Diskussionspapiere der DFG-Forscherguppe (Nr.: 3468269275):

Heterogene Arbeit: Positive und Normative Aspekte der Qualifikationsstruktur der Arbeit

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Entrepreneurial Élites: Industry Structure and Welfare Effects of Incubating New Businesses

Dezember 2005
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Zusammenfassung:

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The analysis compares two institutional settings in which individuals with complementary task abilities match to found new firms: corporate spin-offs of initially randomly matched production teams and the rational matching of such teams in an incubator organization. The alternative always consists of seeking employment in industrial firms which pay a certain wage. This wage reflects the expected team quality given that all professionals who do not found firms are randomly matched in production teams. Each institutional setting gives rise to a unique efficient competitive equilibrium such that both industrial and entrepreneurial firms coexist. The efficient incubator equilibrium always induces a larger entrepreneurial sector in the industry. However, the additional entrepreneurial firms founded are rather small. Neither of the two regimes unambiguously induces higher industry-wide investments. Ex-ante welfare comparisons then assume that individuals do not yet know their specific ability combinations. Simulations show that higher degrees of risk-aversion (interest-rates) render the efficient spin-off (incubator) equilibrium dominant.

JEL Klassifikation : L22, M55, L53
Schlüsselwörter : complementary abilities, entrepreneurial partnerships, spin-offs, incubator organization, random vs. rational matching
Download/Reference : http://www.wiwi.uni-konstanz.de/forschergruppewiwi
Entrepreneurial Élites: Industry Structure and Welfare
Effects of Incubating New Businesses

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December 13, 2005

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Abstract

Entrepreneurial Élites: Industry Structure and Welfare Effects of Incubating New Businesses

The analysis compares two institutional settings in which individuals with complementary task abilities match to found new firms: corporate spin-offs of initially randomly matched production teams and the rational matching of such teams in an incubator organization. The alternative always consists of seeking employment in industrial firms which pay a certain wage. This wage reflects the expected team quality given that all professionals who do not found firms are randomly matched in production teams. Each institutional setting gives rise to a unique efficient competitive equilibrium such that both industrial and entrepreneurial firms coexist. The efficient incubator equilibrium always induces a larger entrepreneurial sector in the industry. However, the additional entrepreneurial firms founded are rather small. Neither of the two regimes unambiguously induces higher industry-wide investments. Ex-ante welfare comparisons then assume that individuals do not yet know their specific ability combinations. Simulations show that higher degrees of risk-aversion (interest-rates) render the efficient spin-off (incubator) equilibrium dominant.

**Keywords:** complementary abilities, entrepreneurial partnerships, spin-offs, incubator organization, random vs. rational matching.

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1 Introduction

Bhidé (2000, p. 94) reports that 83% of the founders included in the Inc. 500 1989 start-up survey possess at least a four-year college degree. This observation supports Rajan and Zingales (2000, 2001a) who emphasize that today’s innovations typically originate from human rather than inanimate assets. In particular, individual abilities constitute complements in the production technology. Thus, Lazear (2004) assumes production teams in which two individuals must perform two different necessary tasks. Given a random matching framework, individuals can signal their commitment to either become entrepreneurs or employees. Entrepreneurs receive the residual profit. Since individual abilities remain non-verifiable, the employee receives a salary reflecting the expected ability of employees in the assigned task. The so-called “jack-of-all-trades”-hypothesis then holds that, in equilibrium, individuals with similar - though possibly only mediocre - ability levels in both tasks will become entrepreneurs.

Obviously, the fundamental assumption that one individual must claim the role of the entrepreneur while the other becomes an employee contrasts with the incomplete contracts approach to the theory of the firm.1 As shown by Hart and Moore (1996, 1999), the partnership of owners constitutes a dominant governance structure if contracts cannot be conditioned on necessary human assets. Empirically, Audretsch and Thurik (2001) note that ownership-like incentive schemes constitute one of the most important characteristic associated with innovative, so-called “New Economy” start-ups. Clearly, the 1980 to 1990s have generally witnessed a significant increase in managerial ownership.2 According to Bhidé (2000, p. 87 and 200), stock ownership and stock option plans serve as selection devices to induce the matching of production teams in such new firms.

Hence, Fabel (2004a) uses the so-called “O-Ring”-theory of production3 according to which the probability of project failure equals the probability that a single one of several necessary tasks is carried out imperfectly. Members of entrepreneurial partnerships can observe their respective abilities upon being matched and before production takes place. In contrast, the management of industrial firms owned by outside investors cannot enforce ability-contingent labor contracts.4 Then, with risk-averse individuals, there always exists a competitive equilibrium such that less able individuals become employees in industrial firms

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1Grossman and Hart (1986).
3Kremer (1993).
4Bhidé (2000, p. 324) notes that corporate policies in well-established firms to “recruit individuals who will fit their culture and norms to promote cooperation and team work [...] limit their ability to employ the best individual for a given task”.

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and high-ability individuals found entrepreneurial partnerships. Yet, in this model individual ability determines the quality of task performance in all tasks. In contrast to Lazear (2004), the model can therefore not address the issue of matching production teams when individual abilities differ across the tasks.

However, according to Bhidé (2000, p. 282-288) again, recruiting matching team members constitutes a key success factor for innovative start-ups. Obviously, the place of current employment offers prime opportunities for individuals to test and observe each others task abilities prior to deciding on founding their own firms. It can therefore serve as an “incubator” for new firm foundations - a term coined by Cooper and Bruno (1977). Thus, Bhidé (2000, p. 54) notes that 71% of the start-ups in his survey are founded by individuals who “replicated or modified an idea encountered during their previous employment”. According to Baily and Lawrence (2001), the emergence of the “New Economy” to a considerable extent reflects the out-sourcing of human-capital-intensive production in the form of spin-offs. Rajan and Zingales (2001b) then conclude that the prospect of becoming owners themselves limits the exploitation risk and enhances the incentives to specialize for young managers.

Moreover, industrial and, to some extend, even educational policy has recognized the importance of matching individuals with different task abilities in entrepreneurial activities. Thus, following the Silicon Valley experience, technology or science parks have been set up in many regions of the world. According to Löfsten and Lindelöf (2002) and Audretsch et al. (2005), the inclusion of, or simply the geographic proximity to a research university then significantly enhances the frequency and success of innovative start-ups. Universities themselves have increasingly set-up technology transfer centers or spin-off consulting activities. Also, specific study programs intend to equip academics of various scientific backgrounds with the necessary business knowledge and, generally, encourage entrepreneurial activities.

In contrast to corporate spin-offs in which prospective entrepreneurial teams are still randomly matched in their current employments, such incubator organizations obviously aim to achieve a rational matching of individuals. The organization provides a pool of potential
partners and allows to test and observe abilities before individuals are matched in particular production teams. Given the different matching technologies associated with corporate spin-offs and such incubator organizations, the question then remains which of the two institutions actually serves better in fostering entrepreneurial activities. Furthermore, with most incubator organizations directly or - when a university participates in the project - indirectly subsidized, a second important issue concerns the respective welfare effects.

The current analysis sets out to address these two issues. The next section introduces the model framework based on the “O-Ring” production technology. The model endogenizes the choice of physical capital input while else - following Lazear (2004) - each production team consists of only two individuals. Irrespective of the differing task abilities, individuals who can observe each others’ abilities will always found partnerships of equals if deciding to become entrepreneurs. The subsequent two sections then analyze “spin-off” and “incubator”-equilibria. In the former case individuals are first randomly matched in teams of two, observe their respective ability profiles, and then decide whether to spin off an entrepreneurial partnership. In “incubator”-equilibrium all individuals first observe each other’s ability profiles and then rationally match to found such partnerships.

Competitive equilibria can be shown to exist in both cases and imply that industrial and entrepreneurial firms always coexist. Moreover, there are unique efficient equilibria. Section 5 first shows that the entrepreneurial sector of the industry is always smaller in efficient “spin-off”-equilibrium compared to the efficient “incubator”-equilibrium. Assuming CRRA-utility and independently, uniformly distributed abilities, the section then proceeds by simulating equilibrium outcomes. The additional entrepreneurial firms founded in incubator equilibrium can then be shown to be rather small in terms of capital usage. Further, comparing populations of professionals which differ in their risk-attitude, neither of the two regimes yields higher industry-wide capital input in general.

Moreover, welfare conclusions - where (societal) welfare is defined as the expected utility of an individual who does not yet know its own ability profile\textsuperscript{11} - are generally ambiguous. For a reasonable value of the elasticity of capital in production, higher degrees of risk-aversion then render the efficient “spin-off”-equilibrium welfare dominant. Clearly, this result reflects that such equilibria entail better risk-sharing. Higher interest rates increase the number of entrepreneurs in both efficient “spin-off” and “incubator”-equilibrium. This effect reflects that the \textit{ex-post} income-spread between successful and unsuccessful entrepreneurial firms decreases due to the optimal adjustment of the capital input. However, it then also implies that production generally becomes less capital-intensive. Since this effect is weaker with

\textsuperscript{11}Thus, this welfare criterion can be interpreted as the objective function of an individual who has to decide on risky human capital investments. See Fabel (2004b) again.
rational matching of entrepreneurs, higher interest rates therefore further tend to render the efficient “incubator”-equilibrium welfare dominant.

The results are summarized and discussed in the concluding section.

2 The model

2.1 Basic assumptions and notations

Throughout the analysis focuses on an industry in which each firm produces a single unit of an output good. Higher-quality variants of this good require higher capital input $K$. The market price of capital is $\rho$. For parsimony, the revenue associated with successful completion of the production process is given by $r = K^\gamma$, with $0 < \gamma < 1$. This process also combines two necessary human tasks, indexed $t = 1, 2$ in the following. Imperfect performance of either of these two tasks renders the production process incomplete. The output resulting from an incomplete process possesses zero market value. Hence, the firm’s revenue equals zero if one of the two tasks is not performed perfectly.

There exists a pool of professionals who are trained in the two tasks. Professional $i$’s ability in performing task $t$ is denoted $a^{ti}$. These abilities constitute realizations of two random variables $\tilde{a}^{ti}$ which are each drawn from the interval $A = [a_L, 1]$. Let $S = \{(a^{1i}, a^{2i}) | a^{ti} \in A, t = 1, 2\}$ then denote the set of possible ability profiles of industry professionals. The joint density function $f_{\tilde{a}^{1}, \tilde{a}^{2}}(a^{1}, a^{2}) > 0$, for individual profiles $(a^{1}, a^{2}) \in S$, and $f_{\tilde{a}^{1}, \tilde{a}^{2}}(a^{1}, a^{2}) = 0$, for $(a^{1}, a^{2}) \notin S$, constitutes common knowledge of all economic agents. The corresponding joint distribution function is denoted $F_{\tilde{a}^{1}, \tilde{a}^{2}}(a^{1}, a^{2})$. For mere technical reasons, the common lower bound on ability realizations $a_L$ is positive. Yet, $a_L$ can be arbitrarily small and in the limit approach zero.

Following Kremer (1993), the ability realizations determine the individual probabilities of perfect task performance. In particular, suppose that two professionals are teamed up such that individual $i$ performs task 1 and individual $j$ carries out task 2. Then, the team realizes revenue $r$ with probability $a^{1i}a^{2j}$. The revenue equals zero with probability $(1 - a^{1i}a^{2j})$. According to this so-called “O-Ring” production technology, differences in individual task performances thus imply differences in team success probabilities.

Individual preferences are characterized by the identical utility function $u(y)$ where $y \geq 0$ denotes income. As usual, $u'(y) > 0$, $u''(y) \leq 0$, for $y > 0$, and $\lim_{y \to 0} u'(y) = \infty$. It is assumed that all individuals possess an identical initial wealth income $Y > 0$. 

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Suppose two individuals $i$ and $j$ have decided to become entrepreneurs and subsequently form a production team. Due to their professional expertise, they can observe each other’s task abilities. Let \( \tilde{a}^{ij} = \{(a^{1i}, a^{2j}), (a^{1j}, a^{2j})\} \) denote the corresponding set of ability profiles within such a team and define the expected utilities of the two professional as

\[
U^{ij} = T(\tilde{a}^{ij}) \left[ a^{1i}a^{2j}u(Y - \phi(\tilde{a}^{ij}) + (1 - \beta(\tilde{a}^{ij}))(K(\tilde{a}^{ij}))^{\gamma} - \rho K(\tilde{a}^{ij})) \right] + (1 - a^{1i}a^{2j})u(Y - \phi(\tilde{a}^{ij}) - (1 - \beta(\tilde{a}^{ij}))) + (1 - T(\tilde{a}^{ij})) \left[ a^{1i}a^{2j}u(Y - \phi(\tilde{a}^{ij}) + (1 - \beta(\tilde{a}^{ij}))) + (1 - a^{1i}a^{2j})u(Y - \phi(\tilde{a}^{ij}) - (1 - \beta(\tilde{a}^{ij}))) \right]
\]

and

\[
U^{ji} = T(\tilde{a}^{ij}) \left[ a^{1j}a^{2i}u(Y + \phi(\tilde{a}^{ij}) + \beta(\tilde{a}^{ij}))(K(\tilde{a}^{ij}))^{\gamma} - \rho K(\tilde{a}^{ij})) \right] + (1 - a^{1j}a^{2i})u(Y + \phi(\tilde{a}^{ij}) - \beta(\tilde{a}^{ij}))) + (1 - T(\tilde{a}^{ij})) \left[ a^{1j}a^{2i}u(Y + \phi(\tilde{a}^{ij}) + \beta(\tilde{a}^{ij})) + (1 - a^{1j}a^{2i})u(Y + \phi(\tilde{a}^{ij}) - \beta(\tilde{a}^{ij}))) \right]
\]

where \( T(\tilde{a}^{ij}) = \{0, 1\} \) indicates the two possible task allocations within the team.

In (1) and (2) \( \phi(\tilde{a}^{ij}) \) constitutes a transfer of fixed income between the two partners. Partner $j$ additionally receives the share \( \beta(\tilde{a}^{ij}) \) in the firm. Thus, if \( \beta(\tilde{a}^{ij}) = 0 \) (\( \beta(\tilde{a}^{ij}) = 1 \)) professional $i$ (professional $j$) becomes a single entrepreneur paying the wage $\phi(\tilde{a}^{ij})$ to her employee $j$ (employee $i$). It is assumed that the ownership structure, the capital input, and the task allocation within this new entrepreneurial firm are simultaneously determined as the solution of the symmetric Nash-bargaining problem

\[
\max_{K(\tilde{a}^{ij}), T(\tilde{a}^{ij}), \phi(\tilde{a}^{ij}), \beta(\tilde{a}^{ij})} \left[ U^{ij} - v^i \right]^{\frac{1}{2}} \left[ U^{ji} - v^j \right]^{\frac{1}{2}}
\]

subject to

\[
T(\tilde{a}^{ij}) \in \{0, 1\}, \quad 0 \leq \beta(\tilde{a}^{ij}) \leq 1, \quad K(\tilde{a}^{ij}) \geq 0, \quad U^{ij} - v^i \geq 0 \text{ and } U^{ji} - v^j \geq 0
\]

where \( v^i \) and \( v^j \) denote reservation utility levels for the two professionals. Let the superscript \( “E” \) denote the bargaining outcomes.
Lemma 1 Suppose that the constraints (7) are not binding and \( v^p = \bar{v} \) for \( p = i, j \). The optimal contract solving (3) - (7) entails \( \phi^E(\tilde{a}^{ij}) = 0 \) and \( \beta^E(\tilde{a}^{ij}) = \frac{1}{2} \). The capital input \( K^E = K^E(q^E(\tilde{a}^{ij}); \rho) \) in such entrepreneurial firms satisfies

\[
q^E(\tilde{a}^{ij})u'(Y + \frac{1}{2}[(K^E)^\gamma - \rho K^E])\gamma(K^E)^{(\gamma-1)} - \rho] = (8)
\]

\[
(1 - q^E(\tilde{a}^{ij}))u'(Y - \frac{1}{2}\rho K^E)\rho \]

where \( q^E(\tilde{a}^{ij}) = \max\{a_1^i a_2^j, a_1^j a_2^i\} \).

Proof. See Appendix. ■

Failing (succeeding) in task performance induces the same income loss (benefit) irrespective of individual abilities in the particular tasks. Given that both professionals also possess identical bargaining powers, the income risk will be distributed evenly between the two professional entrepreneurs in every bilaterally beneficial production project. The corresponding distribution of the realized revenue net of capital costs is therefore achieved by a “partnership of equals”. In the remaining, then denote the resulting expected utility of each partner \( i \) and \( j \) by

\[
U^E(q^E(\tilde{a}^{ij}); \rho) = q^E(\tilde{a}^{ij})u'(Y + \frac{1}{2}[(K^E(q^E(\tilde{a}^{ij}); \rho))^\gamma - \rho K^E(q^E(\tilde{a}^{ij}); \rho)])
\]

\[
+ (1 - q^E(\tilde{a}^{ij}))u'(Y - \frac{1}{2}\rho K^E(q^E(\tilde{a}^{ij}); \rho)) \tag{9}
\]

Notice also that the above assumption that each partner can observe her colleague’s ability profile before production commences is actually not at all restrictive. If the alternative for each team member consists of refusing to participate in the partnership such that she must accept employment in an industrial firm, the expected utility of each partner in a potential entrepreneurial firm generally only depends on the realized team quality. This team quality is maximized by choosing an optimal task allocation. Thus, professionals possess an effective incentive to report their abilities in both tasks truthfully when communicating the plan to found an entrepreneurial firm among them.\(^{12}\)

2.3 Industrial firms and competition

Alternatively, professionals can take up employment in industrial firms. Such firms are organized on behalf of outside investors who supply the capital \( K \) and claim the residual income.\(^{12}\)

\(^{12}\)Thus, Lazear’s (2004) analysis appears to assume that entrepreneurial partnerships cannot be established and, therefore, ability profiles are never revealed truthfully \textit{ex-post.}
Outside investors are assumed to be risk-neutral. However, they cannot observe or verify their employees’ abilities. Such investors are therefore indifferent with regard to the task allocation over their two employees. Competition for task assignments among the employees then implies that the (certain) wages associated with each task must be identically equal.

**Assumption 1** Before occupational choices are made, all economic agents - professionals as well as outside investors - a priori believe that the expected success probability in industrial firms is given by \( q^I \in [(aL)^2, 1] \).

The opportunity costs of becoming an entrepreneur are given by the foregone certain utility of employment in an industrial firm. Hence, professionals must know the wage offers of industrial firms in order to make rational occupational choices. These offers are taken to constitute binding commitments by outside investors. Let \( w^* \) denote the unique wage offer under perfect competition of outside investors for professional labor. Given Assumption 1, all such investors maximize their expected profit

\[
\pi = q^I K^I - \rho K - 2w^*. \tag{10}
\]

which yields the first-order condition

\[
\gamma q^I (K)^{(\gamma-1)} - \rho = 0, \tag{11}
\]

Let \( K^I = K^I(q^I; \rho) \) then denote the optimal capital input which satisfies (11).

**Definition 1** A competitive equilibrium in the industry’s labor market is characterized by the following properties:

(a) Before production commences, all members of the industry’s pool of professionals are either employed by outside investors or have become entrepreneurs.

(b) The occupational choices maximize the professionals’ expected utilities.

(c) The a priori beliefs concerning the expected success probability \( q^I \) in industrial firms are confirmed by the induced occupational choices of the professionals.

(d) Outside investors can freely enter and leave the industry at no costs.

Condition (a) reflects the usual market clearing assumption. According to property (b), the individuals make rational occupational choices. Condition (c) implies that the a priori beliefs are supported by equilibrium occupational choices. The free-entry condition (d) finally
ensures that competition for profitable investment opportunities within the industry will increase the wage-offers until outside investors believe to earn only the market rate of return on their investment.

Consequently, the reservation wage for potential entrepreneurs can be determined as

\[
\begin{align*}
    w^* &= w^*(q^I; \rho) \\
    &= \frac{1}{2} \left[ q^I (K^I(q^I; \rho))^\gamma - \rho K^I(q^I; \rho) \right] \\
    &= \frac{(1 - \gamma) q^I}{2} (K^I(q^I; \rho))^\gamma
\end{align*}
\]  

upon insertion from (11) into (10) above. Let \( U^I(q^I; \rho) = u(Y + w^*(q^I; \rho)) \) then denote the corresponding certain utility of an employee in competitive equilibrium.

3 Self-selection in “spin-off”-equilibria

Industrial firms are often noted to serve as “incubators” for spin-offs. This argument is taken to imply the following information and decision structure.

**Assumption 2** All professionals first apply for employment in industrial firms and are randomly matched to form production teams. Each team member then observes her colleague’s ability profile. Subsequently, the members of such teams can opt out of their employment contract and found an entrepreneurial firm before production commences.

Notice that the reservation utilities of both potential partners equal \( U^I \) in this case. Hence, Lemma 1 applies. The option to spin-off an entrepreneurial firm thus constitutes a means to align the interests of two randomly matched team members in making their occupational choices. All teams of professionals \( i \) and \( j \) for which

\[
U^E(q^E(\tilde{a}^{ij}); \rho) \geq U^I(q^I; \rho)
\]  

will choose to found an entrepreneurial firm. From (13) define \( \bar{q} \) such that

\[
U^E(\bar{q}(q^I); \rho) = U^I(q^I; \rho) .
\]  

Given every \textit{a priori} belief \( q^I \in ([a_L]^2, 1] \), (14) implicitly defines a continuous, monotonically increasing function \( \bar{q}(q^I) \geq q^I \). Clearly, \( \bar{q}(q^I) > q^I \) if professionals are risk-averse and \( q^I \in (0, 1) \).
Let \( q^t(\bar{q}) = \bar{q}^{-1}(q^t) \). Since task assignments in industrial firms constitute independent drawings, equilibrium occupational choices must confirm that

\[
q^t(\bar{q}) = \begin{cases} 
\frac{1}{f_{a_L}^t f_{a_2}(a_2)F(\frac{a}{a_2})da_2} \times \int_{\frac{a}{a_2}}^{\bar{q}} f_{a_L}^t a^1 f_{a_2}^t (a^1)da^1 a^2 f_{a_2}^t (a^2)da^2, & \bar{q} \geq a_L \\
\frac{1}{f_{a_L}^t f_{a_2}(a_2)F(\frac{a}{a_2})da_2} \times \int_{\frac{a}{a_2}}^{\bar{q}} f_{a_L}^t a^1 f_{a_2}^t (a^1)da^1 a^2 f_{a_2}^t (a^2)da^2, & \bar{q} < a_L
\end{cases}
\]

(15)

where \( F_{a^t}(a^t) \) and \( f_{a^t}(a^t) \), \( t = 1, 2 \), denote the unconditional marginal distribution and density functions, respectively. From (14), all teams realizing \( q^E(\bar{a}^{ij}) \geq \bar{q}(q^t) \) will found entrepreneurial firms. Hence, let \( h^t = h(a^{t1}, a^{t2}; \bar{q}(q^t)) \) denote the probability that a professional with ability profile \((a^{t1}, a^{t2}) \in S \) will found such a firm in competitive equilibrium.

**Proposition 1** If professionals are risk-averse, Assumption 2 implies that both firm types coexist in every competitive equilibrium. Further, there exists at least one such equilibrium. In equilibrium satisfying (14) and (15), \( \partial h^t / \partial a^{t1} \geq 0 \) with strict inequality if, for task \( t \), \( a^{t1} \in \left( \frac{a_L}{q(\bar{q})}, \frac{1}{q(\bar{q})} \right) \).

**Proof.** (a) If beliefs were such that all randomly matched teams of professionals should remain employed in industrial firms \( q^t(1) = \int_{a_L}^{1} a^1 dF_{a^1}(a^1) \int_{a_L}^{1} a^2 dF_{a^2}(a^2) < 1 \). However,

\[
\lim_{a^{t1} \to 1, a^{t2} \to 1} [U^E(a^1 a^2; \rho) - U^I(q^t(\bar{q}); \rho)] = u \left( Y + \frac{1}{2} \left( (K^I(1; \rho))^\gamma - \rho K^I(1; \rho) \right) \right) - u \left( Y + \frac{1}{2} \left( q^t(1) \left( K^I(q^t(1); \rho) \right)^\gamma - \rho K^I(q^t(1); \rho) \right) \right) > 0
\]

since \( \lim_{a^{t1} \to 1, a^{t2} \to 1} K^E(a^1, a^1, \rho) = K^I(1; \rho) \) and, according to (11), \( \partial K^I(q; \rho) / \partial q > 0 \).

In contrast, suppose that all randomly matched teams of professionals would spin-off entrepreneurial firms in equilibrium. Then,

\[
\lim_{a^{t1} \to a_L, a^{t2} \to a_L} [U^E(a^1 a^2; \rho) - U^I(q^t(\bar{q}); \rho)] = (a_L)^2 u \left( Y + \frac{1}{2} \left( (K^E((a_L)^2; \rho))^\gamma - \rho K^E((a_L)^2; \rho) \right) \right) + (1 - (a_L)^2) u \left( Y - \frac{1}{2} \rho K^E((a_L)^2; \rho) \right) - u \left( Y + \frac{(a_L)^2}{2} \left( (K^I((a_L)^2; \rho))^\gamma - \rho K^I((a_L)^2; \rho) \right) \right) < 0.
\]
since, according to (11) and (8), $K^E((a_L)^2; \rho) < K_I((a_L)^2; \rho)$ for all $0 < (a_L)^2 < 1$ if professionals are risk-averse. An industrial firm offering $w^*((a_L)^2)$ would therefore attract some employees and earn positive expected profits. Thus, (16) and (17) rule out competitive equilibria in which the entire industry consists of only one firm-type.

(b) Notice that $U^E(\tilde{q}; \rho)$ and $U^I(q^I(\tilde{q}); \rho)$ are both monotonically increasing in $\tilde{q}$ and $q^I(\tilde{q})$, respectively. Also, (15) yields $\partial q^I(\tilde{q})/\partial \tilde{q} > 0$. Given part (a) above, there must exist at least one $\tilde{q}$ which satisfies (14) and (15).

(c) It follows that, in competitive equilibrium,

$$h(a^{1i}; a^{2i}; \tilde{q}) = \begin{cases} 1, & \text{if } \frac{\tilde{q}}{a^{1i}} \leq a_L, \quad \text{for both } t = 1, 2 \\ \frac{1}{2} \left[ 2 - \sum_{t=1}^{2} F_{\alpha_t}(\frac{\tilde{q}}{a^{t}}) \right], & \text{if } \frac{\tilde{q}}{a^{1i}} \in (a_L, 1) \quad \text{for one } t = 1, 2 \\ 0, & \text{if } \frac{\tilde{q}}{a^{1i}} \geq 1 \quad \text{for both } t = 1, 2 \end{cases}$$

The final statement in the proposition then follows immediately.

Inequality (16) reflects that, as the self-selection criterion for entrepreneurial teams $\tilde{q}$ approaches unity, only top ability professionals still found partnerships. Since the probability of project failure converges to zero for such teams, they choose the first-best capital input and receive the corresponding certain utility. In contrast, industrial firms expect to realize average ability in their teams. Although the capital input would also be chosen according to the first-best rule, the respective capital level and the corresponding certain utility of their employees would still be lower than in entrepreneurial firms founded by top-ability professionals.

As the self-selection criterion $\tilde{q}$ approaches its positive lower bound, the pooling risk in industrial firms vanishes. Hence, inequality (17) reflects that outside investors would then only employ a single - e. g. the lowest - ability-type in both tasks. Outside investors would therefore choose the first-best capital input level conditional on the highest project risk which can possibly be realized. Exactly this project risk would also be realized in marginal entrepreneurial firms. However, the respective partners in such firm are risk-averse and would, thus, choose a second-best capital input. Hence, their expected utility would be lower than the certain utility associated with employment in industrial firms.

Since both the expected utility of entrepreneurs and the certain utility of employees monotonically increase if the self-selection of entrepreneurs becomes more restrictive, they exhibit a crossing property. Moreover,

$$\frac{\partial^2 U^E(\tilde{q}; \rho)}{(\partial \tilde{q})^2} = \frac{1}{2} \left[ u'(Y + \frac{1}{2} [(K^E(\tilde{q}; \rho))^{\gamma} - \rho K^E(\tilde{q}; \rho)]) \left((K^E(\tilde{q}; \rho))^{(\gamma-1)} - \rho \right) \right] \frac{\partial K^E(\tilde{q}; \rho)}{\partial \tilde{q}} > 0$$

(19)
due to (8). However, from (12) and the definition of $U^I(q^I(\bar{q}); \rho)$,

$$
\frac{\partial^2 U^I(q^I(\bar{q}); \rho)}{(\partial q^I(\bar{q}))^2} = u''(Y + w^*(q^I; \rho)) \left[ \frac{(K^I(q^I; \rho))^\gamma}{2} \frac{\partial q^I(\bar{q})}{\partial \bar{q}} \right]^2
+ u'(Y + w^*(q^I; \rho)) \frac{\gamma (K^I(q^I; \rho))^{(\gamma - 1)}}{2} \left[ \frac{\partial q^I(\bar{q})}{\partial \bar{q}} \right]^2
+ u'(Y + w^*(q^I; \rho)) \frac{(K^I(q^I; \rho))^\gamma}{2} \frac{\partial^2 q^I(\bar{q})}{(\partial \bar{q})^2}.
$$

From, (15) $\partial q^I(\bar{q}) / \partial \bar{q} > 0$ and the sign of $\partial^2 q^I(\bar{q}) / (\partial \bar{q})^2$ depends on the specific distributional assumptions. Hence, a single-crossing property cannot be taken for granted. Given the specific utility function of the professionals and the distribution of ability profiles over the population, the competitive equilibrium is therefore not necessarily unique.

**Proposition 2** With risk-averse professionals, Assumption 2 implies that there exists a unique efficient competitive equilibrium. The respective self-selection criterion $\bar{q}^*$ satisfies

$$
\bar{q}^* = \arg \max_{\bar{q} \in ((a_L)^2, 1)} q^I(\bar{q})
$$

subject to (14) and (15).

**Proof.** An efficient self-selection equilibrium must solve the above optimization problem, since $U^I(q^I(\bar{q}); \rho)$ is increasing in $q^I(\bar{q})$ and all entrepreneurs’ expected utilities satisfy (13). Hence, using the notation from above, $\bar{q}^*$ also maximizes

$$
V^I = h(a^{1i}, a^{2i}, \bar{q}) E_{\bar{a}^{1i}, \bar{a}^{2i}} \left\{ U^E(q^E(\bar{a}^i; \rho)) \right\}
+ \left( 1 - h(a^{1i}, a^{2i}, \bar{q}) \right) U^I(q^I(\bar{q}); \rho)
$$

for all professionals $i$. According to Proposition 2, $\bar{q} \in ((a_L)^2, 1)$ and the constraint (14) must be binding. Uniqueness then immediately follows from $\partial U^E(\bar{q}; \rho) / \partial \bar{q} > 0$, $\partial q^I(\bar{q}) / \partial \bar{q} > 0$, and (16). These conditions imply the existence of a value $\bar{q}^*$ such that $U^E(\bar{q}; \rho) > U^I(q^I(\bar{q}); \rho)$ for all $\bar{q} \in (\bar{q}^*, 1]$. Hence, $\bar{q} > \bar{q}^*$ cannot characterize a competitive equilibrium and all possible competitive equilibria with $\bar{q} < \bar{q}^*$ are parteto-dominated.

Interestingly, the efficient competitive equilibrium maximizes the team-quality in industrial firms. This conclusion reflects that risk-aversion induces an endogenous separation of professionals into two groups providing industrial and entrepreneurial labor, respectively. Thus, as in standard incentive analysis, the efficient equilibrium implements a second-best trade-off. Risk-shifting by joining industrial firms can only be achieved at the expense of
foregoing some of the allocative benefits associated with rational task-assignments in entrepreneurial firms.\footnote{Notice that a very similar risk-shifting argument can be found in the seminal articles by Kihlstrom and Laffont (1979, 1983). However, these previous studies assume heterogeneity with respect to risk preferences whereas the current approach is based on risk-type heterogeneity among agents.}

4 Self-selection in “incubator”-equilibria

4.1 Rational ability-matching by choosing partners

Intuitively, Assumption 2 above implies that employment contracts of industrial firms contain an initial “evaluation” phase during which professionals learn about each others’ ability profiles. In practice, research departments of large industrial firms frequently offer such spin-off opportunities for professionals who have yet to be matched in production teams. Thus, such departments serve as an organizational institution to incubate new business projects.

Other forms of incubator organizations include regional technology centers combining human capital in innovative new firms, or entrepreneurship programs of universities and colleges attempting to equip students with the necessary tools to found new firms. Such organizations also seek to establish pools of professionals to coordinate entrepreneurial activities. Hence, they allow to observe abilities prior to contracting, to search for partners, and aim at reducing the respective information and search costs. In this section, Assumption 2 is therefore replaced by the following conjecture:

Assumption 3 All professionals observe each others’ ability profiles before making occupational choices.

Assumption 3 implies that there are actually no information and search costs for potential entrepreneurs. Given perfectly informed professionals, part (b) of Definition 1 of a competitive equilibrium then implies that potential entrepreneurs maximize their expected utility by choosing partners.

Lemma 2 Given Assumption 3, superior realizations of the success probabilities in entrepreneurial firms reflect that both tasks are performed perfectly with higher probabilities.

Proof. Suppose four professionals denoted $k$, $\ell$, $m$, and $n$ decide to become entrepreneurs. Without loss of generality, they are taken to team up in two partnerships between $k$ and $\ell$,
respectively $m$ and $n$ and realize $q^E(a^{k\ell}) \leq q^E(a^{mn})$. Given that these individuals have maximized their expected utilities,

(a) $q^E(a^{k\ell}) = a^1 a^{2\ell} \Rightarrow a^{1k} \leq a^{1m} \wedge a^{2\ell} \leq a^2$,

(b) $q^E(a^{k\ell}) = a^1 a^{2k} \Rightarrow a^{1\ell} \leq a^{1m} \wedge a^{2k} \leq a^{2n}$, \hspace{1cm} (23)

(c) $q^E(a^{k\ell}) = a^1 a^{2k} \Rightarrow a^{1\ell} \leq a^{1n} \wedge a^{2k} \leq a^{2m}$,

(d) $q^E(a^{k\ell}) = a^1 a^{2\ell} \Rightarrow a^{1k} \leq a^{1n} \wedge a^{2\ell} \leq a^{2m}$.

At least one inequality must be strict in cases (a) - (d), if $q^E(a^{k\ell}) < q^E(a^{mn})$. Further, $q^E(a^{k\ell}) = q^E(a^{mn})$ implies equalities everywhere. Otherwise, $a^{i\ell} > a^{j\ell}$ for one $t = 1, 2$, with $i = k, \ell$ and $j = m, n$, in (23 (a) - (d)) would imply that either $k$ or $\ell$ could team up with $m$ or $n$ to found a partnership which would yield higher expected utility for both individuals.

The expected utility maximizing behavior of potential entrepreneurs in choosing partners induces a ranking of abilities across the respective production teams. The professional with highest ability in task $t$ teams up with the professional who is characterized by the highest ability in the other task $\tau$, where $t, \tau = 1, 2$ and $t \neq \tau$. Then, the professional with next to top ability in task $t$ founds an entrepreneurial firm with the professional whose ability in task $\tau$ is second-ranked as well.

Finally, the professional with the lowest ability in task $t$ among all professionals who decide to become entrepreneurs teams up with a partner of lowest ability in task $\tau$ which can be found in this sub-pool of professional labor. In competitive equilibrium with a large number of perfectly informed potential entrepreneurs, partnerships with identical success probability $q^E(a^{i\ell})$ can therefore only be characterized by identical professional ability in both tasks.\(^{14}\)

### 4.2 Competitive equilibria with perfectly informed entrepreneurs

Industrial labor contracts can only be conditioned on the expected quality of production teams which are randomly recruited among those professionals who decide not to become entrepreneurs. Outside investors therefore believe that such professionals are characterized by ability profiles $(a^1, a^2) \in SM = SE \cup S^E$, where either

$$S^E = S^E(z_1, z_2) = \{(a_1, a_2) \in S \mid z_1 \leq a_1 \leq 1 \wedge z_2 \leq a_2 \leq 1\} \hspace{1cm} (24)$$

\(^{14}\)In the remaining, it will be assumed that a sufficiently large number of professionals chooses to become entrepreneurs in equilibrium. Divisibility problems due to the fact that each production team must consist of two professionals can then be ignored.
or
\[
S^E = S^E(z_1, z_2) = \{(a_1, a_2) \in S \mid z_1 \leq a_1 \leq 1 \land z_2 \leq a_2 \leq 1 \}.
\] (25)

with \(z_t \geq a_L, t = 1, 2\).

Hence, (24) implies that all professional entrepreneurs are characterized by ability realizations which fall into superior ranges with respect to both tasks. The self-selection of professionals by means of occupational choice would therefore produce an “interdisciplinary” quality signal. In contrast, given (25), occupational choices only reflect superior “disciplinary” abilities of entrepreneurs.

**Proposition 3** Given Assumption 3, competitive equilibria only confirm beliefs of type (25) in which both firm-types coexist.\(^{15}\) There exists at least one such equilibrium.

**Proof.** (a) To begin with, assume \(a_L < z^t < 1\) for \(t = 1, 2\). Let
\[
U^{Ez}(z^1, z^2; \rho) \equiv U^E(q^E(\tilde{a}^{ij}) \mid q^E(\tilde{a}^{ij}) = z^1 z^2; \rho).
\] (26)
Recall that \(\partial U^E(q^E)/\partial q^E > 0\). Thus, \(\partial U^E(q^E(\tilde{a}^{ij})) / \partial a^{pt} = \partial U^E(q^E)/\partial q^E \partial q^E/\partial a^{pt} \geq 0\), for each of the two partners \(p = i, j\) and both tasks \(t\). Strict inequality follows if partner \(p\) actually carries out task \(t\) in the entrepreneurial firm.

(i) If the competitive equilibrium supports beliefs of outside investors which are derived from (24), all entrepreneurial partnerships must be characterized by \(q^E \geq z^1 z^2\). Hence, such equilibrium satisfies
\[
U^{Ez}(z^1, z^2; \rho) = U^I(q^I(z^1, z^1); \rho).
\] (27)
since every theoretically possible ability profile can be realized.

Now, consider two professionals \(i\) and \(j\). Suppose that \(j\) who is characterized by \(a^{bij} < a^{ti}\), for one task \(t = 1, 2\), is currently able to contract with a partner \(\ell\) to found an entrepreneurial firm which yields an expected utility exceeding \(U^I(q^I(z^1, z^1); \rho)\). According to Lemma 3, \(i\) must then also found an entrepreneurial firm with a professional \(m\) characterized by \(a^{\tau m} \geq a^{\tau \ell}\), \(\tau \neq t\). Otherwise, \(\ell\) would prefer to found such a firm with \(i\) rather than \(j\). This argument clearly holds irrespective of \(i\)’s ability in task \(\tau\) and therefore contradicts that equilibrium \(a\) priori beliefs can be of type (24).

(ii) Alternatively, assume that the equilibrium occupational choices support \(a\) priori beliefs of type (25). In this case, \(U^{Ez}(z^1, z^2; \rho)\) defined above constitutes an upper bound on

\(^{15}\)Again, it can also be shown that there exist no equilibria that could confirm \(a\) priori beliefs of type (24) or type (25) with \(z^1 \leq a^1 \leq Z^1 \land (respectively, \lor) z^2 \leq a^2 \leq Z^2\) with \(z^t < Z^t \leq 1, t = 1, 2\).
expected utilities for all professionals \(i\) characterized by abilities \((a^{1i}, a^{2i}) \in S^E\) with \(a^{it} = z^t\), \(a^{i\tau} < z^\tau\) where \(t, \tau = 1, 2\) and \(t \neq \tau\). Hence, (27) must again be satisfied in equilibrium.

The respective \((z^1, z^2)\)-combination induces a separation of pairs of professionals \((i, j)\) who would - hypothetically, as teams - choose to become either entrepreneurs or employees of industrial firms. All teams in which members are characterized by \(a^{it} < z^t\) and \(a^{jt} < z^t\) for both tasks \(t = 1, 2\) would only be able to realize an expected utility which falls short of \(U^I(q^I(z^1, z^1); \rho)\). At the same times, all teams consisting of individuals with \(a^{it} \geq z^t\) and \(a^{jt} \geq z^t\), with \(t, \tau = 1, 2\) and \(t \neq \tau\), can realize expected utilities greater than or equal to \(U^I(q^I(z^1, z^1); \rho)\). Hence, given beliefs of type (25), every \((z^1, z^2)\)-combination, with \(a_L < z^t < 1\) for \(t = 1, 2\), which satisfies (27) constitutes a competitive equilibrium.

(b) Notice that in the case of part (a) (i) above

\[
q^I(z^1, z^2) = \frac{\int_{a_L}^{z^2} \int_{a_L}^{z^1} a^1 f_{\tilde{a}^1, \tilde{a}^2}(a^1, a^2) da^1 da^2}{\int_{a_L}^{z^2} \int_{a_L}^{z^1} f_{\tilde{a}^1, \tilde{a}^2}(a^1, a^2) da^1 da^2} = \frac{\int_{a_L}^{z^2} \int_{a_L}^{z^1} a^2 f_{\tilde{a}^1, \tilde{a}^2}(a^1, a^2) da^1 da^2}{\int_{a_L}^{z^2} \int_{a_L}^{z^1} f_{\tilde{a}^1, \tilde{a}^2}(a^1, a^2) da^1 da^2} \tag{28}
\]

It is easily verified that \(\lim_{z^1 \to 1, z^2 \to 1} [U^{Ez}(z^1, z^2; \rho) - U^I(q^I(z^1, z^2); \rho)]\) yields inequality (16) derived in part (a) of the proof of Proposition 2 again. Also, \(\lim_{z^1 \to a_L, z^2 \to a_L} [U^{Ez}(z^1, z^2; \rho) - U^I(q^I(z^1, z^2); \rho)]\) only restates (17) from above. Consequently, due to \(\partial U^E(q^E)/\partial q^E > 0\) and Lemma 3, there must exist a combination \((z^1, z^2)\), with \(a_L < z^t < 1\) for at least one task \(t = 1, 2\), such that (27) is satisfied.

Given both Assumptions 2 and 3, professionals first observe each others’ ability profiles and then decide whether to found an entrepreneurial firm. As discussed in the preceding section, this argument alone suffices to establish a competitive equilibrium in which both firm-types coexist. To a considerable extend the proof of Proposition 3 therefore only restates results from the proof of Proposition 1.

The important difference arises due to the fact that the probability to found an entrepreneurial firm is now either equal to unity or zero contingent only on the professional’s own ability profile. In particular, top-ability task-specialist will always be able to find a partner with whom to found an entrepreneurial firm which yields higher expected utility for both partners than if accepting the wage offer of an industrial firm. Thus, “interdisciplinary” self-selection criteria are not compatible with competition for better partners among informed professionals.

Although Proposition 3 establishes a crossing property for the expected utilities associated with occupational choice, it is again easily verified that a single-crossing property does not follow.
Proposition 4  Given Assumption 3, an efficient competitive equilibrium is characterized by selection criteria $(\zeta^1, \zeta^2)$ such that

$$(\zeta^1, \zeta^2) = \arg \max_{z^1 \in (a_L, 1), z^2 \in (a_L, 1)} q^I(z^1, z^2),$$

subject to (27) and (28)

Efficient competitive equilibrium uniquely determines the success probability $\overline{Q}^t = \zeta^1 \zeta^2$ in the marginal entrepreneurial firm.

Proof. From Proposition 3, a competitive equilibrium only supports belief structures of type (25) with $z^t \in (a_L, 1)$, for $t = 1, 2$. The arguments pursued in the part (b) of the proof of Proposition 6 imply that (27) constitutes a binding constraint if $q^I(z^1, z^2)$ is given by (28). Then, assume that there exist two competitive equilibria characterized by self-selection criteria $(\hat{\zeta}^1, \hat{\zeta}^2)$ and $(\zeta^1, \zeta^2)$ and $q^I(\hat{\zeta}^1, \hat{\zeta}^2) < q^I(\zeta^1, \zeta^2)$.

Due to $\partial U^I(q^t, \rho)/\partial q^t > 0$, it follows that $U^I(q^t(\hat{\zeta}^1, \hat{\zeta}^2); \rho) < U^I(q^t(\zeta^1, \zeta^2); \rho)$. Further, $U^E(q^E(\hat{\zeta}^1, \hat{\zeta}^2); \rho) > U^E(z^1, z^2; \rho)$ for all professionals $i$ and $j$ who found a non-marginal entrepreneurial firm implying that $a_{pt} \geq z^t$, with $p = i, j$ and $t = 1, 2$, with strict inequality for one of the two tasks $t$. Hence, all industry professionals realize higher expected utility in the equilibrium characterized by $(\zeta^1, \zeta^2)$ than given the equilibrium with selection criteria $(\hat{\zeta}^1, \hat{\zeta}^2)$. Consequently, an efficient equilibrium must satisfy (29).

Part (b) of the proof of Proposition 3 also implies that $U^E(z^1, z^2; \rho) > U^I(q^I(z^1, z^2); \rho)$ for all combinations $(z^1, z^2)$ which yield $z^1 z^2 \in (q^*, 1]$, where $q^* \equiv \zeta^1 \zeta^2$. As shown above, all possible competitive equilibria with $z^1 z^2 \in [(a_L)^2, q^*)$ are not efficient. Hence, $Q^t$ is uniquely determined in efficient competitive equilibrium.

Again, efficiency requires to implement a second-best trade-off between risk-shifting in industrial firms and economizing on the productive advantage of allocating tasks according to comparative advantages. The first-order conditions of the program (29) yield

$$\left[1 + \lambda^* \frac{\partial U^I(q^I(\zeta^1, \zeta^2); \rho) \partial w^*(q^I(\zeta^1, \zeta^2))}{\partial q^I(\zeta^1, \zeta^2)} \frac{\partial q^I(\zeta^1, \zeta^2)}{\partial z^t} \right]$$

$$\lambda^* \zeta^\tau \left[ u(Y + \frac{1}{2} [(K^E(\zeta^1 \zeta^2; \rho))^2 - \rho K^E(\zeta^1 \zeta^2; \rho)]) - u(Y - \frac{1}{2} \rho K^E(\zeta^1 \zeta^2; \rho)) \right]$$

with $t, \tau = 1, 2$ and $t \neq \tau$, where $\lambda^*$ denotes the optimal value of the Lagrange-multiplier associated with the constraint (27). Thus, the conditions (30) can be combined to imply

$$\frac{\partial q^I(\zeta^1, \zeta^2)}{\partial z^1} \zeta^1 = \zeta^2 \frac{\partial q^I(\zeta^1, \zeta^2)}{\partial z^2}.$$  

\(^{16}\)Clearly, the same argument can be made if there are more than two competitive equilibria in which industrial and entrepreneurial firms coexist.
Hence, efficient equilibrium equalizes the elasticities of the expected team quality in industrial firms with respect to the two top task ability realizations that would still be included in such firms’ labor pool.

5 Comparing “spin-off” and “incubator”-equilibria

5.1 General industry structure effects

The possibility of multiple equilibria generally precludes to draw general positive conclusions concerning the impacts of fostering entrepreneurial activity through spin-offs or formal incubator organizations. However, it is possible to compare the respective efficient equilibria with respect to the degree of entrepreneurial activity generated in the industry.

**Proposition 5** The entrepreneurial sector of the industry is smaller in efficient spin-off equilibrium than in efficient incubator-equilibrium: \( Q^* < q^* \).

**Proof.** Take any \((z_1^*, z_2^*)\)-combination that satisfies \( z_1^* z_2^* = \bar{q} \). Comparing (15) with \( \bar{q} = q^* \) and (28) with \((z_1, z_2) = (z_1^*, z_2^*)\), it is immediately clear that \( q^I_1(\bar{q}^*; z_1^*, z_2^*) > q^I_1(z_1^*, z_2^*) \).

It follows that

\[
U^I(q^I_1(\bar{q}^*); \rho) = U^E(q^*; \rho) > U^E(z_1^*, z_2^*; \rho).
\]

Focussing on efficient equilibria only, Propositions 2 and 4 therefore imply \( \zeta^1 \zeta^2 = \overline{Q}^* < q^* \).

**Ceteris paribus** - e. g., holding the team quality of the marginal entrepreneurial firm constant - consider two professionals with high abilities in the same one of the two tasks and very low abilities in the other task. If such individuals happen to be matched in “spin-off”-equilibrium, they would decide not to become entrepreneurs and rather enter the industrial workforce. However, these professionals would become entrepreneurs in “incubator”-equilibrium because they could search for and then team up with individuals characterized by a compensating ability profile.

Hence, moving from “spin-off” to “incubator”-equilibrium more high ability individuals leave the labor pool of industrial firms. Consequently, the expected team quality in such firms decreases. Since efficient equilibria are unique and in both cases maximize this expected team
quality, the team quality of the marginal entrepreneurial firm must also be lower in efficient “incubator”-equilibrium.

5.2 Evaluating industry structure and welfare effects

5.2.1 The assumptions for simulating the model

The general analysis above cannot address the size of the structural effect reported in Proposition 5 above. Obviously, the degree of crowding-out of entrepreneurial activity by moving from an incubator to a spin-off equilibrium depends on risk-preferences and the properties of the ability profile distribution. Moreover, the corresponding welfare effects are generally ambiguous. On the one hand, the certain utility of professionals employed in industrial firms is lower in efficient incubator-equilibrium. On the other hand, high ability professionals do not face the risk of an “unlucky” match.

Simple simulations of the model framework may, however, provide some insights into the relative importance of risk-aversion and the cost of capital for the size of the structural effects and the welfare dominance of the two regimes. Reasonably, such simulations compare only the efficient equilibrium outcomes under both regimes. For parsimony, the analysis above has already assumed a simple Cobb-Douglas-type production function for complete production processes. For our simulations the capital intensity is set to \( \gamma = 0.3 \) to match current estimates of the share of labor income in GDP.\(^{17}\)

Positive initial wealth \( Y \) has actually only been introduced to the model to ensure positive optimal investments of entrepreneurs. In our simulations, \( Y = 0.5 \) then. This value has proved to induce well-measurable effects of varying the degree of risk aversion and the interest rate over broad ranges. Risk-preferences are expressed by a CRRA utility function. Hence, \( u(y) = \frac{y^{1-c}}{1-c} \), for \( c \neq 1 \), and \( u(y) = ln(y) \), for \( c = 1 \).\(^{18}\) According to Kaplow (2003), the degree of relative risk-aversion \( c \) can plausibly take on even very high - i.e., two-digit - values.

Analytic approaches found in the literature typically assume that task abilities are identically and independent distributed. In the remaining, let therefore \( f_{a^1, a^2}(a^1, a^2) = g(a^1)g(a^2) \). Further, we specify \( g \) as the uniform density on \([a_L, 1]\).\(^{19}\) Notice that the qualitative results reported below still hold - albeit numerically weaker - if other symmetric distributions are used, and if we allow for positive correlation between the two abilities of each professional.

\(^{17}\) Gollin (2002)
\(^{18}\) Since \( Y > 0 \), risk preferences can also be seen to reflect HARA rather than CRRA-utility.
\(^{19}\) Compare Lazear (2004) once more.
The following simulations will then demonstrate changes in this industry structure, capital usage by the different types of firms, and the respective welfare effects induced by varying the professional’s degree of risk-aversion and the interest rate.

5.2.2 Changes in industry structure and capital usage

Given these assumptions, the simulations reported in Tables 1 a) and b) confirm Proposition 5. The entrepreneurial sector is always larger in the incubator equilibrium.

INSERT TABLES 1 a) -b) ABOUT HERE!

Interestingly, lower interest rates the size of the entrepreneurial sector in both scenarios. This somewhat counter-intuitive effect can be explained by recalling the occupational options depicted graphically in Figure 1. An increase in the interest rate “harms” successful as well as unsuccessful entrepreneurs. Ex-ante entrepreneurial partnerships respond by reducing the optimal capital input. Obviously, the same adjustment is carried out in industrial firms. Yet, in doing so entrepreneurs also shift payoff from the state in which the project is successful to the state in which it fails. Thus, entrepreneurial partnerships further increase their self-insurance.

INSERT FIGURE 1 ABOUT HERE!

In contrast, higher degrees of risk-aversion decrease the entrepreneurial sector of the industry. Clearly, this effect reflects the enhanced risk-shifting associated with more industrial employment. Although industrial policy often appears to simply aim at fostering entrepreneurial activities per se, these effects then strongly suggest to appreciate the respective welfare effects of such policies.

Since under both matching regimes higher risk-aversion crowds out entrepreneurial activities, the expected team ability in industrial firms improves. Risk-neutral outside investors will then invest more to equip such better-quality teams. At the same time, the team-quality in the marginal entrepreneurial firm increases as well which also implies higher capital inputs in such firms and in the entrepreneurial sector as a whole. However, the capital usage in the marginal entrepreneurial firm may still fall short of the respective input choice in industrial
firms for low degrees of risk-aversion. Moreover, the capital input in industrial firms approaches an upper bound which is lower than the capital input in top-quality entrepreneurial firms.

Thus, the capital usage in the industry - e. g., taking the average over industrial and entrepreneurial firms - is typically a non-monotonic function of the degree of risk-aversion. For low degrees of risk-aversion, it decreases with increasing risk-aversion, but will then reach a minimum and increase for higher degrees of risk-aversion. Since the entrepreneurial sector is always smaller in spin-off equilibrium than in incubator equilibrium, the marginal entrepreneurial firm is always characterized by a better team-quality under the former regime. Consequently, the average capital usage in the industry begins to increase for lower degrees of risk-aversion in the spin-off equilibrium scenario.

Clearly, higher interest rates decrease the capital usage in all firms - industrial as well as entrepreneurial firms. Moreover, since they imply that the entrepreneurial sector increases, lower-quality teams of professionals found entrepreneurial partnerships. Comparing spin-off and incubator regimes again, the marginal entrepreneurial firm therefore always uses less capital in the latter case. Said differently, incubator organizations render entrepreneurial activity relatively more attractive for professionals, but the entrepreneurial partnerships which are additionally “incubated” are rather small and operate with little capital.

Figures 2 a) - c) illustrate these structural effects. The light and the dark columns display the average capital input of entrepreneurial firms and the capital input of industrial firms, respectively. The line then indicates the average capital input in the industry taken over all firms. Capital inputs in all firm types and, therefore, in the industry decrease with higher interest rates. However, due to the structural effect discussed above, neither of the two regimes generally implies a higher or a lower industry-wide capital usage when comparing economies whose populations of professionals differ with respect to their risk-aversion.

5.2.3 Welfare effects

The welfare criterion used below compares the expected utilities and certainty equivalent incomes of individuals who do not yet know the realization of their ability profiles. Thus, welfare effects emerge from the ex-ante risk-type uncertainty as well as the realized ex-post project success risk. This welfare criterion naturally corresponds to the idea that governments
should not deliberately discriminate among individual-types. Moreover, it can be interpreted as an objective function for designing an educational system in which ability profiles reflect the outcomes of risky investment activities.\textsuperscript{20}

Recall that in both the spin-off and the incubator setting, each professional possesses an initial wealth of $Y$. Hence, teams with initial joint wealth of $2Y$ face the payoff alternatives illustrated in Figure 1 when making occupational choices. If the risk aversion parameter $c$ approaches 0 - i.e. if we assume risk neutrality - no team will have an incentive to seek, respectively stay in industrial employment since $q^E \geq q^I$. In the risk neutral case, the expected team quality is therefore given by $E(q) = E(\tilde{a}^1) \cdot E(\tilde{a}^2)$ under the spin-off setting and $E(q) = E((\tilde{a}^1)^2)$ in the incubator regime. The latter always exceeds the former then.\textsuperscript{21} In contrast, for extremely risk averse professionals - hence, if $c$ approaches infinity - the welfare difference between the two regimes approaches zero. Both regimes converge to the same all-employee borderline case.

If individuals are moderately risk averse, a trade off emerges. On the one hand entrepreneurs in the incubator setting enjoy the advantage of being able to pick their partner and therefore - on average - realize a higher team quality than in the spin-off case. On the other hand, compared to the spin-off case employees under the incubator setting receive a lower wage in industrial firms due to the induces lower average employee team-quality in such firms. An increase in risk aversion increases the proportion of individuals becoming employees under both settings. This tends to favor the spin-off setting.

INSERT TABLE 2 ABOUT HERE!

These conclusions are confirmed by the simulations reported in Table 2. For low degrees of risk aversion, the incubator regime is welfare dominant. As $c$ increases, the spin-off regime \textit{ceteris paribus} becomes dominant. Moreover, for very degrees of high risk aversion the welfare differences expressed in certainty equivalents, or in terms of relative difference in expected utility decreases.

As noted above, increasing the interest rate yields more entrepreneurial activity under both regimes. This effect has been explained to reflect the enhanced self-insurance implemented in entrepreneurial partnerships. Thus, higher interest rates should also tend to imply that the “incubator”-equilibrium is welfare dominant. Tables 3 a) - b) then report the respective welfare effects as the two regimes are compared.

\textsuperscript{20}Fabel (2004b).
\textsuperscript{21}This general difference in calculating expected team qualities between the two regimes also implies that the conclusions derived below can be transferred to the case of positively correlated task abilities.
Higher interest rates actually render the “incubator”-regime welfare dominant which *ceteris paribus* entails more entrepreneurial activity. Given our specific simulation model and realistic movements of interest rates, this effect appears to be week though. Increasing the interest rate by 4% and lowering the degree of risk aversion by only one unit yield equivalent conclusions concerning the welfare dominance in comparing the two institutional regimes.

Hence, suppose a situation in which the efficient “spin-off”-equilibrium welfare dominates. Starting from this situation, a 4% increase in the interest rate would then render the “incubator”-equilibrium dominant. However, assuming an increase of the risk-aversion parameter $c$ by one would again restore the original dominance of the “spin-off”-equilibrium.

6 Concluding discussion

Competitive equilibria in which industrial firms and entrepreneurial partnerships coexist are supported by institutions to match complementary individual task abilities prior to making occupational choices. Two such institutions have been analyzed in detail: corporate spin-off of initially randomly matched production teams whose members can observe each others’ ability profiles and incubator organizations in which each member can observe all other members’ profiles and rationally choose a partner. Entrepreneurial firms then constitute “partnerships of equals” founded by élite teams. Further, each of the two institutional regimes entails a unique efficient competitive equilibrium separating an industrial from an entrepreneurial sector.

Comparing these equilibria the incubator case always entails more entrepreneurial activity. However, the additional entrepreneurial firms founded in incubator equilibrium operate with rather low capital inputs. Moreover, from an *ex-ante* welfare point of view this equilibrium also implies less industry-wide risk-sharing. Consequently, higher degrees of risk aversion tend to render the efficient “spin-off”-equilibrium dominant. In contrast, higher interest rates induce a tendency towards a dominating incubator equilibrium. Due to the adjustments in the optimal capital input the income-risk for entrepreneurs is reduced and, hence, more entrepreneurial firms are founded. Since these firms exploit comparative advantages in organizing their production, the negative effect on expected industry production that is derived from the increase in the interest rate is somewhat compensated. This compensatory effect is stronger in “incubator” than in “spin-off”-equilibrium.
Yet, this interest rate effect appears weak and certainly depends on the particular simulation model used. In general, the welfare conclusion are much more sensitive with respect to changes in the degree of relative risk aversion. This yields an interesting interpretation. There currently appears to exist a common understanding that US households are willing to bear considerable more economic risk than their continental European counterparts.22 The writing of Coase (1937), Williamson (1975) and North (1981) then emphasize the positive efficiency principle of institutional economics. Given this perspective, the difference in risk-taking attitudes can well explain why in US incubator organizations have emerged naturally, such as the Silicon Valley network, and generally prove sustainable while in Europe they appear to require persistent public subsidies for their existence.

Hence, European industrial and regional politics should more carefully evaluate the possibility of induced inefficiency resulting from their support of science parks, technology transfer centers, and the like.23 In this respect, finally recall also that neither of the two institutional regimes proves to induce a higher industry-wide capital usage in general. Thus, fostering firm foundations by establishing incubator organizations may even fail to attract more investments in an industry.

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22 See, for instance, Allen and Santonomero (1999).
23 More recently, North (1990) finds that his earlier conclusions require qualifications. The emergence of specific formal organizations (institutions) generally reflects “environmental” constraints. Hence, societies can be lucky if they actually possess efficient institutions to coordinate economic activity.
References


Appendix: Proof of Lemma 1

Consider the optimization problem (3) to (7). Obviously, for every $K(\bar{a}^{ij})$, $\phi(\bar{a}^{ij})$, and $\beta(\bar{a}^{ij})$ (3) is always maximized by choosing the task allocation according to the rule of comparative advantage. Hence, the optimal task allocation implies $T^E(\bar{a}^{ij}) = 1$ (0) if $a^{i1}a^{2j} \geq (<) a^{ij}a^{2i}$ which yields the definition of $q^E(\bar{a}^{ij}) = \max \{a^{i1}a^{2j}, a^{ij}a^{2i}\}$ in the lemma. Further, let

$$y_{ij}^{\bar{s}} \equiv Y - \phi(\bar{a}^{ij}) + (1 - \beta(\bar{a}^{ij}))(K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij}) \quad (33)$$

$$y_{ns}^{\bar{j}} \equiv Y - \phi(\bar{a}^{ij}) - (1 - \beta(\bar{a}^{ij}))\rho K(\bar{a}^{ij}) \quad (34)$$

$$y_{ij}^{\bar{s}} \equiv Y + \phi(\bar{a}^{ij}) + \beta(\bar{a}^{ij}))(K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij}) \quad (35)$$

$$y_{ns}^{\bar{j}} \equiv Y + \phi(\bar{a}^{ij}) - \beta(\bar{a}^{ij})\rho K(\bar{a}^{ij}) \quad (36)$$

For interior solutions, the first-order conditions with respect to $\beta(\bar{a}^{ij})$, $K(\bar{a}^{ij})$, and $\phi(\bar{a}^{ij})$, can then be rearranged to yield

$$\begin{align*}
[q^E(\bar{a}^{ij})u'(y_{ij}^{\bar{s}})][(K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij})] &- (1 - q^E(\bar{a}^{ij}))u'(y_{ns}^{\bar{j}})\rho K(\bar{a}^{ij})] [U^{ij} - v^i]^{-\frac{1}{2}} \\
\leq \quad &\begin{cases} 
0 & \text{if } \beta(\bar{a}^{ij}) \\
1 & \text{else}
\end{cases} \\
\leq \quad &\begin{cases} 
[q^E(\bar{a}^{ij})u'(y_{ij}^{\bar{s}})][(K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij})] - (1 - q^E(\bar{a}^{ij}))u'(y_{ns}^{\bar{j}})\rho K(\bar{a}^{ij})] [U^{ij} - v^i]^{-\frac{1}{2}} (1 - \beta(\bar{a}^{ij})) \quad (37) \\
-q^E(\bar{a}^{ij})u'(y_{ij}^{\bar{s}})[(K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij})] - (1 - q^E(\bar{a}^{ij}))u'(y_{ns}^{\bar{j}})\rho K(\bar{a}^{ij})] [U^{ij} - v^i]^{-\frac{1}{2}} \beta(\bar{a}^{ij}) \quad (38)
\end{cases}
\end{align*}$$

and

$$\begin{align*}
[q^E(\bar{a}^{ij})u'(y_{ij}^{\bar{s}}) + (1 - q^E(\bar{a}^{ij}))u'(y_{ns}^{\bar{j}})] [U^{ij} - v^i]^{-\frac{1}{2}} \\
= \quad &\begin{cases} 
0 & \text{if } \beta(\bar{a}^{ij}) \\
1 & \text{else}
\end{cases} \\
= \quad &\begin{cases} 
[q^E(\bar{a}^{ij})u'(y_{ij}^{\bar{s}}) + (1 - q^E(\bar{a}^{ij}))u'(y_{ns}^{\bar{j}})] [U^{ij} - v^i]^{-\frac{1}{2}} \\
\end{cases}
\end{align*}$$

respectively. In the following, assume that $U^{ij} - v^i > 0$ and $U^{ij} - v^j > 0$.

(i) Suppose that $\beta(\bar{a}^{ij}) = 0$ in the optimum. Then, (39) implies

$$\frac{q^E(\bar{a}^{ij}) + (1 - q^E(\bar{a}^{ij}))u'/Y + F(\bar{a}^{ij})}{u'(Y - F(\bar{a}^{ij}) - \rho K(\bar{a}^{ij}))} \quad (40)$$

$$= \frac{U^{ij} - v^j}{[U^{ij} - v^i]^{-\frac{1}{2}}} \frac{u'(Y + F(\bar{a}^{ij}))}{u'(Y - F(\bar{a}^{ij}) + (K(\bar{a}^{ij}))^\gamma - \rho K(\bar{a}^{ij}))}.$$
The expected surplus \(q^E(a^{ij})(K(a^{ij}))^{\gamma} - \rho K(a^{ij})\) must be positive if \(K(a^{ij}) > 0\) and, hence, production will take place. Then, (40) contradicts that the LHS of (37) can be greater or equal than the RHS.

(ii) Assuming that \(\beta(a^{ij}) = 1\) yields a very similar argument as in (i) above. Hence, this case can also be excluded.

(iii) Consequently, let \(0 < \beta(a^{ij}) < 1\). Conditions (39) and (37) then imply

\[
\left[ q^E(a^{ij})(K(a^{ij}))^{\gamma} - \rho K(a^{ij})\left(1 - q^E(a^{ij})u'(y_{ns}^{j})\right) \right] \times \\
\left[ q^E(a^{ij}) + \frac{(1 - q^E(a^{ij})u'(y_{ns}^{j}))}{u'(y_{ns}^{j})} \right] \\
= \left[ q^E(a^{ij})(K(a^{ij}))^{\gamma} - \rho K(a^{ij})\left(1 - q^E(a^{ij})u'(y_{ns}^{j})\right) \right] \times \\
\left[ q^E(a^{ij}) + \frac{(1 - q^E(a^{ij})u'(y_{ns}^{j}))}{u'(y_{ns}^{j})} \right].
\]

The second terms on each side of (41) are clearly positive. Thus, suppose the two terms in the first quantities on both sides of the equation are also positive. In this case, (41) is easily verified to imply

\[
\frac{u'(y_{ns}^{j})}{u'(y_{ns}^{j})} = \frac{u'(y_{ns}^{j})}{u'(y_{ns}^{j})}.
\]

This conclusion may not hold if, and only if, both first terms on each side of (41) are negative. Yet, in this case (41) and (38) contradict. Hence, (42) must hold true in the optimum.

Either (39) or (37) then further yield

\[
\left[ U^{ji} - v^j \right]^{-\frac{1}{2}} u'(y_{ns}^{i}) = 1.
\]

However, for \(v^j = v^i\), (43) and (42) then necessarily imply \(\phi(a^{ij}) = 0\) and \(\beta(a^{ij}) = \frac{1}{2}\). Insertion into (38) finally yields the capital input rule (8) in Lemma 1.
### Tables 1

a) Cut-off team qualities in the spin-off case ($\bar{q}^*$) and in the incubator case ($\bar{Q}^*$)

<table>
<thead>
<tr>
<th>risk aversion c</th>
<th>$\bar{Q}^*$</th>
<th>$\bar{q}^*$</th>
<th>$\bar{Q}^*$</th>
<th>$\bar{q}^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho = 1%$</td>
<td>0.19</td>
<td>0.65</td>
<td>0.62</td>
<td>0.78</td>
</tr>
<tr>
<td>$\rho = 2%$</td>
<td>0.28</td>
<td>0.53</td>
<td>0.32</td>
<td>0.68</td>
</tr>
<tr>
<td>$\rho = 3%$</td>
<td>0.43</td>
<td>0.44</td>
<td>0.44</td>
<td>0.72</td>
</tr>
<tr>
<td>$\rho = 4%$</td>
<td>0.21</td>
<td>0.38</td>
<td>0.25</td>
<td>0.68</td>
</tr>
<tr>
<td>$\rho = 5%$</td>
<td>0.1</td>
<td>0.32</td>
<td>0.44</td>
<td>0.64</td>
</tr>
<tr>
<td>$\rho = 6%$</td>
<td>0.06</td>
<td>0.28</td>
<td>0.47</td>
<td>0.61</td>
</tr>
<tr>
<td>$\rho = 7%$</td>
<td>0.05</td>
<td>0.25</td>
<td>0.44</td>
<td>0.58</td>
</tr>
<tr>
<td>$\rho = 8%$</td>
<td>0.04</td>
<td>0.22</td>
<td>0.4</td>
<td>0.55</td>
</tr>
<tr>
<td>$\rho = 9%$</td>
<td>0.03</td>
<td>0.19</td>
<td>0.38</td>
<td>0.52</td>
</tr>
<tr>
<td>$\rho = 10%$</td>
<td>0.02</td>
<td>0.19</td>
<td>0.35</td>
<td>0.5</td>
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</table>

b) Percentage of Entrepreneurs in the Economy

<table>
<thead>
<tr>
<th>risk aversion c</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho = 1%$</td>
<td>In</td>
<td>86</td>
<td>42</td>
<td>23</td>
<td>Spin</td>
<td>9</td>
</tr>
<tr>
<td>$\rho = 2%$</td>
<td>cu</td>
<td>98</td>
<td>77</td>
<td>43</td>
<td>off</td>
<td>17</td>
</tr>
<tr>
<td>$\rho = 3%$</td>
<td>ba</td>
<td>99</td>
<td>96</td>
<td>62</td>
<td>25</td>
<td>11</td>
</tr>
<tr>
<td>$\rho = 4%$</td>
<td>tor</td>
<td>&gt;99</td>
<td>98</td>
<td>84</td>
<td>31</td>
<td>14</td>
</tr>
<tr>
<td>$\rho = 5%$</td>
<td>&gt;99</td>
<td>99</td>
<td>94</td>
<td>39</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>$\rho = 6%$</td>
<td>&gt;99</td>
<td>99</td>
<td>97</td>
<td>45</td>
<td>22</td>
<td>11</td>
</tr>
<tr>
<td>$\rho = 7%$</td>
<td>&gt;99</td>
<td>99</td>
<td>98</td>
<td>50</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td>$\rho = 8%$</td>
<td>&gt;99</td>
<td>99</td>
<td>99</td>
<td>55</td>
<td>29</td>
<td>15</td>
</tr>
<tr>
<td>$\rho = 9%$</td>
<td>&gt;99</td>
<td>99</td>
<td>99</td>
<td>61</td>
<td>31</td>
<td>17</td>
</tr>
<tr>
<td>$\rho = 10%$</td>
<td>&gt;99</td>
<td>99</td>
<td>99</td>
<td>61</td>
<td>35</td>
<td>19</td>
</tr>
</tbody>
</table>
### Table 2:

#### Welfare Dominance of Institutional Regimes

under Varying degrees of Risk-Aversion

<table>
<thead>
<tr>
<th>risk aversion c</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>$E(u</td>
<td>incubator)$</td>
<td>-0.28</td>
<td>-1.47</td>
<td>-1.25</td>
<td>-1.53</td>
<td>-2.12</td>
<td>-2.62</td>
<td>-3.20</td>
<td>-4.04</td>
<td>-5.19</td>
</tr>
<tr>
<td>$E(u</td>
<td>spin-off)$</td>
<td>-0.50</td>
<td>-1.73</td>
<td>-1.43</td>
<td>-1.45</td>
<td>-1.61</td>
<td>-1.91</td>
<td>-2.38</td>
<td>-3.07</td>
<td>-4.07</td>
</tr>
<tr>
<td>$CE(incubator)$</td>
<td>0.76</td>
<td>0.68</td>
<td>0.63</td>
<td>0.60</td>
<td>0.59</td>
<td>0.60</td>
<td>0.61</td>
<td>0.62</td>
<td>0.63</td>
<td>0.63</td>
</tr>
<tr>
<td>$CE(spín-off)$</td>
<td>0.61</td>
<td>0.58</td>
<td>0.59</td>
<td>0.61</td>
<td>0.63</td>
<td>0.64</td>
<td>0.64</td>
<td>0.65</td>
<td>0.65</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Definitions: $E(u|incubator)$ [$E(u|spin-off)$] and $CE(incubator)$ [$CE(spín-off)$] denote the ex-ante expected utility and the certainty equivalent income, respectively, associated with the efficient incubator [spin-off] equilibrium. $\tilde{q}|incubator$ [$\tilde{q}|spín-off$] denote the cut-off team quality associated with the efficient incubator [spin-off] equilibrium. All teams with quality higher than $\tilde{q}$ found an enterprise.

Note: The interest rate $\rho$ has been set to 4% in this simulation.
Tables 3:

Welfare effects of varying interest rates and relative risk aversion

a) Expected utilities $[E(u|incubator)$, respectively $E(u|spin-off)]$:

<table>
<thead>
<tr>
<th>risk aversion $c$</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho = 1%$</td>
<td><strong>In</strong></td>
<td>-1.137</td>
<td>-1.013</td>
<td>-0.935</td>
<td><strong>Spin</strong></td>
<td>-0.951</td>
</tr>
<tr>
<td>$\rho = 2%$</td>
<td><strong>cu</strong></td>
<td>-1.199</td>
<td>-1.409</td>
<td>-1.498</td>
<td><strong>off</strong></td>
<td>-1.195</td>
</tr>
<tr>
<td>$\rho = 3%$</td>
<td><strong>ba</strong></td>
<td>-1.229</td>
<td>-1.499</td>
<td>-1.878</td>
<td></td>
<td>-1.343</td>
</tr>
<tr>
<td>$\rho = 4%$</td>
<td><strong>tor</strong></td>
<td>-1.252</td>
<td>-1.527</td>
<td>-2.124</td>
<td></td>
<td>-1.433</td>
</tr>
<tr>
<td>$\rho = 5%$</td>
<td></td>
<td>-1.270</td>
<td>-1.546</td>
<td>-2.189</td>
<td></td>
<td>-1.504</td>
</tr>
<tr>
<td>$\rho = 6%$</td>
<td></td>
<td>-1.286</td>
<td>-1.564</td>
<td>-2.220</td>
<td></td>
<td>-1.549</td>
</tr>
<tr>
<td>$\rho = 7%$</td>
<td></td>
<td>-1.310</td>
<td>-1.593</td>
<td>-2.235</td>
<td></td>
<td>-1.580</td>
</tr>
<tr>
<td>$\rho = 8%$</td>
<td></td>
<td>-1.322</td>
<td>-1.605</td>
<td>-2.269</td>
<td></td>
<td>-1.628</td>
</tr>
<tr>
<td>$\rho = 9%$</td>
<td></td>
<td>-1.332</td>
<td>-1.617</td>
<td>-2.284</td>
<td></td>
<td>-1.636</td>
</tr>
<tr>
<td>$\rho = 10%$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

b) Certainty equivalent incomes $[CE(incubator)$, respectively $CE(spinn-off)]$:

<table>
<thead>
<tr>
<th>risk aversion $c$</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\rho = 1%$</td>
<td><strong>In</strong></td>
<td>0.663</td>
<td>0.690</td>
<td>0.719</td>
<td><strong>Spin</strong></td>
<td>0.725</td>
</tr>
<tr>
<td>$\rho = 2%$</td>
<td><strong>cu</strong></td>
<td>0.646</td>
<td>0.618</td>
<td>0.639</td>
<td><strong>off</strong></td>
<td>0.647</td>
</tr>
<tr>
<td>$\rho = 3%$</td>
<td><strong>ba</strong></td>
<td>0.638</td>
<td>0.606</td>
<td>0.604</td>
<td></td>
<td>0.610</td>
</tr>
<tr>
<td>$\rho = 4%$</td>
<td><strong>tor</strong></td>
<td>0.632</td>
<td>0.602</td>
<td>0.586</td>
<td></td>
<td>0.591</td>
</tr>
<tr>
<td>$\rho = 5%$</td>
<td></td>
<td>0.627</td>
<td>0.600</td>
<td>0.581</td>
<td></td>
<td>0.577</td>
</tr>
<tr>
<td>$\rho = 6%$</td>
<td></td>
<td>0.624</td>
<td>0.597</td>
<td>0.579</td>
<td></td>
<td>0.568</td>
</tr>
<tr>
<td>$\rho = 7%$</td>
<td></td>
<td>0.620</td>
<td>0.595</td>
<td>0.578</td>
<td></td>
<td>0.563</td>
</tr>
<tr>
<td>$\rho = 8%$</td>
<td></td>
<td>0.618</td>
<td>0.594</td>
<td>0.577</td>
<td></td>
<td>0.558</td>
</tr>
<tr>
<td>$\rho = 9%$</td>
<td></td>
<td>0.615</td>
<td>0.592</td>
<td>0.576</td>
<td></td>
<td>0.554</td>
</tr>
<tr>
<td>$\rho = 10%$</td>
<td></td>
<td>0.613</td>
<td>0.591</td>
<td>0.575</td>
<td></td>
<td>0.553</td>
</tr>
</tbody>
</table>
Figure 1:
The Payoff (Lottery) Associated with Occupational Choices

\[ Q_{1} = (K^{E})^{\gamma} - r \cdot K^{E} \]

\[ 1 - q^{E} \]

\[ r \cdot K^{E} \]

\[ w = (1 - \gamma) \cdot q^{I} \cdot (K^{I})^{\gamma} \]
Figure 2a): Capital input as a function of risk-aversion
(interest rate: 3 %)

Remarks: dark columns: capital input of the industrial firm; light columns: average capital input of entrepreneurial firms; line with diamonds: average capital input in the industry.
Figure 2b): Capital input as a function of risk-aversion
(interest rate: 5 %)

Efficient incubator equilibrium
Efficient spin-off equilibrium

Remarks: dark columns: capital input of the industrial firm; light columns: average capital input of entrepreneurial firms; line with diamonds: average capital input in the industry.
Figure 2c): Capital input as a function of risk-aversion
(interest rate: 10 %)

Efficient incubator equilibrium
Efficient spin-off equilibrium

Remarks: dark columns: capital input of the industrial firm; light columns: average capital input of entrepreneurial firms; line with diamonds: average capital input in the industry.