioned. Instead, human capital has become crucial in determining corporate success (Rajan and Zingales, 2001). Firms have thus entered into fierce competition for the most talented and creative employees. However, attracting talented workers has proved to be a difficult task, because their preferences for different types of jobs have been changing over time.

Surveys during the nineties show that talented workers began to expect opportunities for personal growth from their jobs (Stum, 1998) and to spurn secure jobs in large and stable organizations, formerly considered prestigious (Malone, 2003).[1] Changes in worker attitudes and occupational choice coincided with an increase in small firms' employment and decreasing average firm size, in particular, in the high-tech sectors of OECD countries (Pryor, 2001). Large firms, attempting to attract the most skilled workers, tried to imitate the way small firms operate by creating spin-offs (Day et al., 2001; Lawler et al., 1995; Michaels et al., 2001). Some of these attempts were of rather short-term nature. After the burst of the new economy bubble, large firms have become more attractive again. Similarly, some of the most extreme changes of the nineties have been reversed and large companies have been dismantling their corporate venture funds (*The Economist*, 2001).

This paper aims to identify the driving forces behind the changes in worker attitudes towards large and small firms. In our theory, talented workers care for realizing their ideas because this can increase their lifetime income, but they also wish to be insured against income risk. Large firms are less likely to default (Caves, 1998) and thus offer a safer income stream than small firms (Guiso, Jappelli and Pistaferri, 2002). But they also investigate ideas more thoroughly before funding them: the ideas of workers have risky payoffs and large firms have more of their assets, reputation or future cash flows of other projects at stake than small firms when implementing an idea. The investigation produces valuable but noisy information about the success probability of ideas. For this reason, large firms are more likely to reject good ideas than small firms. This entails

[1] For instance, an increasing number of MBAs from top U.S. business schools were declining job offers with the highest pay, such as positions in investment banking and consulting (Cappelli, 1999). Rather they were taking jobs in small companies and start-up ventures. MBAs became more willing to forgo job security in order to gain the "possibility of hitting it big". Cappelli also reports that confronted with the hypothetical alternative between a risky job involving a possibly big payoff or a secure one, MBAs became increasingly prone to the risky choice, even if the expected compensation was not much higher than in the secure job.

a particularly high cost for the most creative workers, who are the most concerned to see their ideas realized, in order to receive higher compensation. Nonetheless, any worker also appreciates the insurance that jobs in large firms can provide. Workers thus face a trade-off between better insurance and lower probability of realizing their own ideas.

How this trade-off affects workers' choice between small and large firms depends on the insurance offered by the financial market and on the expected payoff of ideas. First, if household borrowing constraints relax – as happened in the U.S. during the nineties[2] – the propensity of creative workers to work in large firms decreases. In fact, if their firm defaults, they can borrow against their future income, while looking for a new job. This implies that better access to household credit makes the insurance offered by large firms less desirable. Small firms thus gain a competitive edge over large firms in attracting creative workers. Similarly, the model implies that workers' choices between small and large firms may change over the business cycle when access to consumer credit changes. Second, when the expected payoffs of ideas increase, workers' expected loss due to large firms rejecting some of the ideas increases. The most talented workers then prefer to work in small firms even though the entry wage differential between large and small firms may increase.

Our model implies that better access of households to capital markets and technological change may reduce average enterprise profitability in sectors in which worker talent is important. Better access to credit and technological change raise the number of ideas that are funded, as small firms are less choosy in accepting new projects. When too many ideas are funded, the variance of small firms' profits increases, and there are more bankruptcies because small firms do not fully internalize the cost of investment. We thus provide a new rationale for why easier access to consumer credit may increase the volatility of the economy.[3]

The desire of creative workers to realize their ideas may also spur changes in capital and organizational structure. The thorough investigation to which large firms submit workers' ideas is *ex post* optimal from the point of view of maximizing the return to investment, but it has *ex ante* implications on the attractiveness of jobs in large firms. Large firms cannot commit themselves to offer jobs in which workers realize as many of their ideas as they could in small firms. For this reason, they lose their most creative workers and may become less profitable than small firms.

[2]The process of financial deregulation made consumer access to credit markets easier. As a consequence, the liabilities of households increased substantially, especially in the U.S. See Guiso et al. (2002) and Sullivan (2008).

[3]The macroeconomic literature has stressed that easing liquidity constraints, by favouring indebtedness of households, has made them more sensitive to changes in the interest rate, income, and asset prices (Debelle, 2004).

The loss of competitiveness may induce large firms to change their organizations. In particular, to commit themselves to fund new ideas without a thorough investigation, large firms may attempt to reduce what they have at stake by buying back stocks and by increasing leverage. Perhaps more importantly, large firms may have an incentive to create spin-offs that – being less capitalized – behave more like small firms. We thus show that companies may have an incentive to spin off some of their activities not only to affect workers *ex post* incentives to provide effort, as, for instance, in Scharfstein and Stein (2000) and Gromb and Scharfstein (2002), but also to influence workers' *ex ante* occupational choice.[4]

The main contribution of this paper is to show that the availability of finance affects corporations not only through financial markets, but also through the labour market. A better understanding of the determinants of the supply of talent to small firms is important as human capital plays a similar role for innovation as financial capital (Mohnen and Roeller, 2005). Our theory thus complements the ones that stress the importance of financial development for the availability of capital to small firms and start-ups (see, for instance, Zingales, 2000 and Rajan and Zingales, 2001). The relevance of this mechanism is undeniable, but it does not explain the documented changes in worker attitudes towards large and small firms. An increase in the number of start-ups induces higher demand for talent from small firms and could account for their increasing employment share. However, it does not explain why talented workers would spurn large organizations and the security they offer, especially because the wage growth in large firms has equalled or exceeded that in small firms (Hu, 2003). Beyond these observations, we also provide direct empirical evidence supporting the mechanism of our theory. In particular, we show that individuals with less tight credit constraints are more likely to be employed in small firms thus confirming that access to insurance is important for occupational choice.

The remainder of the paper is organized as follows: Section II describes the model; Section III derives the results. Section IV discusses some existing empirical evidence in support of our theory, while Section V presents new empirical evidence. Section VI concludes. All proofs are in the Appendix.

[4] Relatedly, Crémer (1995) and Aghion and Tirole (1997) point out that less information acquisition by the principal can be desirable as it strengthens worker incentives. In our model, information acquisition is always optimal with respect to maximizing the return to investment. It also does not adversely affect the payoff of the idea, which is exogenous. Nonetheless, more information acquisition may be bad for a firm as it makes it harder to recruit talented workers.

II The Model

We first describe the essentials of the model, the timing and the definition of equilibrium. A more specific description of investors' payoffs and strategies is given in Section III.

A Essentials

There is a set of workers of mass 1, one large firm and free entry of identical small firms. All firms are risk-neutral. Workers are risk-averse, impatient with discount rate r and can borrow against their future income up to an exogenously fixed amount B.

There are two alternative production technologies. First, a risk-free traditional technology yields return r ($\underline{w}$) per unit of capital (per worker). All workers have access to this technology. Since capital and labour are perfect substitutes, $\underline{w}$ can be interpreted as the reservation wage.

Second, a firm with a worker who after being hired has an idea can decide to fund the idea.[5] Ideas are risky projects that require investment I; they produce positive output Y with probability α and output zero otherwise. If the firm decides to realize her idea, the worker cannot work with the risk-free technology. Firm and worker are complementary in the realization of the idea: neither can the worker realize the idea outside of the firm, nor can the firm do without the worker. Since we want to explore how large and small firms compete to fund profitable innovation, we assume that new ideas have positive expected net present value. This is the case if funding an idea has a higher expected return than employing the capital and the worker in the risk-free technology, that is, $Y > \frac{I(1+r)+\underline{w}}{\alpha}$.

Since ideas are risky, firms may investigate their prospects before investing by observing an informative but noisy signal about the probability of success. An idea that is going to be successful generates a positive signal with probability $p \equiv prob\,(s = g \mid Y)$, where $\frac{1}{2} < p < 1$. To avoid unnecessary parameters, we assume that ideas that are bound to fail generate a positive signal with probability $prob\,(s = g \mid 0) = 0$. For the same reason, we assume that the cost of observing the signal is negligible.

Contracts are assumed to be incomplete in the sense of Grossman and Hart (1986). First, the

[5] A worker's idea consists of a product or process innovation that may increase the expected profits of the firm. This is in line with the broad interpretation of value-improving innovations in organizational economics. See, for instance, Rotemberg and Saloner (2000). Workers (or firms) cannot pretend to have an idea if they do not.

signal and the technology in which the worker is employed are not verifiable and can be incorporated neither in financial nor in labour contracts. Second, being its precise nature unknown, any aspect of the idea is non-contractible before the idea actually occurs. Thus, the large (a small) firm offers workers a fixed wage w_1^L $\left(w_1^S\right)$ provided that it does not default. If *ex post* the worker has an idea that turns out to be successful, however, firm and worker share its output. The firm receives a share λ, and the worker $(1-\lambda)$ of the output.[6] We treat λ as an exogenous parameter.[7] One may think that λ depends on the bargaining power of the firm and the worker after the idea occurs. Note that our model implies a lower bound for λ due to the fact that firms fund the idea only if $\alpha\lambda Y > I(1+r)$, and an upper bound due to the fact that the worker finds it optimal to communicate the idea only if $(1-\lambda)Y$ is larger than her fixed wage.

The worker's compensation resembles common job contracts that generally involve both an explicit wage and some expectations about the probability of being promoted and receiving higher compensation in the future (here, associated with the possibility of realizing one's own idea). These expectations, however, are not bargained about *ex ante*. The worker's compensation follows naturally from our assumptions, because when the worker is hired, the firm cannot make compensation contingent on success or failure of the idea (or on any other aspect of the idea); these contingencies are impossible to define before the idea actually occurs.[8]

We assume that the large firm has an initial amount of self-financed assets A^L which is sufficient to finance internally any number of ideas. The number of workers in the large firm is determined in equilibrium. To model the insurance function of the large firm as simply as possible, we assume that the large firm never defaults. Rather, it has enough capital to pay wages w_1^L to all workers even if all ideas fail: $A^L \geq (I + w_1^L)$.[9]

A small firm enters if it can hire a worker. Each small firm hires only one worker and has no

[6] Our parametrization implies that the worker does not receive the fixed wage if the idea is successfully realized. It would be equivalent if the worker received a fixed wage in all states of the world plus a share of the output if the idea were successfully realized.

[7] This is common in models of entrepreneurial finance because large parts of the returns are distributed in later investment rounds through ex post bargaining. See Sorensen (2008) for a discussion.

[8] Also note that large firms typically have many divisions. Hence, before the idea occurs, it is unknown which division output a successful realization of the idea may affect and therefore impossible to make compensation contingent on output.

[9] Note that A^L can also be interpreted as the value of concurrent projects. Future cash flows generated by these projects allow the repayment of external financiers even if the idea default. Since the firm can issue risk-free debt, it has incentives that are identical to the ones created by the use of internal funds.

assets.[10] All firms can raise an infinite amount of capital from outside investors[11] as long as they offer the return of the risk-free technology in expectation.[12] Hence, no firm has an incentive to borrow to invest in the risk-free technology. Investors have correct beliefs on the risk of ideas and their claims are senior to wage claims. The nominal value of their claim, D^S, must thus satisfy the participation constraint of investors, $D^S \geq \frac{(1+r)I}{\widehat{\alpha}}$, where $\widehat{\alpha}$ is the belief about the probability that a realized idea succeeds.

Workers differ in the probability of having an idea, ϕ, which is uniformly distributed on the support $[0, 1]$. Parameter ϕ captures worker creativity. Workers know their type ϕ, but firms do not. The workers' information advantage may originate from the fact that they are aware of their contributions to previous projects that are not easily documented. Differences in innate ability have been shown to play an important role in explaining workers' productivity and cannot be easily communicated as all workers have an incentive to claim to be highly creative (Lazear, 1986, 2000, 2001). For the sake of simplicity, we assume that the the expected payoff of the idea is the same for all workers and is common knowledge.

B Timing

Firms and workers live for two periods.

First Period

Job offers. At $t = 0$, firms offer wages.

Occupational choice. At $t = 1$, workers choose to work in the large firm or any of the small firms in order to maximize their expected utility.

Idea. At $t = 2$, each worker has an idea with probability ϕ. Workers communicate their idea, if they have one, to the employer.

Investment. At $t = 3$, the firms choose whether to immediately fund the idea a worker may have suggested, to reject it right away, or to first investigate it. An investigation results in a signal

[10] We make the assumptions about capital endowment of the large and the small firms for the sake of simplicity. As will be clear in Section III, the implications of the model hold if the large firm is partially outside financed, or conversely, if small firms have some internal funds.

[11] An infinitely elastic supply of capital implies that the sector we are looking at is small with respect to the overall economy. This assumption is common in small open economy models and general equilibrium models analyzing specific sectors of the economy like ours (see Michelacci and Suarez, 2004).

[12] Note that in our model, ideas either fail or succeed once their are funded. Hence, as there are only two states of the world, debt and equity are equivalent.

about the success probability of the idea. Firms decide which technology to invest in, potentially after observing the signal. If needed, firms raise external funds.

Output and payoffs. At $t = 4$, the output is realized. Outside investors are paid out and workers receive their compensation, provided that the firm does not default. Otherwise, the firm cannot pay outside investors and workers. After receiving their compensation (or nothing), workers can borrow and consume.

Second Period

At $t = 5$, all workers and assets are employed in the traditional technology. Workers receive a wage; for simplicity we assume this to be $\underline{w}$ for all of them. They pay back their loans, if any, and consume.

C Definition of equilibrium

The equilibrium is defined as follows:

- Workers maximize their expected utility by making consumption and borrowing decisions and by accepting the offer of the large or any of the small firms. Workers take wages as given. They have rational beliefs about the probability of realizing an idea in the large or in a small firm.

- The large and small firms offer wages that maximize their expected profits. They take other firms' wages as given and have correct beliefs on the effect of their offers on the expected creativity of the workers that they attract.

- The large and small firms choose whether to investigate an idea to maximize their expected profits. Firms cannot commit *ex ante* to realize a worker's idea with a certain probability.

- The capital market supplies any amount of capital provided that the expected return equals the return of the risk-free asset. Investors do not observe whether a firm investigates an idea,[13] but have correct expectations about firms' decisions.

- The labour market clears. In particular, the mass of workers employed by the large firm (small firms) is such that all the workers who prefer to work in the large firm (small firms)

[13] Firms would always declare to their investors that they have done so, but this is not credible.

do so in equilibrium.

In what follows we focus on an equilibrium in which the sets of workers employed in the large firm and in small firms are non-empty. We determine conditions on the parameters under which this is true.

III Results

We describe first firms' investment decisions ($t = 3$), then workers' occupational choice ($t = 1$), and finally firms' wage offers ($t = 0$).

A Investigation and funding of ideas

Firms investigate an idea only if their funding decisions are affected by the signal. Since ideas have *ex ante* positive net present value and a positive signal reveals a success, this implies that the firm must have an incentive not to fund the idea after a negative signal. Using Bayesian updating, after a negative signal, the probability of a successful completion of the idea is $\frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)} < \alpha$.

First, consider the large firm's incentives to investigate the idea. The large firm rejects the idea after a negative signal if the expected payoff from realizing the idea is lower than the expected payoff from from investing in the risk-free technology. Formally, this implies:

$$\frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)}\lambda Y - \left(1 - \frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)}\right) w_1^L - I(1+r) < \underline{w} - w_1^L. \tag{1}$$

The expected payoff from realizing the idea (left-hand side) takes into account that the firm obtains a share of the output λY if the idea succeeds, but it cannot invest in the risk-free technology and is committed to pay the wage w_1^L. Similarly, the payoff from investing in the risk-free technology (right-hand side) considers that the worker can produce $\underline{w}$ and must be paid w_1^L.

The wage w_1^L is chosen optimally by the large firm and is determined in Subsection III.C. As argued before, the worker has an incentive to communicate her idea only if: $w_1^L < (1-\lambda)\,Y$. Hence, after simplifying, we can substitute $(1-\lambda)\,Y$ for w_1^L and give a sufficient condition under which the large firm investigates ideas before deciding whether to fund them:

$$\frac{\alpha(1-p)}{\alpha(1-p)+(1-\alpha)} < \frac{\underline{w}+I(1+r)}{Y}. \tag{2}$$

In other words, a sufficient condition for the large firm to have an incentive to investigate the idea instead of funding it immediately is that after a negative signal, the idea is a project with negative net present value. This is the case if the investigation leads to a sufficiently infomative signal (i.e., $p > 1 - \frac{(1-\alpha)(\underline{w}+I(1+r))}{\alpha(Y-\underline{w}-I(1+r))}$). Henceforth, we assume that (2) is satisfied.[14] If the sufficient condition is satisfied, investigating the idea is efficient. However, the large firm may reject ideas even if they have positive net present value because condition (1) is less restrictive than condition (2).

We now consider small firms' incentives to investigate ideas before funding them. A small firm's payoff of a successful idea is $\max\left\{\lambda Y - D^S, 0\right\}$ because the firm appropriates its share of the cash flows from the idea after reimbursing external financiers, and because the firm is protected by limited liability. The firm's payoff is nil if the idea fails. The payoff of investing in the traditional technology is also not positive, as the firm cannot pay a wage below $\underline{w}$. If $\lambda Y - D^S > 0$, small firms would fund ideas even after a bad signal. Hence, they would choose to fund ideas without previously investigating them. In equilibrium, since investors have correct expectations on the idea's probability of success: $D^S = \frac{(1+r)I}{\alpha}$. Thus, small firms do not investigate ideas because under our assumptions $\lambda Y - \frac{(1+r)I}{\alpha} > 0$.

Clearly, assuming that small firms have no capital at stake is a drastic simplification, but the implications are more general than what it may appear. First, even if small firms had some capital, they would still have less at stake than the large firm.[15] Therefore, they would have stronger incentives to fund risky projects (ideas). Second, these incentives do not depend on the form of financing unless the firm issues pure equity, which is rarely the case for small innovative firms (Kaplan and Stromberg, 2003). Usually, these firms are funded by pennyless entrepreneurs. Outside investors do get equity stakes in the firm, while the entrepreneur gets an equity stake for contributing

[14] Note that inequality (2) makes redundant the assumption that a worker's idea can be realized only within the firm. Rather, this arises as an equilibrium outcome. If the large firm does not realize a worker's idea after investigating it, the expected payoff of the idea is negative *ex post*. Hence, any idea that has been previously rejected by the large firm would not find any financiers.

[15] Similarly, if the large firm is partially outside financed, condition (2) becomes more restrictive. However, as long as the large firm has more at stake than small firms, it is more inclined to observe the signal.

his human capital but does not contribute any financial capital. Hence, the description of small firms' incentives to realize ideas can capture such a situation as well. Finally, one may wonder to what extent monitoring by venture capitalists may substitute the internal investigation of the idea. Gompers and Lerner (2000) find that start-ups funded by large firms generally have higher returns compared to start ups funded in small independent firms backed by venture capitalists. This suggests that even venture capitalists may not be able to observe a signal as precise as the one within the firm.

The following Lemma summarizes the different strategies of the large and the small firms.

Lemma 1 *Small firms always fund workers' ideas without prior investigation. In contrast, if inequality (2) is satisfied, the large firm always investigates ideas and funds them only after a good signal.*

Lemma 1 implies that the large firm is more choosy in the decision to realize an idea and that the small firms accept more ideas, but also that more of the ideas that small firms fund fail. These differences in firms' willingness to realize new ideas depend on what companies have at stake. The effect is similar to the one highlighted by Jensen and Meckling (1976) who have shown that less capitalized firms have stronger incentives to choose riskier projects. Our result is even more closely related to Sah and Stiglitz (1988) who argue that when considering new projects, organizations require a minimum consensus level (equivalent to a thorough investigation), which depends on what the organization has at stake.

While here the large firm's reluctance to realize ideas depends on the capital invested and the opportunity cost of not employing the worker in the risk-free technology, other (similar) mechanisms could lead to the same behaviour. For instance, the large firm may be less likely to fund an idea because the commercialization of the innovation would cannibalize existing revenues from other projects. Condition (2) shows that the large firm may have an incentive to realize *ex ante* positive net present value ideas with a probability that is strictly less than 1 even if there are no negative externalities on concurrent projects.

Thus, companies can risk internal funds, future cash flows from concurrent projects, but also reputation and other intangible assets such as their customer base. Naturally, large firms have more at stake than smaller and younger firms. Hence, they adopt more centralized and hierarchical

structures, which are a way to submit new ideas to a thorough investigation (Child, 1973).

B Workers' occupational choice

Here, we determine how workers with different levels of creativity sort between the large and small firms. We solve for the equilibrium strategies assuming that small firms offer a wage $\underline{w}$ and the large firm offers $w_1^L \geq \underline{w}$. We show in Subsection III.C that these are indeed the firms' equilibrium strategies.

At $t = 1$, workers choose between the large and any of the small firms by comparing the expected utility from these two options. The utilities depend on the expected compensation in different states of nature, their probabilities and the worker's probability of having an idea. Table 1 summarizes the probabilities of different states of nature for a worker with creativity ϕ and the corresponding first-period compensation paid by the large and small firms. Compensation depends on the states of nature as follows: the worker may be employed in the traditional techonology because she had no idea or because her idea was rejected ($j = trad$); the worker may have an idea that turns out to fail ($j = fail$) or an idea that succeeds ($j = suc$).

[Insert Table 1]

At $t = 4$, after the output is realized, workers take consumption and borrowing decisions in order to maximize their intertemporal utility: $u(c_1) + \frac{u(c_2)}{1+r}$, where c_t is consumption at time t and $u(.)$ is the per-period utility function. We define the indirect utility functions (U_j^f) for different levels of compensation in the large *vs* small firms (f) below as a function of first and second period income:

$$
\begin{aligned}
U_{suc}^L = U_{suc}^S \equiv U_{suc} &\equiv U^* \left((1-\lambda) Y, \underline{w} \right) \\
U_{trad}^L &\equiv U^* \left(w_1^L, \underline{w} \right) \\
U_{trad}^S &\equiv U^* \left(\underline{w}, \underline{w} \right) \\
U_{fail}^S &\equiv U^* (0, \underline{w}).
\end{aligned}
$$

Note that the worker has the same payoff from realizing a successful idea in the large or in

a small firm.[16] Given the possible income profiles and the assumption that the intertemporal discount rate is equal to the risk-free interest rate, workers borrow only if they are employed in a small firm, their idea is realized, and it fails. For this reason, only U^S_{fail} is weakly increasing in B, the maximum amount that may be borrowed at $t = 4$. All other indirect utilities are not affected by B. Since intertemporal utility maximization implies that workers want to consume the same amount in both periods of their life, they wish to borrow $\frac{w}{2}$ if their idea is realized in a small firm and fails. Therefore, the borrowing constraint is binding in equilibrium only if $B < \frac{w}{2}$. In what follows, we assume that this is the case.

Table 1 makes clear that occupational choice is affected by the following trade-off. On the one hand, the large firm never defaults and in equilibrium always pays a wage that is higher than the one offered by small firms. On the other hand, since the large firm's investigation produces valuable but noisy information about ideas' prospects, the probability of realizing a successful idea is larger in a small firm. The condition stated in Proposition 1 requires that this last effect is strong enough to make the most creative workers, who expect to lose most from the conservatism of the large firm, prefer small firms. This is particularly likely if p is relatively small or Y is relatively large.

Proposition 1 *If* $p < \frac{\alpha U_{suc}+(1-\alpha)U^S_{fail}-U^L_{trad}}{\alpha\left(U_{suc}-U^L_{trad}\right)}$ *at* $w^L_1 = \underline{w}$*, the level of creativity at which a worker is indifferent between a large and a small firm is:*

$$\phi^* = \frac{U^L_{trad} - U^S_{trad}}{\alpha U_{suc} + (1-\alpha)U^S_{fail} - U^S_{trad} - \alpha p\left(U_{suc} - U^L_{trad}\right)} \in (0,1). \tag{3}$$

Workers with creativity $\phi \leq \phi^*$ *choose the large firm, while workers with creativity* $\phi > \phi^*$ *choose small firms.*

Proposition 1 evokes results in the literature on entrepreneurial choice (see, for instance Lucas, 1978), which has established that the most productive workers choose to become entrepreneurs (i.e., to realize their ideas). Here, creativity is equivalent to expected productivity. Thus, as highlighted by Lazear (1986 and 2001), workers with higher expected productivity choose organizations where compensation is more strongly related to performance.

Proposition 1 also implies that for given wages higher expected payoffs of ideas make relatively

[16] Results would be qualitatively similar if we allowed the worker bargaining power to differ in the large and small firms or if firm and worker bargained on the surplus that remains after paying external financiers.

less creative workers inclined to choose small firms because the expected cost of having an idea erroneously rejected by the large firm increases.

Corollary 1 *For given wages, ϕ^* decreases in the expected payoff of ideas (αY) and increases in w_1^L.*

Conditions (2) and (3) imply that if

$$p \in \left(1 - \frac{(1-\alpha)\left(\underline{w} + I(1+r)\right)}{\alpha\left(Y - \underline{w} - I(1+r)\right)}, \frac{\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^L}{\alpha\left(U_{suc} - U_{trad}^L\right)}\right) \tag{4}$$

at $w_1^L = \underline{w}$ and the previous interval is well defined, there exists an equilibrium in which the large firm is more conservative than small firms in the realization of new ideas and the most creative workers choose to be employed in small firms (the latter statement follows from the fact that Proposition 2 will prove that the large firm never raises w_1^L to the point that even the most creative worker prefers the large firm). The interval for p is well defined as long the firm's private cost from realizing the idea (that does not affect the upper limit of the interval), $I(1+r)$, is large enough. The fact that p must be included in an interval with an upper bound that is strictly smaller than 1 implies that the signal about ideas' future prospects must be sufficiently informative to make the large firm willing to follow the signal, but also sufficiently noisy because the most creative workers must find it optimal to renounce the safe income offered by the large firm. In what follows, we explore the model implications under the assumption that (4) holds. In Section IV and V, we provide existing and novel empirical evidence supporting the notion that this equilibrium is empirically relevant.

C Wage determination

Finally, we determine the wages that firms offer workers at $t = 0$. As discussed in Section II.A, our assumptions on what is verifiable and contractible at $t = 0$ imply that the wage is paid in all states of the world, except when the firm defaults or when a successful idea is realized.[17]

[17] Also, note that alternative compensation policies would not be possible. First, if firms offered a higher wage to workers who have an idea also when this is not realized, any worker could pretend to have an idea to obtain the higher wage. Second, if firms that do not default paid a lower wage to workers whose ideas fail, the commitment to offer

We first determine the wage offered by small firms. Since there is free entry of small firms, in equilibrium a small firm cannot offer a wage below $\underline{w}$, because there would always be another small firm willing to pay an ε more. Second, small firms cannot offer a wage higher than $\underline{w}$ because they have no own funds. Under the assumption that investors' claims are senior to wage claims,[18] small firms cannot finance wages through external funds and therefore are not able to pay $w_1^S > \underline{w}$. Thus, in equilibrium small firms offer $w^S = \underline{w}$.

We then determine the large firm' s wage offer. First, note that Corollary 1 establishes that when w_1^L goes up, ϕ^* increases. Therefore, both the mass and expected creativity of the workers employed in the large firm increase with w_1^L. Wages can thus be used to attract creative workers. In other words, compensation is used as a tool to affect worker sorting, as in Lazear (1986).

At $t = 0$, the large firm maximizes:

$$\max_{w_1^L} E\Pi\left(w_1^L\right) = \int_0^{\phi^*} \left((1-\phi)\left(\underline{w} - w_1^L\right) + \phi E\left(\pi_1^L\right)\right) d\phi. \tag{5}$$

In (5), the argument of the integral is the large firm's expected payoff from a worker of type ϕ: $\underline{w} - w_1^L$ is the payoff if the worker does not generate an idea and is employed in the traditional technology; $E\left(\pi_1^L\right) \equiv \alpha p\left(\lambda Y - (1+r)\, I\right) + (1-\alpha p)\left(\underline{w} - w_1^L\right)$ is the expected payoff if the worker has an idea that is realized only after a good signal.

Note that Proposition 1 implies that the large firm has to offer $w_1^L > \underline{w}$ to attract a non-empty set of workers. Proposition 2 establishes when this is optimal.

Proposition 2 *If the expected payoff of ideas is sufficiently high, the large firm offers a wage $w_1^L > \underline{w}$. Otherwise, it does not employ any workers and does not fund any ideas. The large firm never finds it optimal to offer w_1^L such that $\phi^* = 1$.*

Proposition 2 implies that if the large firm decides to compete with small firms for creative workers, it must offer higher wages. The trade-off it faces is the following: by offering high wages, it attracts a larger mass of workers and, on average, more talented workers. But a higher wage also

a wage larger than $\underline{w}$ would not be credible. In fact, at $t = 3$ firms would find it optimal to make workers without ideas (or with ideas that are not realized) fail, as a failure cannot be clearly defined at $t = 0$ and firms could always drive the productivity of the worker to zero to make it appear as a failure. The large firm would thus not succeed in attracting any workers. Also note that under our assumptions, in the large firm, ideas never fail in equilibrium.

[18] If investor claims were not senior, it would be possible to overpay non-creative workers employed in the risk-free technology at the expense of external financiers. This would undermine the feasibility of external financing.

implies that the per-capita profit of each worker employed in the traditional technology decreases. It is hence optimal for the large firm to compete with small firms if the expected surplus generated by new ideas is sufficiently large. The large firm, however, never finds it optimal to offer a wage so high that it attracts even the most creative worker.

Finally, it is interesting to know that a small firm funds ideas $\int_{\phi^*}^{1} \phi\alpha d\phi = \alpha\frac{1-(\phi^*)2}{2}$, while the mass of ideas funded in a large firm is: $x \equiv \int_{0}^{\phi^*} \phi\alpha p d\phi = \alpha p\frac{(\phi^*)^2}{2}$. Therefore, our simplifying assumption that the large firm has enough funds for all ideas implies $A^L \geq x(I + w_1^L)$.

D Better access to credit

Access to consumer credit increased dramatically in the second half of the eighties and during the nineties. As Guiso et al. (2001) and Sullivan (2008) show, it has become easier for U.S. households to borrow through unsecured debt such as credit card debt during unemployment spells. Proposition 3 shows that these developments in household access to financial markets are important for both occupational choice and firm profitability. In particular, as the borrowing constraint B relaxes, consumption can be smoothed more easily when an idea fails. As a consequence, the cut-off level of creativity at which workers prefer to be employed in small firms decreases, which implies the next Proposition.

Proposition 3 *If B increases, the set of workers employed in small firms increases.*

An increase in B – through its effect on occupational choice – has other interesting effects which can be summarized as follows:

1. The large firm attracts fewer and less creative workers and realizes fewer ideas. Thus, its profits per worker decrease.

2. Small firms also employ on average less creative workers. Thus, small firms' profits per worker also decrease, because there are more workers without ideas who work with the traditional technology, and make zero profits.

3. More ideas are realized in equilibrium because small firms realize ideas with larger probability. This implies that more ideas fail because small firms do not investigate ideas, but also that less good ideas are rejected.

4. Small firms take more risk than the large firm. Thus, profit volatility of the affected sectors increases, while the aggregate output decreases.

5. The expected utility of creative workers employed in small firms increases because their expected first-period compensation increases. Also, the utility of workers employed in the large firm can increase because w_1^L may increase.

E Extensions

E.1 Organizational change and capital structure

According to our analysis, competition from small firms impairs the large firm's ability to attract creative workers and may thus make its profitability lower than the one of small firms.

The large firm can react to small firms' competition by spinning off units, that is, by creating low-capitalized separate legal entities. This commits the firm not to investigate ideas as managers of spin-offs consider the capital provided by the headquarters as external funds. Hence, they are less conservative about realizing the workers' ideas.

The implications of our model are in line with the way innovation is promoted in sectors in which worker creativity is crucial for success. In biotechnology, for instance, innovation often takes place in small independent start-ups that have contractual ties to large asset-intensive firms in the pharmaceutical industry (Lerner and Merges, 1998). Interestingly, biotechnological research involves the application of ideas within the organization, just as in our model.

An effect similar to the one of organizational change can be achieved through changes in capital structure: a large firm can distribute dividends (or buy back equity) and increase leverage. This was common during the nineties (*The Economist*, 2002). However, when new ideas are realized within the existing firms, their cash flows are mingled with the firm's other cash flows. Therefore, for large firms with many simultaneous projects, it may not be optimal to choose a capital structure that improves incentives with respect to one project but distorts incentives with respect to other projects. For this reason, we believe that the implications for organizational change are more relevant.

E.2 Ideas in large and small firms

We have assumed that all ideas are identical and have positive net present value. An extension of our model can explain why large and small firms often fund different types of ideas. Small firms appear to contribute a disproportionate number of break-through innovations that involve low development costs, while large firms specialize in incremental improvements and innovation with high development costs (Arrow, 2000; Baumol, 2004).

While break-through innovations may resemble the positive net present value ideas we have considered so far, incremental innovation with high development costs are likely to generate relatively low payoffs (αY) for large investment ($(1+r)I$). In other words, these ideas are likely to have *ex ante* negative net present value: $\alpha Y < (1+r)I$.

As they are not able to commit themselves to a thorough investigation, small firms cannot raise external funds to finance negative net present value ideas. The conservatism of the large firm becomes an advantage because observing the signal may reveal that an idea has good prospects even though the prior is pessimistic.

If all ideas were a priori non-profitable, the large firm could attract *all* workers by offering a wage $w_1^L = \underline{w}$. The wage would be equal to the one offered by small firms, but the large firm would also give the possibility of realizing innovative ideas.[19] The small firms, not being able to raise external funds, would not fund any ideas.

In reality, some ideas are likely to generate large cash flows for small investments. Consistently with the empirical evidence, our model implies that most of these ideas are funded by small firms that attract the most creative workers who besides having more ideas may also have more profitable ideas. The least creative workers would be more likely to choose the large firm for implementing their incremental innovations.

IV Existing empirical support

We first present evidence consistent with the result that large firms are less inclined to realize risky ideas than small firms and that this affects workers' attitudes towards large *vs* small firms. Second, we summarize what is known about the relationship between income risk and occupational choice.

[19] The most creative workers expecting to have an idea with higher probability could even accept a wage discount.

A Large firms *vs* small firms: screening and occupational choice

There is some directly related empirical evidence that what firms have at stake influences their willingness to realize workers' ideas. Harberg (1963) finds that in contrast to small firms, the industrial laboratories of large companies are only minor sources of inventions. He states that even research-minded companies "wallowing in large profits from previous projects" are reluctant to realize new ideas. Rather, they concentrate on improving old products. In large industrial laboratories, the research director spends much effort in developing research programmes for the entire team. Each worker is assigned a prearranged task, and innovative ideas are subject to careful screening, as they could jeopardize the company's profits from previous projects and its assets. Hence, despite good salaries and security, elaborate facilities and technical support, the most creative scientists shy away from industrial laboratories.

Harberg's findings seem to fit well with more recent circumstances. For instance, the *Wall Street Journal* (2002) reports that science and engineering Ph.Ds at General Electric, a large and highly diversified company, felt frustrated because they were spending too much time on routine tasks instead of pursuing broader ideas. Zenger (1994) presents survey evidence that for the same reason, small firms attract superior talent for their R&D personnel. He shows that "individuals with exceptional ability and skills" – the most creative workers in our model – seek the independence small firms offer, precisely because their abilities and skills are more likely to be rewarded with the successful realization of their ideas.

Large companies have reacted differently to the increased competition for talent that seems to have occurred through the nineties. A few of them, which considered innovation at the core of their business have decentralized by breaking up units and creating spin-offs. Others maintained their centralized organization at the risk of attracting less creative workers.

In line with our theory, Rajan and Wulf (2003) find that during the nineties hierarchies have become flatter and employees have been conferred more freedom to choose what to work on. As predicted by our theory, this is mainly true for companies with less physical assets per employee. The authors argue that organizational changes depend upon increasing competition for employees' talent. In the light of our model, this does not only depend on the ease of finding start-up capital, but also on the willingness to choose jobs with riskier income profile.[20]

[20] Some of the implications of our model on non-hierarchical organizations and innovative activity are similar to

Our model allows us to generate novel predictions on the link between firm organization and corporate volatility. Rajan and Wulf (2003) find that companies where employees are granted more responsibility have higher volatility of earnings. In our theory, this is a consequence of the organizational change implying the realization of more ideas. In this respect, our theory can explain the increase in firm level volatility during the nineties, especially in sectors with more research and development and higher use of external funds (Comin and Philippon, 2005). Consistently with the mechanism of our model, Comin and Philippon also find that small firms have more volatile returns and higher exit rates and that firm level volatility is a good predictor of unemployment risk and wage volatility and dispersion.

B Income risk and occupational choice

A number of papers are consistent with the link we establish between income risk and occupational choice. Individual income variability depends mainly on fluctuations in employment status (Guiso, Jappelli and Pistaferri, 2002). The probability of losing the job, in turn, is higher at smaller companies (Caves, 1998; Comin and Philippon, 2005). Furthermore, Gruber (1997) provides evidence that unemployment is followed by a drop in consumption, which is larger for individuals with higher after-tax real wages. The empirical evidence also shows that more risk-averse individuals self-select in secure jobs (Fuchs-Schundeln and Schundeln, 2005), and that less risk-averse individuals are more likely to be self-employed (Guiso and Paiella, 2007). Since borrowing constraints make individuals more risk-averse (Gollier 2000), these findings are in line with our argument.

Moreover, occupational choice is known to be influenced by institutional factors that affect downside risk in a way similar to relaxed borrowing constraints. Fan and White (2003) and Berkowitz and White (2004), for instance, study the effect of U.S. bankruptcy exemptions that reduce downside risk. Bankruptcy exemptions provide partial wealth insurance for risk-averse potential entrepreneurs. Empirically, in states with higher bankruptcy exemptions, small firms and households are more likely to be denied credit and are granted smaller loans at higher interest rates. Nonetheless, the probability of owning a business is higher when exemption levels are higher.

Aghion and Tirole (1997). In their paper, flatter hierarchies and employee empowerment increase the initiative of workers and may hence contribute to spur innovation. Beyond Aghion and Tirole (1997), our model implies that (i) more creative workers are more likely to choose flatter organizations, i.e., organizations where they are more likely to realize their ideas; (ii) firms that have less at stake (small firms) have stronger incentives to empower their employees.

This suggests that incentives for risk-taking are equally important as access to start-up capital for entrepreneurial activity, and, more generally, for occupational choice. In the above papers, the channel is bankruptcy exemptions, in our model, it is relaxed borrowing constraints

V Empirical evidence

Overall, the existing empirical evidence suggests that income risk matters for worker sorting. In our model, a relaxation in the borrowing constraint provides insurance against downside risk and affects occupational choice. Borrowing constraints for households have been relaxing in several countries during the second half of the eighties and the nineties (Jappelli and Pagano, 1994; Debelle, 2004).[21] There is also anecdotal evidence that workers became more inclined to take risky jobs in small firms during the same period (Cappelli, 1999; Malone 2003). However, the link between borrowing constraints and changes in workers' attitudes over jobs has not been established before. Our empirical analysis explores this link in a systematic way. We also show that a proxy for the upside of risky ideas helps to explain changes in workers' occupational choice.

A Data and empirical strategy

We use the "Survey of Consumer Finances (SCF)", a triennial survey about wealth, income and demographic characteristics of U.S. households, conducted by the Board of Governors of the Federal Reserves System since 1989. The latest edition of SCF we have access to is 2001.[22] SCF is one of the primary data sources for research on entrepreneurship and small businesses (see, for instance, Wolken, 1998, Moskowitz and Vissing-Jorgensen, 2002).

SCF provides detailed information on employment of household members. In particular, we know the size of the firm that employs an individual and whether an individual runs her own business. There are also several items capturing household access to consumer credit, such as credit card limits and the maximum amount that can be drawn on credit lines. We also have information on whether households were denied credit or were discouraged from borrowing.

[21] Especially in the U.S. during the nineties, households have been able to increase their indebtedness. The U.S. household balances on unsecured loans, such as credit cards and overdraft provisions on checking accounts, have doubled in real terms between 1984 and 1999, and unsecured debt has helped households to smooth consumption during unemployment spells (Sullivan, 2008). In addition, increasing housing prices have allowed households to increase their mortgages, contributing to relaxed liquidity constraints.

[22] SCF provides repeated cross-sections, but does not allow us to follow the same household over time.

[Insert Figure 1 and 2]

Figures 1 and 2 plot the fraction of individuals that work in small firms (defined as firms with fewer than 100 employees) and the maximum amount that can be drawn on the household's credit cards and credit lines. The figures suggest a picture that is largely consistent with the stylized facts mentioned in the Introduction. Employment in small firms increased substantially from 1989 to 1992. Then it oscillated, possibly driven by different expectations on the business cycles and the expected payoff of new ideas. Such an explanation would be consistent with the fact that employment in small firms appears higher in 1998 – the peak of the high-tech bubble – than in 2001 (after the burst of the bubble) or in 1995 (when expectations about the payoffs of ideas were less inflated). The unused credit limit of the median household also increased in real terms during the sample period, suggesting a relaxation of borrowing constraints.

The information provided by SCF allows us to develop a test of our theory. In our empirical strategy, we use the fact that individuals differ not only in respect to their unobserved creativity (as the model assumes), but also in the ability to receive consumer credit. According to our theory, other things equal, workers with less tight borrowing constraints should be more likely to sort into risky jobs. Put differently, we exploit individual heterogeneity in access to credit to test whether borrowing constraints are related to occupational choice. The estimates we report are based on the 1998 SCF. The results are similar for the other survey rounds.

Our main proxy for the ease of accessing credit is the unused part of credit card balances and lines of credit, defined as the maximum amount that can be drawn minus any amount that the household already owes. Such variables are often used in corporate finance as an inverse measure of financing constraints (see, for instance, Petersen and Rajan, 1997 and Kaplan and Zingales, 1997). They are generally considered good proxies for the size of the buffer that the financial system can provide in bad times. However, the actual value of the variable depends on the demand for credit. For this reason, we also use the limits on credit cards and lines of credit (without subtracting the amount that is actually owed) as alternative proxies. To the extent that they are supply-determined, as Sufi (2007) argues, they represent the actual willingness of intermediaries to provide credit.

[Insert Table 2]

Table 2 provides descriptive statistics for the main variables. Approximately, half of the indi-

viduals are either employed in small firms or are self-employed. As expected, the limit on credit cards is significantly smaller than the total amount that can be borrowed on credit cards and credit lines. Slightly less than 20 percent of the respondents declare that they were credit-constrained or were discouraged from borrowing. Notice that the average net wealth of households in the sample is very high (over 4 million U.S. dollars in 1998). The distribution is, however, highly skewed; the median household has a net wealth of less than 5,000 dollars in 1998 and net wealth (including pension assets and real estate) is less than 100,000 dollars for more than two thirds of the sample. Additionally, one quarter of the sample has negative net wealth.

B Borrowing constraints and occupational choice

We estimate the probability that the head of household is employed in a small firms or is self-employed. We treat similarly the decisions to work in a small firm and to be self-employed because small firms always realize ideas in our model. Table 3 shows that the proxy for access to credit is indeed associated with higher probability of holding a risky occupation. Without sorting, it would be hardly conceivable that borrowing constraints matter for occupational choice in this way. Rather, one would expect the opposite, namely, that workers with safer jobs and more stable flows of income have easier access to credit, as banks consider them safer borrowers.

[Insert Table 3]

We control for a number of individual characteristics that may affect occupational choice, like age, number of dependants, whether the individual has a college degree and household income (including the individual and the spouse income) and wealth. The spouse income also helps to control for an additional channel through with the availability of insurance may affect occupational choice – the possibility of risk sharing within the household. Finally, we include controls for the sector of activity, the type of task an individual performs on her job and gender.

Individuals who belong to wealthier households are indeed more likely to have risky occupations. Interestingly, workers with lower incomes are more likely to be employed in small firms. This is consistent with the implication of our model that small firms offer lower wages.[23] Older workers are

[23] This result is in line with a large literature showing that large firms usually pay higher wages (Oi and Idson,1999). One of the leading hypotheses is that the organization of the workplace and the selection of employees with unobservable characteristics are responsible for the positive relation between wages and employer size. Our empirical results are fully in line with this and the theory builds on related ideas.

more likely to be employed in small firms, which suggests that workers may move to small firms after having gained an experience at a larger company.

An alternative explanation of our results is that less financially constrained individuals have easier access to start up capital and, for this reason, are more likely to be self-employed.[24] To explore this possibility, we exclude from our regression individuals who are self-employed. Thus, we can focus on the effect of access to credit on the choice between employment in large and small firms (Table 3, regression 2). The choice between large and small firms cannot be driven by access to start-up capital as we here look at employees, not entrepreneurs. Yet, if borrowing constraints affect occupational choice, as we argue, the more constrained workers should prefer a safer income profile. The data support this; individuals with larger unused credit limits are less likely to work in large firms. Since financial intermediaries should be more willing to lend to individuals with safer and highly verifiable salaries, such as large firms' employees, if anything, our estimates may underestimate the actual effect of borrowing constraints on occupational choice. Interestingly and in accordance to our conjecture that access to start capital should not affect the choice between small and large firms, wealth does not enter significantly in the regression.

We also consider alternative proxies for access to credit (Table 3, regressions 3 and 4): First, we consider only the credit card limit, which is more likely to be supply-determined, as credit card companies often mail free credit cards. Also, we use a dummy that takes value one if the household has been denied credit or has been discouraged from applying for a loan, in a way similar to Guiso, Jappelli and Terlizzese (1996) who analyze the effect of borrowing constraints on the decision to buy equity. In both cases, the estimates suggest that individuals with easier access to credit are more likely to be employed in small firms. Similar estimates obtain when we use the maximum amount that can be drawn on the households credit cards and credit lines (results omitted). Also, the results are similar for different rounds of the survey. Table 3 (regression 6) shows the estimates obtained when pooling all survey rounds.

There are alternative mechanisms that could explain our results. One possibility is that individuals employed in small firms expect faster income growth. This would lead to reverse causality. According to the life cycle theory (Modigliani, 1986), it would be optimal for them to apply for

[24] Hurst and Lusardi (2004) find that availability of initial capital, proxied by an individual's initial wealth, does *not* affect the decision to become an entrepreneur and rationalize this by the small amount of capital necessary to start a new business.

credit lines and higher credit card balances in order to anticipate consumption. We can investigate this alternative mechanism. The survey reports whether households expect their income to grow in the following year. In Table 4 (regression 1), we include a dummy variable that takes value one if households answers yes, and zero otherwise. Individuals working in small firms expect higher income growth, but this leaves the coefficient of the credit limit unchanged. Hence, this alternative mechanism can be discarded.

[Insert Table 4]

Another possibility is that individuals who work in small firms actively seek to obtain higher credit limits because their income is more volatile. The survey asks whether people "save for bad times". Household with higher income uncertainty may be more likely to save for the bad times and, at the same time, to attempt to increase their credit limits. The dummy variable *income uncertainty* takes value 1 if they answered yes, and zero otherwise. The estimates show that this variable is not statistically significant. Most importantly, the coefficient of our variable of interest is qualitatively invariant. In an alternative specification that we omit here, we proxy for income uncertainty by including a dummy variable equal to one if the households reports not to be able to give a good estimate of the following year income. Also in this case, the proxy for income uncertainty is not statistically significant and the coefficient of our variable of interest is not affected.

Another concern could be that our sample includes very wealthy individuals, who are unlikely to ever be financially constrained, because they can use their wealth to smooth consumption. If our results were driven by the richest individuals, we should be concerned that our proxies for access to credit capture some omitted factor. Hence, in Table 4 (regression 3), we estimate the parameters excluding all individuals with more than 50,000 dollars wealth.[25] In accordance to our theory, the credit limit has a larger effect on the probability of being employed in a small firm. Interestingly, the coefficient of the spouse income becomes positive and almost statistically significant. This suggests that there may be insurance within the family besides insurance through financial markets for poorer households. Hence, besides the relaxation of borrowing constraints, also the increasing proportion of two-earner households may have a role in explaining why job security has become less important.

[25] This is quite a small number if one considers that it includes real estate and pension assets, which an individual may not want to liquidate following a temporary income shock.

Overall, we believe that our estimates, together with the fact that different proxies for access to credit yield qualitatively similar results, suggest that the credit limit affects occupational choice. To mitigate remaining concerns about endogeneity problems, we construct a more direct test of the mechanism of our model.

Our theoretical mechanism applies mainly to jobs where creativity is important. Individuals in management or R&D gain more from realizing their ideas than others. Therefore, we run our regression for two different subsamples: workers with managerial or research-related jobs and workers with manual jobs. Access to credit should increase the probability of working in a small firm only in the first subsample. The estimates in Table 4 (regressions 4 and 5) suggest that this is indeed the case. The effect of borrowing constraints is more than double for managers and scientists with less than 1,000 dollars wealth (estimates not reported), in other words, for the individuals who are more likely to value the ability to borrow to smooth consumption over time.

Finally, we use the time-series dimension of SCF to investigate whether after controlling for wages, individuals become more prone to work in small firms when the expected payoff of the ideas is larger. Both increases in α or Y should increase the probability of employment in small firms (provided that (4) is still satisfied). In particular, individuals with relatively less access to credit should choose to be employed in small firms.

We conjecture that the expected payoff of ideas is positively related to the yearly number of initial public offers (IPOs). Arguably, years with a large number of IPOs are preceded by a lot of news on the good performance of entrepreneurial companies. This may lead individuals to revise upward their expectation on the upside of their ideas. Using the yearly number of IPOs from Loughran and Ritter (2004), we run a regression similar to the previous ones, but we now use all survey rounds. We also include the yearly number of IPOs and an interaction term between the unused credit limit and the yearly number of IPOs.

The estimates presented in Table 4 (regression 6) show that an increase in yearly number of IPOs increases the probability of any individual being employed in a small firm. This alone is also consistent with the fact that labour demand from small firms is particularly strong in those years. However, the positive and significant sign of the interaction variable suggests that in years in which the payoff of ideas is expected to be higher, more individuals with relatively less access to credit are employed in small firms. In the absence of our theory, this is more difficult to explain. The

alternative hypothesis based on labour demand of small firms could explain why more individuals work in small firms during those years, but could not explain why sorting of workers changes over time.

The estimated effect is not only statistically, but also economically significant: An increase in the number of IPOs from 344 to 566, respectively the median and the highest number of IPOs in our sample period, increase by 2.5 percentage points the probability that an individual with a credit limit of 7,000 dollars (the median credit limit in the sample) is employed in a small firm.

VI Conclusions

In our theory, financial market development eases household access to credit. When their borrowing constraints relax, workers change their attitude towards jobs and wage security in large firms. Rather, they seek riskier jobs in small firms that allow them to realize their own ideas. As the upside of ideas is particularly important for talented workers, large firms lose while small firms gain in competing for talented workers. Thus, the paper shows that the availability of finance affects corporations not only through financial markets, but also through the labour market.

Our theory has a number of implications. First, financial development and technological progress have dark sides: they may create excessive volatility and affect average firm profits negatively. Small firms may recklessly fund new ideas and steal the most creative workers from large firms. Although large firms' conservatism may be optimal, large firms may adopt policies to commit to investigate ideas less thoroughly by creating spin-offs and increasing leverage to attract creative workers.

Second, it should be noted that excessive risk-taking can also be optimal. For instance, if workers exert effort *ex ante* to generate profitable ideas, firms would want to commit themselves to realize ideas with high probability to increase incentives for workers. Whether excessive risk-taking is beneficial for the overall economy is ultimately an empirical issue beyond the scope of this paper.

Third, the relative competitiveness of large *vs* small firms may change along the business cycle. During booms, individuals find it easier to borrow and an increasing number of creative workers choose small firms. In contracting phases of the business cycle, household access to credit becomes more difficult because real estate prices decrease or because households are too indebted. Then, a

stable income becomes more important. This effect is reinforced because during recessions the ex ante expected payoff of ideas may be lower. Also, it becomes more difficult to find new jobs, and as a consequence, income losses after firm defaults are larger. Hence, jobs in large firms become what they used to be before the boom: safe havens for workers.

If one interprets employment in small firms as entrepreneurial activity, then, the model also predicts that entrepreneurial activity is procyclical. This is similar to Rampini (2004). The reason however is very different: in Rampini's model, during recessions, potential entrepreneurs have difficulties to fund risky projects because of agency problems. In our model, workers sort themselves differently into small or large firms when the expected payoff from ideas changes. This, in turn, affects how many ideas are realized in large and small firms, respectively. In this way, we can also explain why an improvement in the expected payoffs of ideas is followed by an increase in firm defaults without relying on irrational or overoptimistic expectations.

Finally, the logic of our model can be applied in other contexts. Lenient bankruptcy laws, unemployment insurance, the ease to find new jobs affect workers' payoffs after firm default in a way very similar to the ease of borrowing constraints. The mechanism highlighted in our model suggests that these factors should spur risk taking in the labour market and, ultimately, innovation.

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A Appendix

A Proof of Proposition 1

In Proposition 1, the creativity level of the worker who is indifferent between working in the large or in a small firm, ϕ^*, is determined by equating the expected utility from working in the large and in a small firm:

$$\phi^* \alpha U_{suc} + \phi^* (1-\alpha) U^S_{fail} + (1-\phi^*) U^S_{trad} = \phi^* \alpha p U_{suc} + (1 - \phi^* \alpha p) U^L_{trad}.$$

This can be rewritten as:

$$\phi^* \left(\alpha U_{suc} + (1-\alpha) U^S_{fail} - U^S_{trad} + \alpha p \left(U^L_{trad} - U_{suc} \right) \right) = U^L_{trad} - U^S_{trad}, \tag{6}$$

from which the equation in Proposition 1 follows.

Note that under our assumptions $U^L_{trad} - U^S_{trad} \geq 0$ and $U^L_{trad} - U^L_{suc} \leq 0$. Hence, $\phi^* \in (0,1)$ and there exists an equilibrium in which a non-empty set of workers is employed both in the large and the small firms if $\alpha U_{suc} + (1-\alpha) U^S_{fail} - U^S_{trad} + \alpha p \left(U^L_{trad} - U_{suc} \right) > 0$. This implies:

$$p < \frac{\alpha U_{suc} + (1-\alpha) U^S_{fail} - U^L_{trad}}{\alpha \left(U_{suc} - U^L_{trad} \right)}. \tag{7}$$

Inequality (7) requires that the benefits from working in a small firm exceed the costs for the most creative worker ($\phi = 1$). If (7) is satisfied, the left hand side of equation (6) increases in ϕ faster than the right hand side. This implies that the expected utility from working in a small firm is larger than the expected utility from working in a large firm for all workers with creativity $\phi > \phi^*$.

Inequality (7) depends on the endogenous variable w^L_1. In Corollary 2, however, we prove that the large firms never finds it optimal to raise w^L_1 to the point that even the most creative worker prefers to be employed in the large firm if at $w^L_1 = \underline{w}$ some workers prefer the small firms. Hence, a sufficient condition for an equilibrium with a non-empty set of workers employed in small firms to exist is that inequality (7) is satisfied at $w^L_1 = \underline{w}$.

Finally, note that $\phi^* \in (0,1)$ implies $w_1^L > \underline{w}$. The set of workers in the large firm is non-empty only if the utility from working in the large firm exceeds the utility in the small firm for the least creative worker ($\phi = 0$), which implies $U_{trad}^L - U_{trad}^S > 0$, and thus $w_1^L > \underline{w}$.

B Proof of Corollary 1

Corollary 1 simply follows from the fact that if $p < \frac{\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^L}{\alpha\left(U_{suc} - U_{trad}^L\right)}$, then:

$$\frac{d\phi^*}{d\alpha} = -\phi^* \frac{U_{suc} - U_{fail}^S - p\left(U_{suc} - U_{trad}^L\right)}{\left(\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^S - \alpha p\left(U_{suc} - U_{trad}^L\right)\right)} < 0$$

because inequality (7) implies $p\alpha\left(U_{suc} - U_{trad}^L\right) < \alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^L < \alpha\left(U_{suc} - U_{fail}^S\right)$ and $U_{trad}^L > U_{trad}^S > U_{fail}^S$; and

$$\frac{d\phi^*}{dY} = -\phi^* \frac{U'_{suc} - pU'_{suc}}{\left(\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^S - \alpha p\left(U_{suc} - U_{trad}^L\right)\right)} < 0$$

because $U'_{suc} > pU'_{suc}$ (where U' refers to the first derivative of U).

Finally,

$$\frac{d\phi^*}{dw_1^L} = \frac{U_{trad}^{L\prime}\left(\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^S - \alpha p\left(U_{suc} - U_{trad}^S\right)\right)}{\left(\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^S - \alpha p\left(U_{suc} - U_{trad}^L\right)\right)^2} > 0$$

if $p < \frac{\alpha U_{suc} + (1-\alpha)U_{fail}^S - U_{trad}^L}{\alpha\left(U_{suc} - U_{trad}^L\right)}$ as assumed in Proposition 1.

C Proof of Proposition 2

By employing capital in the traditional technology, the large firm can always obtain a payoff of zero. The large firm thus chooses to employ a subset of creative workers offering a wage $w_1^L > \underline{w}$ only if the maximum of program (5) is larger than zero. The first-order condition of program (5)

with respect to w_1^L is:

$$\left((1-\phi^*)\left(\underline{w}-w_1^L\right)+\phi^* E\left(\pi_1^L\right)\right)\frac{d\phi^*}{dw_1^L}+\int_0^{\phi^*}\left(-(1-\phi)+\phi\frac{dE\left(\pi_1^L\right)}{dw_1^L}\right)d\phi=0. \tag{8}$$

Integrating by parts, we obtain:

$$\left((1-\phi^*)\left(\underline{w}-w_1^L\right)+\phi^* E\left(\pi_1^L\right)\right)\frac{d\phi^*}{dw_1^L}-\phi^*+\frac{\phi^{*2}}{2}+\frac{\phi^{*2}}{2}\frac{dE\left(\pi_1^L\right)}{dw_1^L}=0. \tag{9}$$

The first term in the above first-order condition represents the effect of an increase of w_1^L on the mass of workers in the large firm, multiplied by the per-capita profit of the large firm. This effect is positive for $w_1^L=\underline{w}$ (the lowest admissible wage). The first-order condition can thus be satisfied with equality with levels of w_1^L larger than $\underline{w}$ because $-\phi^*+\frac{\phi^{*2}}{2}+\frac{\phi^{*2}}{2}\frac{dE\left(\pi_1^L\right)}{dw_1^L}$ is unambiguously negative for $\phi^*>0$.

Since the large firm's expected profits increase in w_1^L when $\phi^*=0$, in equilibrium the large firm offers $w_1^L>\underline{w}$ that satisfies the first-order condition with equality, if the expected profits are strictly larger than zero. This is case if the expected payoff from realizing an idea is large enough.

By contradiction, assume that the large firm offers w_1^L so high that $\phi^*=1$. Considering that at $\phi^*=1$ $\frac{d\phi^*}{dw_1^L}=0$, (9) becomes $-1+\frac{1}{2}-\frac{1}{2}(1-\alpha p)<0$. Thus, it would be optimal for the firm to decrease w_1^L. This proves that in equilibrium the large firm never offers a wage that attracts all creative workers.

D Proof of Proposition 3

As pointed out in Subsection III.B, the borrowing constraint is relevant only for workers in small firms if their idea fails and $B<\frac{w}{2}$. Workers would then like to borrow to smooth their consumption, but they encounter a binding borrowing constraint. Hence, when B increases to B', U_{fail}^S increases. This implies that $\frac{d\phi^*}{dB}=-\frac{\phi^*(1-\alpha)U_{fail}^{S\prime}}{\left(\alpha U_{suc}+(1-\alpha)U_{fail}^S-U_{trad}^S-\alpha p_1\left(U_{suc}-U_{trad}^L\right)\right)}<0$. Hence, ϕ^* decreases, and for given wages, more workers want to be employed in small firms.

The wage small firms pay does not change, as it is pinned down by competition among firms and their lack of capital. By contradiction, assume that after the increase in B, the large firm

would increase wages such that the set of workers it employs is larger ($\phi^{*\prime} > \phi^*$). This would imply $w_1^{L\prime} > w_1^L$.

$\phi^{*\prime}$ is the optimal mass of worker to employ in equilibrium if

$$\int_0^{\phi^{*\prime}} \phi E\left(\pi_1^L(B', \phi^{*\prime})\right) + (1-\phi)\left(\underline{w} - w_1^L(B', \phi^{*\prime})\right) d\phi \geq \int_0^{\phi^*} \phi E\left(\pi_1^L(B', \phi^*)\right) + (1-\phi)\left(\underline{w} - w_1^L(B', \phi^*)\right) d\phi.$$

Here, $w_1^L(B', \phi^{*\prime})$ is the wage, and $\pi_1^L(B', \phi^{*\prime})$ the level of expected profits per idea when the possible maximum borrowing is B' and the mass of workers employed in a large firm is $\phi^{*\prime}$.

Similarly, when the borrowing constraint is B, profit maximization implies

$$\int_0^{\phi^*} \phi E\left(\pi_1^L(B, \phi^*)\right) + (1-\phi)\left(\underline{w} - w_1^L(B, \phi^*)\right) d\phi \geq \int_0^{\phi^{*\prime}} \phi E\left(\pi_1^L(B, \phi^{*\prime})\right) + (1-\phi)\left(\underline{w} - w_1^L(B, \phi^{*\prime})\right) d\phi.$$

At $B < B'$, the firm can employ a given mass of workers at a lower wage as $\frac{d\phi^*}{dB} < 0$. This implies that

$$\int_0^{\phi^{*\prime}} \phi E\left(\pi_1^L(B, \phi^{*\prime})\right) + (1-\phi)\left(\underline{w} - w_1^L(B, \phi^{*\prime})\right) d\phi > \int_0^{\phi^{*\prime}} \phi E\left(\pi_1^L(B', \phi^{*\prime})\right) + (1-\phi)\left(\underline{w} - w_1^L(B', \phi^{*\prime})\right) d\phi,$$

which leads to a contradiction.

Hence if $B' > B$, $\phi^{*\prime} < \phi^*$.

Table 1

Payoffs and probability of different states of nature in large and small firms

	Idea realized, succ.	Idea realized, fail.	Idea rejected	No idea
Probability in large firm	$\phi\alpha p$	0	$\phi\alpha\left(1-p\right)$	$1-\phi$
Probability in small firm	$\phi\alpha$	$\phi\left(1-\alpha\right)$	0	$1-\phi$
Payoff in large firm	$\left(1-\lambda\right)Y$	$-$	w_1^L	w_1^L
Payoff in small firm	$\left(1-\lambda\right)Y$	0	$-$	$\underline{w}$

Table 2
Descriptive Statistics

Panel A. This Table presents mean and standard deviation for the main variables used in the analysis. All survey rounds include the 1989, 1992, 1995, 1998, and 2001 rounds of the Survey of Consumer Finances (SCF). Only head of households who are employed at the time of the survey are included. *Risky occupation* is a dummy variable that takes value equal to 1 if the head of the household runs his own business or is employed in a firm with fewer than 100 employees and zero otherwise. *Employed in small firms* is a dummy variable that takes value equal to 1 if the head of the household is employed in a firm with fewer than 100 employees and zero otherwise (observations regarding individuals who run their own business are excluded). *Credit limit* is the unused part of the credit limit of all credit lines and credit cards of the household in thousands USD. *Credit card limit* is the unused part of the credit limit of all credit cards of the household in thousands USD. *Credit constraint* is a dummy variable that takes value 1 if the household has been denied credit or did not apply for a loan because anticipated to be denied credit and zero otherwise. *Own income* is the income of the head of the household in thousands USD. *Spouse income* is the income of the spouse in thousands USD. *Household wealth* has been computed as the sum of all financial and real assets of the household net of any liabilities and includes pension assets and is expressed in thousands USD. *Age* is the age of the head of the household. *Number of dependants* is the number of members of the household who are financially dependent. *College degree* is a dummy variable that takes value 1 if the head of the household has a college degree and zero otherwise. *Expectation of income growth* is a dummy variable that takes value 1 if the household expects the income to grow during the following year and equal to zero otherwise. *Income uncertainty* is a variable that takes value 1 if the household declares to save for the bad times and zero otherwise. *Yearly IPOs* is the number of IPOs during the year.

	1998 sample			All survey rounds		
	No. obs.	Mean	Standard Deviation	No. obs.	Mean	Standard Deviation
Risky occupation	14910	0.56	0.49	58644	0.44	0.497
Employed in small firms	14091	0.53	0.49	52140	0.37	0.484
Credit limit	14910	77.76	1066.90	58644	70.20	1160
Credit card limit	14910	19.10	35.04	58644	17.74	4920
Credit constraint	14910	0.19	0.39	58644	0.19	0.39
Own income	14910	62.43	225.31	58644	73.07	701.38
Spouse income	14910	9.03	26.36	58644	9.63	41.85
Household wealth	14910	4615.60	23100	58644	3785.91	24000
Age	14910	44.90	12.80	58619	44.97	12.88
Number of dependants	14910	1.79	1.41	58644	1.54	1.33
College degree	14910	0.50	0.50	58644	0.51	0.50
Expectation of income growth	14910	0.33	0.47	30704	0.16	0.37
Income uncertainty	14910	0.31	0.46	58644	0.55	0.50
Yearly IPOs	14910	602	0	58644	517.63	101.82

Panel B. This table presents the correlation matrix of the main variables as defined in Panel A. All survey rounds have been used to compute the correlation coefficients.

	Risky occupation	Employed in small firms	Credit limit	Credit card limit	Credit constraint	Own income	Spouse income	Household wealth	Age	Number of dependants	College degree	Expectation of income growth	Income uncertainty
Risky occupation	1												
Employed in small firms	0.7502	1											
Credit limit	0.0598	0.0382	1										
Credit card limit	0.0272	0.0121	0.3514	1									
Credit constraint	-0.1168	-0.0539	-0.0367	-0.0375	1								
Own income	-0.025	-0.0354	0.0217	0.0394	-0.0285	1							
Spouse income	0.0037	-0.0075	0.3096	0.8981	-0.0271	0.0059	1						
Household wealth	0.0712	0.0485	0.1344	0.1003	-0.0471	0.1177	0.0886	1					
Age	0.3066	0.2161	0.0602	0.0473	-0.2573	0.0387	0.0117	0.115	1				
Number of dependants	0.0318	0.0161	-0.0064	0.0173	-0.0039	0.0249	0.0326	0.0108	-0.0963	1			
College degree	0.1472	0.0394	0.0516	0.0515	-0.1771	0.0629	0.0469	0.0753	0.1481	0.0075	1		
Expectation of income growth	-0.0248	-0.0056	-0.01	-0.0165	0.1171	-0.0127	-0.0119	-0.014	-0.1397	0.0218	-0.0377	1	
Income uncertainty	0.0367	0.0722	0.0056	-0.0025	0.0732	-0.01	-0.0107	0.0061	-0.0502	-0.0332	-0.077	-0.0331	1

Table 3
Access to Credit and Occupational Choice

This table links the occupation of the head of the household to measures of access to credit and control variables. Specification (1)-(4) include only observation relative to the 1998 round of the survey. Specification (5) includes the 1989, 1992, 1995, 1998, and 2001 rounds. All variables are defined in Table 1. The following additional dummy variables have been included in the equations, but their coefficients are not reported: A dummy that takes value 1 if the head of the household is a female and zero otherwise, six dummies variables concerning the task of the head of the household in his (her) occupation, seven dummies concerning the sector of occupation of the head of the household. Additionally, in specification (5), four year dummies have been included. All equations have been estimated using a probit model and marginal effects and t-statistics are reported. Standard errors are corrected for heteroskedasticity.

	Risky occupation (1)		Small vs. large firms (2)		Small vs. large firms (3)		Small vs. large firms (4)		Small vs. large firms (5)	
									All survey rounds	
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Credit limit	0.0001	2.36	0.0001	2.41					0.00003	4.13
Credit card limit					0.0001	3.68				
Credit constraint							-0.0050	-1.94		
Own income	-0.0208	-19.17	-0.0211	-18.85	-0.0211	-18.86	-0.0047	-19.9	-0.0306	-41.55
Spouse income	0.0001	-0.68	-0.0001	-0.61	-0.0001	-0.81	0.00002	0.41	-0.0001	-1.31
Household wealth	0.0013	3.87	0.0002	0.70	0.0000	0.74	0.0000	1.10	0.0000	0.38
Age	0.0074	19.09	0.0069	17.51	0.0067	16.66	0.0017	20.07	0.0059	30.53
Number of dependants	0.0078	2.39	0.0073	2.19	0.0069	2.04	0.00164	2.19	0.0067	3.55
College degree	-0.0279	-2.26	-0.0369	-2.92	-0.0423	-3.31	-0.0069	-2.52	-0.0482	-7.61
Obs.		14910		14091		14091		14091		52120
Pseudo R-squared		0.15		0.14		0.14		0.14		0.19

Table 4
Robustness Analysis

This table links the occupation of the head of the household to measures of access to credit and control variables. Specification (1)-(5) include only observation relative to the 1998 round of the survey. Specification (6) includes survey rounds 1989-2001. Specification (4) includes only observations relative to heads of the household who have managerial or research related jobs (managers and scientists). Specification (5) includes only observations relative to heads of the household who are employed as armed force, manual workers, drivers or farmers (manual workers). All variables are defined in Table 1. The following additional dummy variables have been included in the equations, but their coefficients are not reported: A dummy that takes value 1 if the head of the household is a female and zero otherwise, six dummies variables concerning the task of the head of the household in his (her) occupation, seven dummies concerning the sector of occupation of the head of the household. All equations but equation (6) have been estimated using a probit model and marginal effects and t-statistics are reported. Equation (6) has been estimated by ordinary least squared to be able to directly interpret the interaction term. Standard errors are corrected for heteroskedasticity.

	Small vs. large firms (1)		Small vs. large firms (2)		Small vs. large firms (3)		Small vs. large firms (4)		Small vs. large firms (5)		Small vs. large firms (6)	
					Wealth<50000		Managers and scientists		Manual workers		All survey rounds	
	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Credit limit	0.00001	2.34	0.00001	2.41	0.0005	2.64	0.00002	3.88	-0.0001	-1.6	0.000001	1.83
Credit limit *Yearly IPOs											0.000001	2.67
Own income	-0.0210	-18.77	-0.0211	-18.83	-0.0023	-7.96	-0.0422	-13.31	-9.96	-7.03	-0.0002	-4.16
Spouse income	-0.0001	-0.79	-0.0001	-0.6	0.0006	1.58	-0.0001	-0.46	0.0001	1	-0.0005	-0.7
Household wealth	0.0002	0.63	0.0002	0.68	-0.0046	-7.77	-0.00002	-0.09	0.0024	5.17	0.0008	2.49
Age	0.0072	18.01	0.0069	17.51	0.0049	10.06	0.01	15.53	0.0022	2.84	0.0073	33.26
Number of dependants	0.0079	2.36	0.0074	2.19	0.0039	1	0.01408	2.77	-0.0008	-0.14	0.0102	4.57
College degree	-0.0369	-2.92	-0.0370	-2.93	-0.0294	-1.97					-0.0152	-2.08
Expectation of income growth	0.0692	5.37										
Income uncertainty			0.0065	0.66								
Number of IPOs during the previous year											0.0001	6.71
Obs.		14091		14091		9199		6691		4232		52120
Pseudo R-squared		0.14		0.14		0.13		0.16		0.23		0.20

Figure 1
Employment in Small Firms

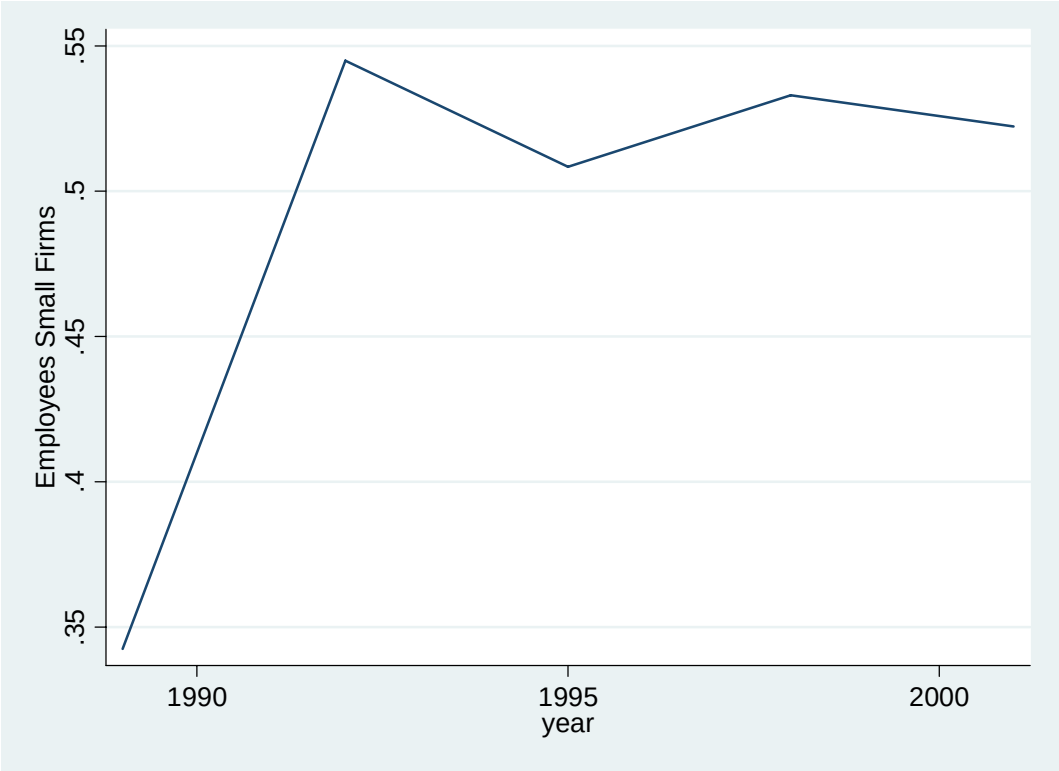
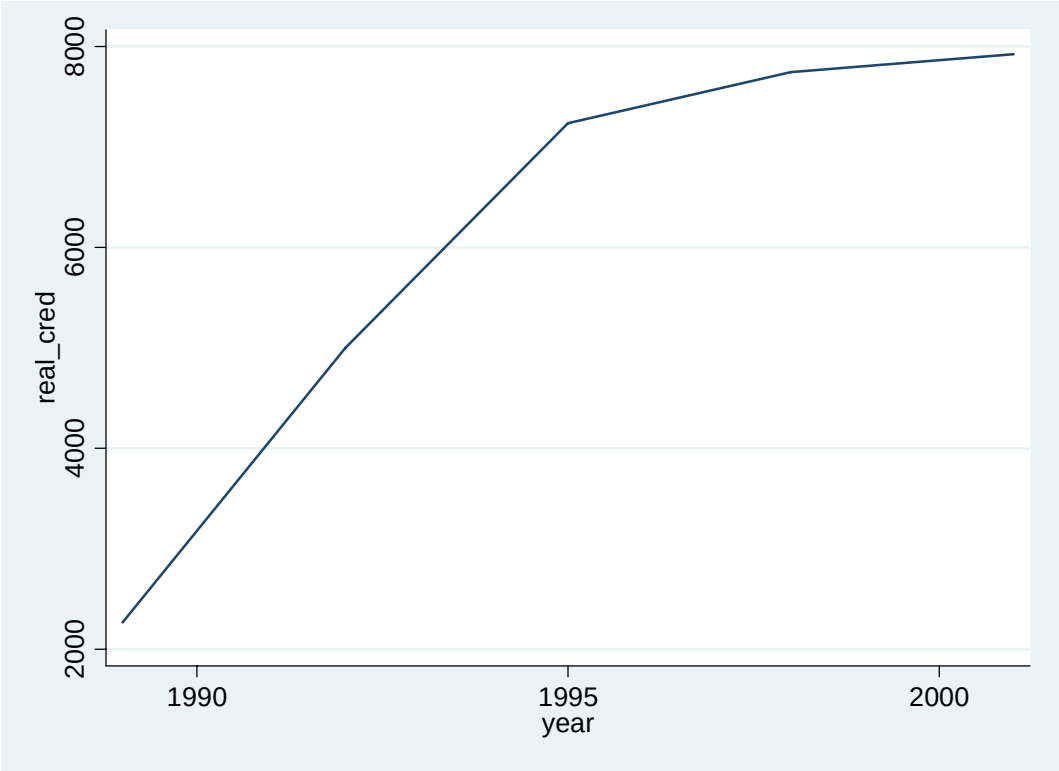


Figure 2
Credit Limit

This Figure reports the maximum amount that on average a household can drawn on credit cards and credit lines in 1992 U.S. Dollars.



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