Dynastic entrepreneurship, entry, and non-compete enforcement*

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Abstract

We investigate entry in a dynastic entrepreneurship (overlapping generations) environment created by employee spinoffs. Contracting failures, caused by non-verifiability of profits from new activities in original firms and overall profits from subsequent entrants, may lead respectively to implementation of new employee ideas in spinoffs and constraints on borrowing to buy out non-compete agreements. If borrowing constraints are not binding, enforcement of non-compete agreements unambiguously improves social welfare outcomes, increasing the entry of both original firms and subsequent generations of spinoffs. However, if employees are unable to buy out their non-compete covenants, enforcement of these agreements shuts down socially profitable spinoff firms. Non-enforcement sacrifices entry of original firms that would be marginally profitable in the absence of employee spinoffs, but otherwise clearly improves social welfare outcomes over enforcement in the presence of binding finance constraints.

Keywords: entrepreneurship, entry, finance constraints, non-competes, overlapping generations, spinoffs

JEL Classification: K12, L26

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1 Introduction

Employee spinoffs are widely recognized to be a major mode of entrepreneurship in high-tech manufacturing (Klepper and Sleeper 2005, Franco and Filson 2006). Recognition of their importance in the rest of the economy has been growing (Phillips 2002, Eriksson and Kuhn 2006, Hvide 2009, Muendler, Rauch, and Tocoian 2012). Muendler et al. were the first to tabulate employee spinoffs for an entire economy: depending on definition, employee spinoffs account for between one-sixth and one-third of all new formal private sector firms in Brazil during the period 1995-2001. They found that, regardless of definition, employee spinoffs perform better on average than new firms without (identifiable) parents: their sizes at entry are larger and their survival rates are higher.

Employee spinoffs often go into direct competition with their parent firms. This is natural since they build on knowledge of technology, clients/markets, and suppliers acquired during employment at their parents (Klepper and Sleeper 2005, Franco and Filson 2006, Muendler and Rauch 2014). Parents therefore have an incentive to prevent spinoffs through enforcement of restrictive employment clauses such as non-compete covenants (hereafter simply called non-competes). Outside the high-tech sector the knowledge acquired by spinoffs is unlikely to be protected by patents,[1] and Stone (2002) finds that trade secret protection is sufficiently difficult and uncertain that non-compete enforcement is more likely to substitute for trade secret protection than the other way around.[2] In developing countries where large extended families are common, employers may try to restrict spinoff opportunities to family members to at least keep the employee spinoff profits in the family (Shieh 1992), but even there a tradeoff exists because family members may be less able than professional managers (Bertrand and Schoar 2006).

A tentative consensus has formed in the literature in favor of not enforcing non-competes (Acs, Glaeser, Litan, Fleming, Goetz, Kerr, Klepper, Rosenthal, Sorenson, and Strange 2008). Yet

[1] Table 5 in Hirakawa, Muendler, and Rauch (2010) shows that for their preferred spinoff definition, covering new firms with five or more employees, employee spinoffs were indeed more prevalent in high-tech manufacturing, but that this sector constituted a small share of new firm formation so that the number of spinoffs was dominated by the rest of the economy.

[2] She writes (p. 747), "The historical link between non-compete covenants and trade secrets is somewhat paradoxical because disclosure of trade secrets and confidential information can be restrained in the absence of a covenant. However, it has been argued that, for procedural reasons, it is difficult to obtain enforcement of a trade secret, so that a restrictive covenant provides employers with important additional protection. At the same time, some scholars have posited that courts are more likely to enjoin misappropriation of a trade secret or confidential information in the face of a covenant not to compete because the existence of a covenant permits the court to avoid the difficult legal issue of determining what constitutes a trade secret."

this consensus is based on narrow empirical evidence, mainly for high-tech industry, where circulation/spillover of ideas through employee mobility is especially important (Fallick, Fleishman, and Rebitzer 2006, Gilson 1999, Marx, Strumsky, and Fleming 2009). A broadly-based counter-argument is that enforcement of non-competes gives employers greater incentives to invest in their employees. It can be objected, however, that non-enforcement gives employees greater incentives to innovate, or more generally make investments of their own (Motta and Roende 2002, Baccara and Razin 2009, Kräkel and Sliwka 2009). Garmaise (2011) finds that executive compensation is negatively related to strength of non-compete enforcement, which he interprets as evidence that increased incentives for employees to invest in their general human capital empirically dominate reduced incentives by employers to invest in their employees' firm-specific human capital. We will see that the model developed in this paper is consistent with his results and interpretation.

This main purpose of this paper, however, is to evaluate a very different counter-argument: insofar as employee spinoffs hurt their parents, failure to enforce non-competes may reduce entry by parent firms. This in turn may reduce the very spinoff entrepreneurship that the non-enforcement policy was supposed to encourage. I will investigate entry in a dynastic entrepreneurship (overlapping-generations) world. I find that, if employees can buy out their non-compete contracts, enforcement of non-compete agreements unambiguously increases entry of both original (parent) firms and all subsequent spinoffs. However, if employees are finance-constrained and hence unable to buy out their non-compete contracts, enforcement of these agreements prevents startup of socially profitable spinoff firms. Non-enforcement sacrifices entry of original firms that would be marginally profitable in the absence of employee spinoffs, but otherwise clearly improves social welfare outcomes over enforcement in the presence of employee finance constraints by facilitating entry of socially profitable spinoff firms.

The market frictions that drive my model are the results of non-verifiability of profits: non-verifiability of profits from a new activity initiated by an employee in an original firm, and non-verifiability of overall profits for subsequent entrants. Non-verifiability of profits from the employee's new activity leads to inability to infer and contract on his effort, generating suboptimal effort and profits that can cause the employee to implement his idea in a new firm instead. This motive for employee spinoffs is in the spirit of Acs et al. (2009), who write (p. 17), "Our results show that entrepreneurial activity is strongly influenced by knowledge created but not exploited by incumbent firms." Non-verifiability of firm-level profits for subsequent entrants leads to inability

to borrow to buy out non-compete contracts.

Franco and Mitchell (2008) also investigate theoretically the impact of non-compete enforcement on entry of both parent and spinoff firms. My model differs from theirs in several important respects. First, as already mentioned I recognize that spinoff entrepreneurship implies a dynastic environment: like any other firm, a spinoff can have a spinoff. The "family tree" spawned by Fairchild Semiconductor is a famous example.[3] Second, spinoffs in my model are caused by non-verifiability of employee effort, rather than by asymmetric information regarding employee ability to learn parent firm technology. Third, instead of differing by this privately known ability, agents in my model differ by their commonly known profitability of entry (driven by differences in their startup costs). Fourth, I analyze the case in which finance constraints on employee-entrepreneurs prevent them from buying out their contracts with their employers, without which enforcement of non-competes does not pose a barrier to (socially beneficial) spinoffs (Rauch and Watson 2015). Thus in Franco and Mitchell (2008) enforcement achieves the social optimum even with the contracting friction caused by asymmetric information. Interestingly, it is my results with finance constraints that are consistent with Franco and Mitchell: enforcement leads to more entry of original firms and eliminates spinoffs. Without finance constraints, however, enforcement does better than non-enforcement in all respects, unlike in Franco and Mitchell: there is more entry of both original firms and spinoffs.[4]

Without finance constraints, the importance of a dynastic (overlapping generations) rather than two-period analysis in my framework becomes especially clear. Enforcement of non-competes is predicted to increase the rate of spinoffs from original entrants relative to non-enforcement, whereas in a two-period setting enforcement would have no effect on this rate. This positive prediction has corresponding normative consequences: enforcement improves social welfare relative to non-enforcement because of both increased original firm entry and increased rate of spinoffs, rather than only because of the former as would be the case in a two-period analysis. The dynastic model also brings out an interesting contrast with the patent literature, specifically Bessen and Maskin (2009). In their "sequential" model, original innovation, subsequent imitation, and patent

[3] Systematic investigation of spinoffs of spinoffs is hampered by the fact that the time dimension of a typical firm-level panel data set is short relative to the length of a typical spinoff "generation." Klepper and Sleeper (2005) find that the highest rate of spinoffs in the laser industry is from firms aged 11 to 15. The average age of parents at birth of (first) spinoff in the Brazilian data set used by Muendler, Rauch, and Tocoian (2012) is 15 years, and the median age is nine years.

[4] It follows that whether enforcement increases or reduces spinoffs indirectly reveals the salience of finance constraints. I discuss this further in my Conclusions.

protection play roles similar to original entry, spinoff entry, and non-compete enforcement in my model. Eliminating patent protection can make both the original innovator and subsequent imitator better off in their model, whereas elimination of non-compete enforcement always hurts the original firm in my model. In my model the gap between the non-enforcement outcome and the social optimum widens in the dynastic analysis relative to a two-period analysis, whereas it narrows in their model for the sequential relative to the static case.

I lay out the basics of my model in the next section of this paper. In section 3 I consider equilibria and the social welfare outcomes they generate when enforcement of non-compete agreements is impossible. In section 4 I consider equilibria and social welfare when non-competes can be enforced, maintaining the assumption of no finance constraints. Finally, I add employee finance constraints to the environment with non-compete enforcement in section 5. The results for sections 3, 4, and 5 are presented in parallel. Propositions 2.1, 3.1, and 4.1 specify the equilibria that prevail following entry of the original firm under the assumptions of lack of non-compete enforcement, non-compete enforcement without finance constraints, and non-compete enforcement with binding finance constraints, respectively. Propositions 2.2 - 4.2 work backward from Propositions 2.1 - 4.1 to determine the conditions under which the original firm enters. Propositions 2.3 - 4.3 build on Propositions 2.1 - 4.1 and 2.2 - 4.2 to find the conditions under which the constrained social optimum is and is not achieved. I discuss empirical evidence and policy implications in the concluding section.

2 The model

2.1 Profits, effort, and non-verifiability

We assume that profit $\tilde{\pi}$ from an activity is an increasing and concave function of effort e by the leader of that activity, where $\lim_{e\to\infty} \tilde{\pi}'(e) = 0$ and $\lim_{e\to 0} \tilde{\pi}'(e) = \infty$. We measure effort in monetary units so that profit net of leader effort is given by $\tilde{\pi}(e) - e$. Let e^* be the level of effort that maximizes this expression and therefore satisfies the first-order condition $\tilde{\pi}'(e^*) = 1$. Our assumptions on the profit function ensure the existence of this solution. We then define $\pi \equiv \tilde{\pi}(e^*) - e^*$ as the maximized net profit.

Now consider a firm with a core activity led by the firm's entrepreneur. One of the firm's employees has an idea for an additional activity that can be implemented either inside the firm or

as a new firm. If implemented as a new firm, we designate the new firm as an employee spinoff S and the incumbent firm as its parent P. The incumbent entrepreneur then earns net profit $\pi_P \equiv \tilde{\pi}_P(e_P^*) - e_P^*$ and the employee entrepreneur earns net profit $\pi_S \equiv \tilde{\pi}_S(e_S^*) - e_S^*$, not inclusive of any entry costs.

We assume that if the new activity is implemented inside the incumbent firm it is still led by the employee. We also assume that the effort supplied by the employee cannot be verified outside the firm. It cannot be observed directly, and cannot be inferred from profits because, even if it were possible to verify the incumbent firm's total profits, the profits from the core and new activities are mixed together and cannot be separately identified. Since the employee's effort is not verifiable, it is non-contractible. The best the employee and incumbent entrepreneur can do is work without a contract and, following the employee's effort decision, rely on their bargaining powers to obtain shares of the profit from the new activity.[5] The employee and the incumbent entrepreneur have weights λ and $1 - \lambda$, respectively, in the generalized Nash bargaining solution.

Let us assume that the profit function for the new activity is the same whether it is implemented inside or outside the incumbent firm. The employee makes his effort decision anticipating that the employer will transfer $\lambda\tilde{\pi}_S(e)$ to him, so he chooses effort to maximize $\lambda\tilde{\pi}_S(e) - e$. Let e_{ST}^* be the level of effort that maximizes this expression, where T indicates the employee is staying together with the incumbent firm, and define $\pi_{ST} \equiv \tilde{\pi}_S(e_{ST}^*) - e_{ST}^*$. It is straightforward to show that $e_{ST}^* < e_S^*$ and $\pi_{ST} < \pi_S$. The contracting failure caused by non-verifiability of profits and hence employee effort causes the employee to exert suboptimal effort when he implements his idea inside the incumbent firm. The consequent reduction in profits can motivate an employee spinoff even in a purely static environment.

When there is no employee spinoff, we denote the maximized net profit from the core activity of the incumbent firm by $\pi_{PT} \equiv \tilde{\pi}_{PT}(e_{PT}^*) - e_{PT}^*$. We assume that, as a result of competition from the spinoff, $\pi_{PT} > \pi_P$.[6] If this were not true, the employer would have no incentive to enforce a non-compete contract when a spinoff occurs. The existence of competition calls into question our assumption that the profit function for the new activity is the same whether it is implemented

[5] We implicitly assume that if the employee and employer cannot reach an agreement the new activity yields zero profits. For example, the employee may be critical to marketing the output of the new activity as well as producing it, and refuse to market it if an agreement is not reached after he expends his effort on production. If the employer is able to extract some profit from the new activity anyway (by finding another employee to market the output, say), this only reduces the employee's incentive to exert effort and strengthens the motivation for an employee spinoff.

[6] Note that the incumbent entrepreneur exerts optimal effort whether or not there is a spinoff.

inside or outside the incumbent firm. We could relax this assumption, in which case the difference between π_S and π_{ST} would not be entirely determined by the difference in effort between the employee-entrepreneur and the employee. There are reasons to believe this difference could be larger or smaller.[7] The difference between π_S and π_{ST} only has to be large enough to satisfy the sufficient condition $\pi_{PT} - \pi_P < \pi_S - \pi_{ST}$ in the next subsection, which allows spinoffs to incur positive startup costs and still have the potential to contribute to social welfare.

2.2 Dynastic entry and constrained social optimum

We consider parent and spinoff entry in a stationary, overlapping generations environment. At the beginning of time (period 0), a firm enters that we will call the original firm. In period 1, an employee spinoff from the original firm may enter. In period 2, the original firm exits, and a second generation spinoff firm may enter. The model continues in this way indefinitely, with each entrant surviving for two periods and generating a potential spinoff in its second period of operation. It follows that, starting in period 1, any entrant is a spinoff, and any incumbent firm is a potential parent. Also starting in period 1, if entry fails to occur in a period the line of firms dies out at the end of that period.[8]

An entering firm sinks costs at the beginning of a period. These are K_0 for the original firm and K_S for all subsequent entrants (spinoffs). After entering, the entrepreneur exerts effort, hires labor, produces, and earns profits during the period. Maximized net profits inclusive of entry costs are $\pi_0 - K_0$ for the original firm and $\pi_S - K_S$ for all subsequent entrants. At the end of the period one of the firm's employees, selected at random, gets an idea for a new activity that builds on his experience during the period. At the beginning of the next period, this employee informs his employer that he may resign and start a new firm, at which point employer and employee try to reach an agreement. They bargain under complete information regarding profits and sunk costs. If they agree, any compensating transfers are made immediately. The subject of the bargaining and especially the threat points in the event of disagreement will be influenced by the legal environment and will be specified in subsequent sections of this paper. Independent of the legal environment, if the employee and employer stay together in an incumbent firm they exert

[7] When implemented inside the incumbent firm the new activity may be restricted so as not to cannibalize the firm's existing customers. On the other hand, it is possible some synergy with the core activity will be lost when the new activity is implemented in a spinoff.

[8] Dunne, Roberts, and Samuelson (1988) find (Table 11) that the exit rate for new U.S. manufacturing firms after only five years ranges between 57 and 64 percent, depending on entry cohort.

effort, hire labor, produce, and earn profits during the period, dividing the profits resulting from the employee's effort as described in the previous subsection. The incumbent firm then exits at the end of the period. We let $\pi_T \equiv \pi_{PT} + \pi_{ST}$ denote the profits of an incumbent firm net of employer and employee effort when the employer (firm) and employee stay together.

The labor market is frictionless in the sense that, if the employer and employee separate, the employer can costlessly replace him, and the employee can also costlessly find new employment if he does not found a spinoff firm. However, the replacement employee does not have the experience needed to implement the former employee's idea, and instead receives the market wage received by all other employees of the incumbent firm. If the former employee tries to implement his idea at his new employer, his effort is still non-verifiable, and he also has to sink some cost to make the new firm suitable for his idea's implementation. Given these circumstances, we assume that the payoff to the former employee of trying to implement his idea at a new employer is less than the market wage, which he chooses to receive instead.[9] In sum, every employee earns the market wage during the first period of his employment at a firm, and for simplicity we normalize this market wage to zero.[10]

We assume that the sunk costs K_0 and K_S are, like effort e, measured in monetary units but paid in "sweat equity" rather than cash.[11] Subsequent to sinking these costs entering firms earn profits

[9]This rules out benefits to existing firms from circulation of ideas through employee mobility, emphasized by Fosfuri and Roende (2004) and many others. It is striking that a very well known group of existing high-tech firms (including Adobe, Apple, and Google; see Streitfeld 2014) appears to have found it valuable to restrict employee mobility despite these potential benefits. A model with the goal of addressing non-compete enforcement policy as it applies to employee mobility rather than firm entry is more appropriately focused at the industry level than the firm level we use here.

[10]We follow Franco and Mitchell (2008, p. 592) by not allowing firms to pay less than the market wage, thereby ruling out the possibility, explored in Franco and Filson (2006), that parent firms could capture the entire values of employee spinoffs through payment of below-market wages to their employees. Even setting aside the possibility of employee finance constraints (which we take up in section 5 below), such an equilibrium may not obtain in the real world. For example, employees can differ in their propensities to found spinoff firms. If, as seems reasonable, these propensities are private information, there may not exist a separating equilibrium in which employees with high propensities accept lower wages than employees with low propensities, particularly if the former are in the minority. Employees with high propensities will have incentives to report low propensities, and the cost to an employer of distorting the contract for the majority of workers so as to make its refusal incentive compatible for a minority may be too high for him to offer a separate contract directed at the latter, a phenomenon known as "non-responsiveness" in the literature (see, e.g., Laffont and Martimort 2001, section 2.11.2).

[11]Djankov, La Porta, Lopez de Silanes, and Shleifer (2002) find that the monetary cost of satisfying government regulatory requirements to establish a new business in the United States is less than one-half of one percent of per capita GDP. Empirically, we expect $K_S < K_0$, but we do not impose this restriction. A spinoff entrepreneur should have the advantage of having already learned on the job, and thus needs to invest less time in developing his business idea, should make fewer mistakes in setting up his business, etc. In each of Figures 1.2, 2.2, and 3 below, we place K_0 on the horizontal axis and K_S on the vertical axis, and the reader can imagine a 45° line below which lies the more empirically relevant parameter space.

$\tilde{\pi}_0(e_0^*)$ or $\tilde{\pi}_S(e_S^*)$ in their first periods of operation, giving them a source of retained earnings out of which they can finance transfers to employees in their second periods of operation.[12] Employees, however, have no source of cash to finance transfers to employers. We will see that, when non-competes are enforced, equilibria in which spinoff firms enter require transfers from employees to employers. As discussed in the Introduction, the ability to borrow, and hence for lenders to be able to verify firm-level profits, now becomes an issue. In section 4 below we avoid this financing issue, implicitly assuming that employees have an unmodeled source of inherited wealth adequate to finance transfers, or that borrowing is frictionless. We then explore the implications of the financing problem in section 5.

To facilitate welfare analysis in our dynastic setting, we will not model labor or product markets explicitly. We therefore measure the contributions of firms to social welfare solely by their net profits. This is also the criterion for optimality used by Franco and Mitchell (2008) and greatly simplifies the analysis of policy below.

We conclude this subsection by deriving the maximum contribution to social welfare that can be generated by the entry of an original firm. This will serve as a benchmark for all of our subsequent analysis. Note that this social optimum will be constrained by the non-verifiability of employee effort in an incumbent firm, leading to a suboptimal amount of that effort as we saw in the previous subsection. Thus when we refer to the social optimum hereafter we mean the maximum social welfare that can be achieved given this constraint.

Our notation for profits and costs lacks time subscripts, reflecting the stationary environment of our model. This stationary environment facilitates a simple computation of the maximum contribution to social welfare (maximum discounted sum of net profits less entry costs) resulting from entry of an original firm, where we let δ denote the discount rate:

Proposition 1. *The maximum contribution to social welfare generated by entry of an original firm is given by* $\pi_0+\delta(\pi_P+\pi_S-K_S)/(1-\delta)-K_0$ *if* $K_S < \pi_P+\pi_S-(1-\delta)\pi_T$ *and by* $\pi_0+\delta\pi_T-K_0$ *otherwise.*

Proof. Entry of an original firm necessarily yields π_0-K_0 in period 0. In period 1, if the employer and employee stay together net profits equal π_T in that period and zero in every subsequent period. Spinoff entry in period 1 yields $\pi_P+\pi_S-K_S$ and an identical choice between entry and no

[12] It is easily shown that $\tilde{\pi}_S(e_S^*)$ is greater than the transfer made from employer to employee in any of the equilibria studied in the following sections. We can assume $\tilde{\pi}_0(e_0^*) \geq \tilde{\pi}_S(e_S^*)$ to ensure that there is an adequate source of retained earnings for the original firm as well.

entry in period 2. Thus if spinoff entry is best for society in period 1 it must also be best for society in period 2, and in every subsequent period as well. The maximum contribution to social welfare generated by entry of an original firm is therefore given by either $\pi_0 + \delta\pi_T - K_0$ or $\pi_0 + \sum_{t=1}^{\infty} \delta^t(\pi_P + \pi_S - K_S) - K_0 = \pi_0 + \delta(\pi_P + \pi_S - K_S)/(1-\delta) - K_0$. Finally, the inequality $\pi_0 + \delta(\pi_P + \pi_S - K_S)/(1-\delta) - K_0 > \pi_0 + \delta\pi_T - K_0$ reduces to $K_S < \pi_P + \pi_S - (1-\delta)\pi_T$. □

Let us examine the key inequality in Proposition 1 more closely. Substitute for the definition of π_T to obtain $K_S < \pi_P + \pi_S - (1-\delta)(\pi_{PT} + \pi_{ST})$. We see that this inequality can hold for $K_S > 0$ only if $(1-\delta)(\pi_{PT} + \pi_{ST}) < \pi_P + \pi_S$. Considering the limiting case as δ approaches zero and rearranging, we have $\pi_{PT} - \pi_P < \pi_S - \pi_{ST}$. This condition is sufficient to ensure that it is possible for employee spinoffs to make a positive contribution to social welfare. It states that, within a period, the increase in net profits from the core activity of the incumbent (parent) firm that would result from elimination of competition from the spinoff is less than the increase in net profits from the new activity resulting from the greater incentive to exert effort provided by establishment of the spinoff.[13] Clearly the greater is δ (the less society discounts the future), the greater K_S can be and still allow spinoffs to make a positive contribution. This reflects the fact that, although spinoff entrepreneurship emerges in response to a static inefficiency, it also yields "dynastic vitality," giving birth to new firms that offset the deaths of existing firms. Our model is consistent with the key role in promoting economic growth that Acs et al. (2009) assign to entrepreneurship emerging from incumbent firms.

3 Equilibria and social welfare without non-compete enforcement

In this section we consider equilibria and the social welfare outcomes they generate when enforcement of non-compete agreements is impossible. The timing of the model without non-compete enforcement is shown in Figure 1.1.[14] At the beginning of period 1 the employer and the employee with the idea for a new activity negotiate over whether or not they will stay together. In an abuse of notation, in Figure 1.1 the employer is denoted by P (for parent) and the employee is

[13] If we were to include in social welfare any benefit from increased competition, this would only make it more likely that the sufficient condition is satisfied.

[14] This figure follows the conventions for extensive-form representation used in Watson (2013).

denoted by S (for spinoff), even though these labels only apply if the employee founds a spinoff firm. If the employer and employee agree to stay together there will be a transfer τ_1 between them. Next they bargain over the division of the profit from the new activity, as described in subsection 2.1. This leads to a transfer $\tau_2 = \lambda\tilde{\pi}_S(e^*_{ST})$ from the employer to the employee of the latter's share of the profits from the new activity. (The parties could also fail to reach an agreement to divide the profits, but since this outcome is strictly dominated we omit it from the figure for simplicity.)

Returning to consideration of the bargaining problem at the beginning of the period, either party can unilaterally compel separation (disagreement). If they separate (fail to agree), then the employee has a choice as to whether to found a spinoff firm or take a job with another firm. We denote the continuation value of the employee who founds a spinoff by v_P, even though the employee does not become a parent in the next period in every equilibrium of the game. The timing of period 1 repeats itself indefinitely in future periods; only the identities of the employer and employee change, with the employee in each period taking over the role of employer in the next period.

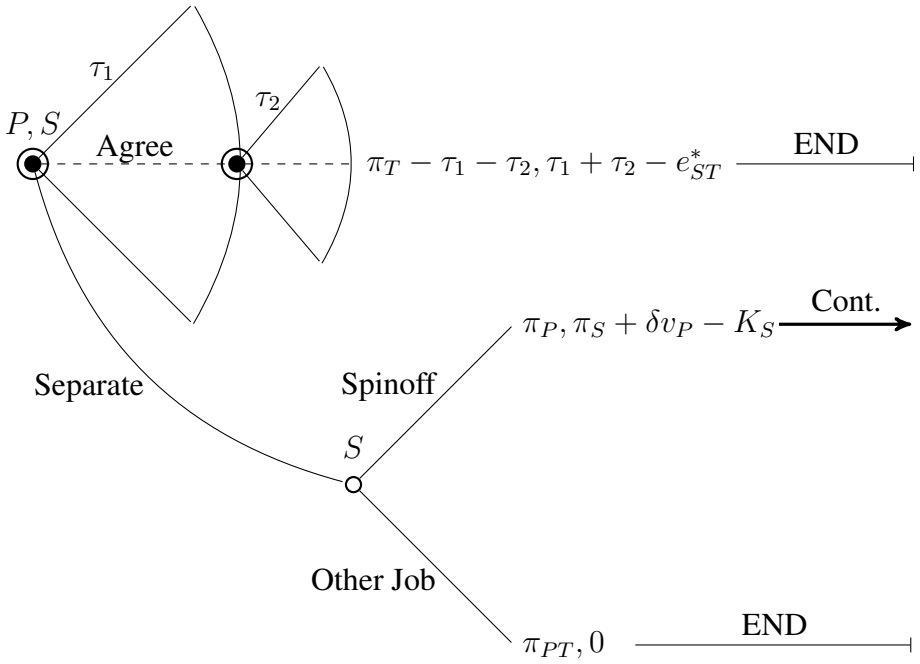

Figure 1.1: One period of the extensive form without non-compete enforcement

We will search for Markov perfect equilibria of the game described by our model. The Markov assumption is a weak one in our setting because, although the game has a history in every period following period zero, in no period do the agents have a history of play with each other. Moreover,

in no period does the employer have a history of play with other employees, nor does the employee have a history of play with other employers.

We will show that, in an environment without enforcement of non-compete contracts, there exist two Markov perfect equilibria. In the *spinoff equilibrium*, the two parties always separate and the employee always founds a spinoff firm. In the *no-spinoff equilibrium*, the two parties always agree to stay together.

We first establish the threat points of the parties in the spinoff equilibrium. If the employee founds a spinoff firm when the two parties separate, his continuation value v_P in the next period is the profit of a parent firm, because one of his employees will have founded a spinoff. If the employee takes another job, his continuation value is zero. After separation, therefore, the employee compares $\pi_S + \delta\pi_P - K_S$ to zero. The threat point of the employee is then $\pi_S + \delta\pi_P - K_S, K_S < \pi_S + \delta\pi_P$, and zero otherwise. It follows that the threat point of the employer is $\pi_P, K_S < \pi_S + \delta\pi_P$, and π_{PT} otherwise.

Computation of the threat points of the parties in the no-spinoff equilibrium is more involved. If the employee founds a spinoff firm when the parties separate, the threat point of the employer is π_P as before. The continuation value for the employee v_P is now the payoff to an incumbent firm that has agreed to stay together with its own employee. Since there is no spinoff in this equilibrium, we denote this continuation value by v_{NS}. We have $v_{NS} = \pi_P + (1-\lambda)(\pi_T - \pi_P - \pi_S - \delta v_{NS} + K_S)$. We can solve this equation to obtain $v_{NS} = [\lambda\pi_P + (1-\lambda)(\pi_T - \pi_S + K_S)]/[1 + (1-\lambda)\delta]$. The threat point of the employee if he founds a spinoff firm when the parties separate is then $\pi_S + \delta v_{NS} - K_S$. On the other hand, the threat point of the employee when he takes another job is zero, and the threat point of the employer in this case is π_{PT}.

Using this information, we are able to prove the following in the Appendix:

Proposition 2.1. *Consider an environment without enforcement of non-compete contracts. Assume entry of the original firm in period 0. Given $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P$, a unique Markov perfect equilibrium exists in which there is spinoff entry in period 1 and every subsequent period. Given $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta\pi_P$, a unique Markov perfect equilibrium exists in which the employer and employee agree to stay together in period 1 (and would agree to stay together in every subsequent period if the game continued).*

Proposition 2.1 shows that the spinoff and no-spinoff equilibria obtain for a mutually exclusive and exhaustive partition of the possible values of K_S. As one would expect, low values of spinoff

startup costs lead to the spinoff equilibrium and high values lead to the no-spinoff equilibrium.

Using Proposition 2.1, we can work backwards to the entry decision of the original firm. When the spinoff equilibrium obtains, the original firm anticipates earning $\pi_0 + \delta\pi_P - K_0$. When the no-spinoff equilibrium obtains, the original firm anticipates earning $\pi_0 + \delta v_{NS} - K_0$, where $v_{NS} = [\lambda\pi_P + (1-\lambda)(\pi_T - \pi_S + K_S)]/[1 + (1-\lambda)\delta]$ if $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$ and $\pi_T - \lambda\pi_{ST}$ otherwise.[15] We thus have

Proposition 2.2. *When the spinoff equilibrium obtains, the original firm enters if and only if* $\pi_0 + \delta\pi_P > K_0$. *When the no-spinoff equilibrium obtains, the original firm enters if and only if* $\pi_0 + \delta[\lambda\pi_P + (1-\lambda)(\pi_T - \pi_S + K_S)]/[1 + (1-\lambda)\delta] > K_0$, *when* $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$, *or* $\pi_0 + \delta(\pi_T - \lambda\pi_{ST}) > K_0$, *when* $K_S \geq \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$.

Figure 1.2 shows the regions of K_0, K_S space in which the spinoff equilibrium, no-spinoff equilibrium, or neither obtains. The figure is drawn under the assumption that $(\pi_P - \pi_T) + \pi_S + \delta\pi_P > 0$, which holds under our sufficient condition $\pi_{PT} - \pi_P < \pi_S - \pi_{ST}$ for spinoffs to be able to make a positive contribution to social welfare. We do not consider values of K_0 for which it is infeasible for entry of the original firm to generate benefits for society. This boundary in the figure is drawn using Proposition 1.

Clearly the social optimum is not achieved when the original firm does not enter even though it is feasible for its entry to generate benefits for society. When the original firm does enter, the spinoff equilibrium yields the discounted sum of profits $\pi_0 + \delta(\pi_P + \pi_S - K_S)/(1-\delta) - K_0$ and the no-spinoff equilibrium yields the discounted sum of profits $\pi_0 + \delta\pi_T - K_0$. Proposition 2.3 then follows from a comparison of Propositions 2.1 and 2.2 with Proposition 1:

Proposition 2.3. *When the spinoff equilibrium obtains, the social optimum is achieved. When the no-spinoff equilibrium obtains, the social optimum is achieved when* $K_S \geq \pi_P + \pi_S - (1-\delta)\pi_T$, *but not for* $\pi_P + \pi_S - \pi_T + \delta\pi_P \leq K_S < \pi_P + \pi_S - (1-\delta)\pi_T$, *when the social optimum would be achieved if there were spinoff entry. When the original firm does not enter and* $K_0 < \pi_0 + \delta\pi_T$ *for* $K_S > \pi_P + \pi_S - (1-\delta)\pi_T$ *or* $K_0 < \pi_0 + \delta(\pi_P + \pi_S - K_S)/(1-\delta)$ *for* $K_S \leq \pi_P + \pi_S - (1-\delta)\pi_T$, *the social optimum is not achieved.*

[15] As shown in the proof of Proposition 2.1, in the no-spinoff equilibrium the best action for the employee in the event of separation is to found a spinoff if $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$ and to take another job otherwise. If he takes another job his threat point is zero and the surplus from agreement is π_{ST}.

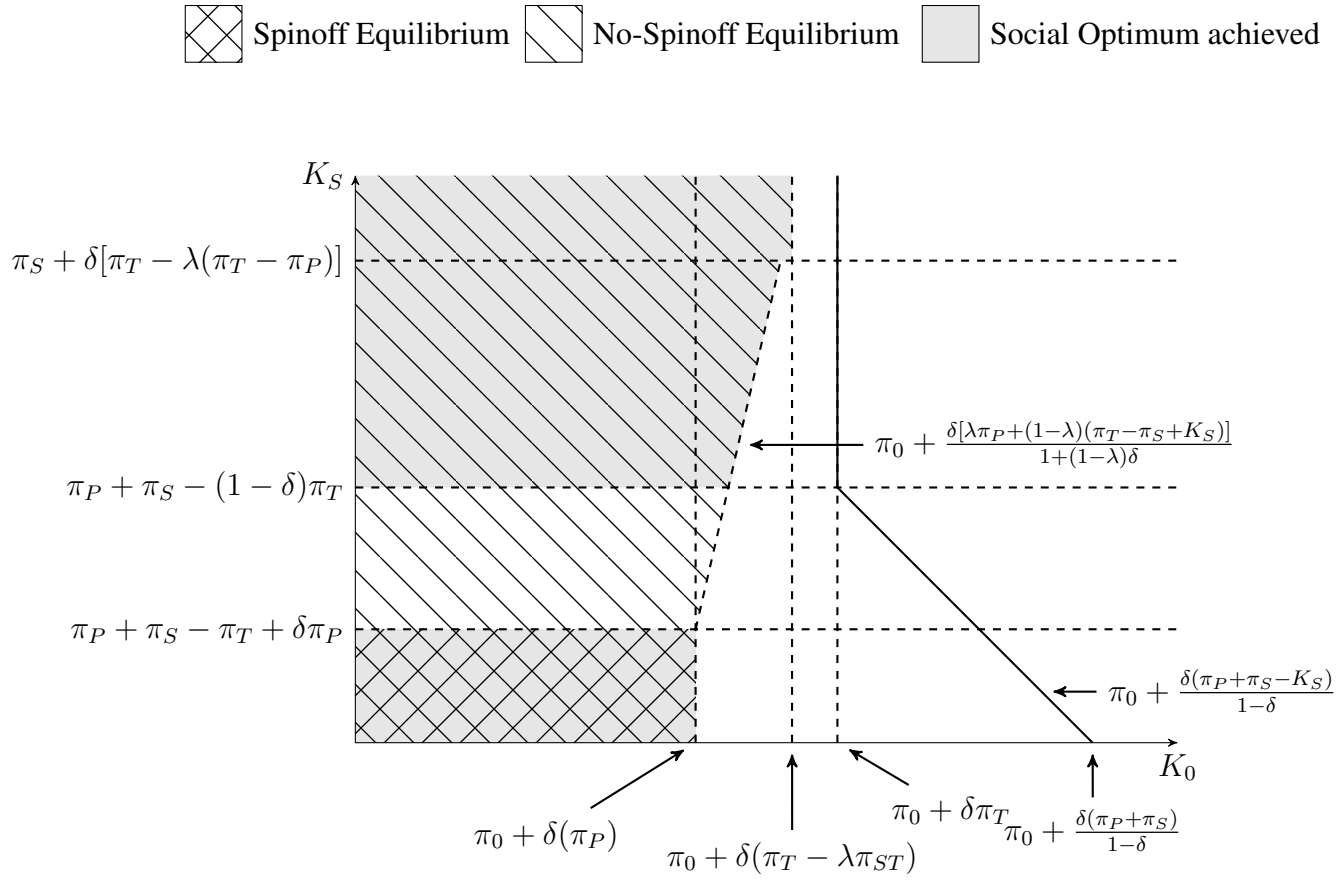

Figure 1.2: Equilibria and social optimum without enforcement of non-compete contracts

Propositions 2.2 and 2.3 are illustrated in Figure 1.2. We see from Figure 1.2 that an original firm fails to enter when it would be socially profitable for it to do so when its profits in the absence of spinoffs would be low or negative. This occurs because the lack of non-compete enforcement leaves the original firm with no means of extracting profits from the spinoff firms that would not exist without its entry.[16] Ironically, the same problem arises for spinoffs themselves when their profitability is low, because they are unable when they become parents to extract profits from subsequent spinoffs. These problems of entry become less important the more heavily society discounts the future, so as δ decreases the ranges of K_0 and K_S for which entry is inadequate also decrease. This will remain true in the following two sections of the paper.

We conclude this section by noting that there is legitimate cause for concern that the threat of spinoff entry deters parent (original) firm entry when the latter is socially profitable. In a world

[16]The firm could ask each of its workers to post a bond that would be forfeit if he founds a spinoff. However, it is hard to see why a court would enforce payment of this bond if it does not enforce non-compete agreements.

without employee spinoffs, it is clear that the original firm should enter when $\pi_0 + \delta\pi_T - K_0 > 0$, yet it may not because entry or negotiation is the best response of its employee with an idea for a new activity, which decreases the original firm's expected profits. The inefficiency resulting from non-enforcement of non-compete contracts is reflected in the fact that the original firm is *more* likely to enter when K_S is high so that benefits to society from entry are lower. This occurs because a higher K_S reduces the probability of a spinoff or weakens the bargaining power of the employee when the employer and employee stay together.

4 Equilibria and social welfare with non-compete enforcement (and no binding finance constraints)

We now add to our model the possibility that an incumbent firm will block entry of a spinoff firm by petitioning a court to enforce a non-compete agreement that the potential spinoff entrepreneur has signed. (We assume that firms are able to compel employees to sign such agreements as a condition of being hired.) We therefore amend our specification of the nature and timing of employer and employee actions. The employer and employee now negotiate over whether or not they will stay together and, if not, whether they will renegotiate the employee's contract to release him from the non-compete agreement. If they reach an agreement there will be an immediate transfer between them. If they fail to agree, then as before they separate and the employee has a choice as to whether to found a spinoff firm or take a job with another firm. If the employee goes ahead with his plan to found a spinoff firm and sinks K_S, the employer files suit to block operation of his business.[17] The payoff to the employee is then $-K_S$.

The timing of the model with non-compete enforcement is shown in Figure 2.1, which uses the same notation and conventions as Figure 1.1. It is clear from the bottom of the figure that, when the employer (P) and the employee (S) separate, the employee will choose to take a job with another firm rather than found a spinoff. The separation branch therefore reduces to the payoffs $\pi_{PT}, 0$ for the employer and employee, respectively, which therefore become their threat points in negotiations. At the top of Figure 2.1 we see that the employer and employee can either agree to

[17] The employer may incur court costs. As long as these are less than the loss in profits $\pi_{PT} - \pi_P$ the incumbent firm would suffer as a result of the spinoff, the employer will still choose to block the entry of the spinoff firm and our results would be unchanged.

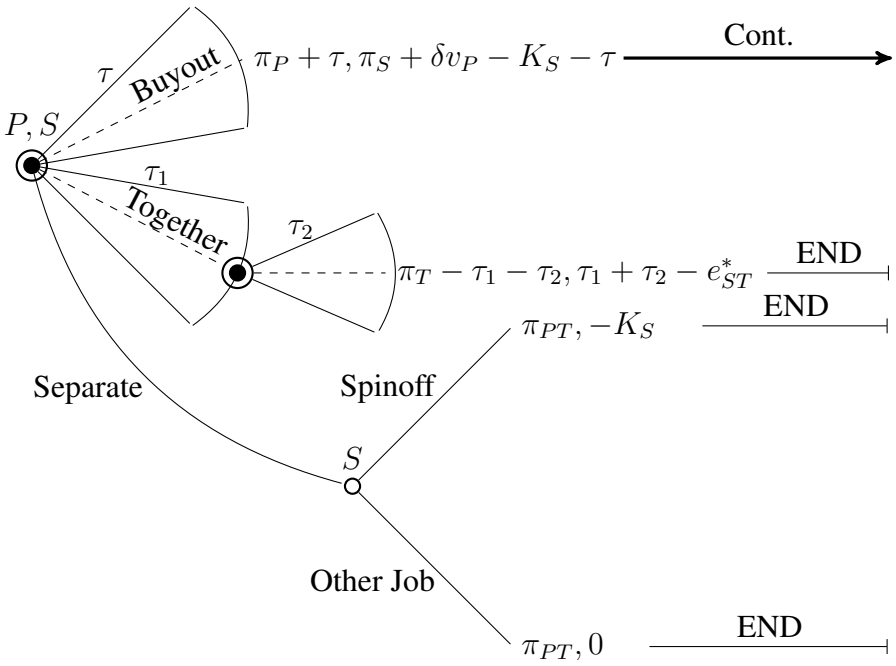

Figure 2.1: One period of the extensive form with non-compete enforcement

stay together, in which case the game proceeds as it does at the top of Figure 1.1, or agree to release the employee from his non-compete agreement, in which case the employee founds a spinoff firm and the game continues in the next period with the same timing and the employee now in the role of employer.

We can quickly see that, unlike in the previous section, there will not exist any Markov perfect equilibrium in which the two parties disagree in every period. They can always agree to stay together and divide a surplus from agreement π_{ST}, making the employer better off by $(1-\lambda)\pi_{ST}$ and the employee better off by $\lambda\pi_{ST}$ relative to the disagreement point. The candidates for Markov perfect equilibria are therefore an equilibrium in which the employer and employee agree to stay together in period 1 (and would agree to stay together in every subsequent period if the game continued), and an equilibrium in which the employer agrees to release the employee from the non-compete agreement in period 1 and every subsequent period. We will call the former equilibrium a *together equilibrium* and the latter equilibrium a *buyout equilibrium*. The reason for the latter name is that, with a threat point of zero, the employee will have to transfer some of the profits from his spinoff firm to his former employer, in effect buying out the non-compete clause in his employment contract.

Considering the buyout equilibrium first, the surplus from agreement is $\pi_P + \pi_S + \delta v_B -$

$K_S - \pi_{PT}$, where v_B is the continuation value for the employee and is given by the payoff to the incumbent firm in the buyout equilibrium. We have $v_B = \pi_{PT} + (1-\lambda)[\pi_P + \pi_S + \delta v_B - K_S - \pi_{PT}]$, or $v_B = [\lambda\pi_{PT} + (1-\lambda)(\pi_P + \pi_S - K_S)]/[1-(1-\lambda)\delta]$. Turning to the together equilibrium, the surplus from agreement is π_{ST}, as we have seen. The parties then prefer the buyout equilibrium when $\pi_P + \pi_S + \delta v_B - K_S - \pi_{PT} > \pi_{ST}$ or $\pi_P + \pi_S + \delta v_B - K_S - \pi_T > 0$, and prefer the together equilibrium otherwise. This condition reduces to $K_S < \pi_P + \pi_S - (1-\delta)\pi_T - \delta\lambda\pi_{ST}$. In other words, the buyout equilibrium is the unique Markov perfect equilibrium for $K_S < \pi_P + \pi_S - (1-\delta)\pi_T - \delta\lambda\pi_{ST}$, and the together equilibrium is the unique Markov perfect equilibrium otherwise.

We have now established

Proposition 3.1. *Consider an environment with enforcement of non-compete contracts and no finance constraints. Assume entry of the original firm in period 0. Given $K_S < (\pi_P - \pi_T) + \pi_S + \delta(\pi_T - \lambda\pi_{ST})$, a unique Markov perfect equilibrium exists in which, in period 1 and every subsequent period, the employee buys out his non-compete contract and founds a spinoff firm. Given $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta(\pi_T - \lambda\pi_{ST})$, a unique Markov perfect equilibrium exists in which the employer and employee agree to stay together in period 1 (and would agree to stay together in every subsequent period if the game continued).*

Comparing Proposition 3.1 with Proposition 2.1, it follows from $\pi_T - \pi_{ST} = \pi_{PT} > \pi_P$ that enforcement of non-compete contracts actually supports spinoff entry (and does not keep the employer and employee together) for a higher level of spinoff entry cost than non-enforcement of non-compete contracts. This occurs because the employer and employee, when agreeing to release the latter from his non-compete contract so he can found a spinoff firm, are able to collectively extract profits from future spinoff firms.

Using Proposition 3.1, we can again work backwards to the entry decision of the original firm. When the buyout equilibrium obtains, the original firm anticipates earning $\pi_0 + \delta v_B - K_0 = \pi_0 + \delta[\lambda\pi_{PT} + (1-\lambda)(\pi_P + \pi_S - K_S)]/[1-(1-\lambda)\delta] - K_0$. When the together equilibrium obtains, the original firm anticipates earning $\pi_0 + \delta(\pi_T - \lambda\pi_{ST}) - K_0$. We thus have

Proposition 3.2. *When the buyout equilibrium obtains, the original firm enters if and only if $\pi_0 + \delta[\lambda\pi_{PT} + (1-\lambda)(\pi_P + \pi_S - K_S)]/[1-(1-\lambda)\delta] > K_0$. When the together equilibrium obtains, the original firm enters if and only if $\pi_0 + \delta(\pi_T - \lambda\pi_{ST}) > K_0$.*

The same reasoning that leads to Proposition 2.3 then yields

Proposition 3.3. *When the buyout equilibrium obtains, the social optimum is achieved. When the together equilibrium obtains, the social optimum is achieved when* $K_S \geq \pi_P + \pi_S - (1-\delta)\pi_T$*, but not for* $\pi_P + \pi_S - \pi_T + \delta(\pi_T - \lambda\pi_{ST}) \leq K_S < \pi_P + \pi_S - (1-\delta)\pi_T$*, when the social optimum would be achieved if there were spinoff entry. When the original firm does not enter and* $K_0 < \pi_0 + \delta\pi_T$ *for* $K_S > \pi_P + \pi_S - (1-\delta)\pi_T$ *or* $K_0 < \pi_0 + \delta(\pi_P + \pi_S - K_S)/(1-\delta)$ *for* $K_S \leq \pi_P + \pi_S - (1-\delta)\pi_T$*, the social optimum is not achieved.*

Propositions 3.2 and 3.3 are illustrated in Figure 2.2. A comparison of Figure 2.2 with Figure 1.2 shows that enforcement of non-compete contracts with no finance constraints unambiguously dominates non-enforcement. The combinations of original firm and spinoff entry costs for which the original firm enters and for which the social optimum is achieved without enforcement of non-competes are strict subsets of those respective combinations with enforcement and no finance constraints.

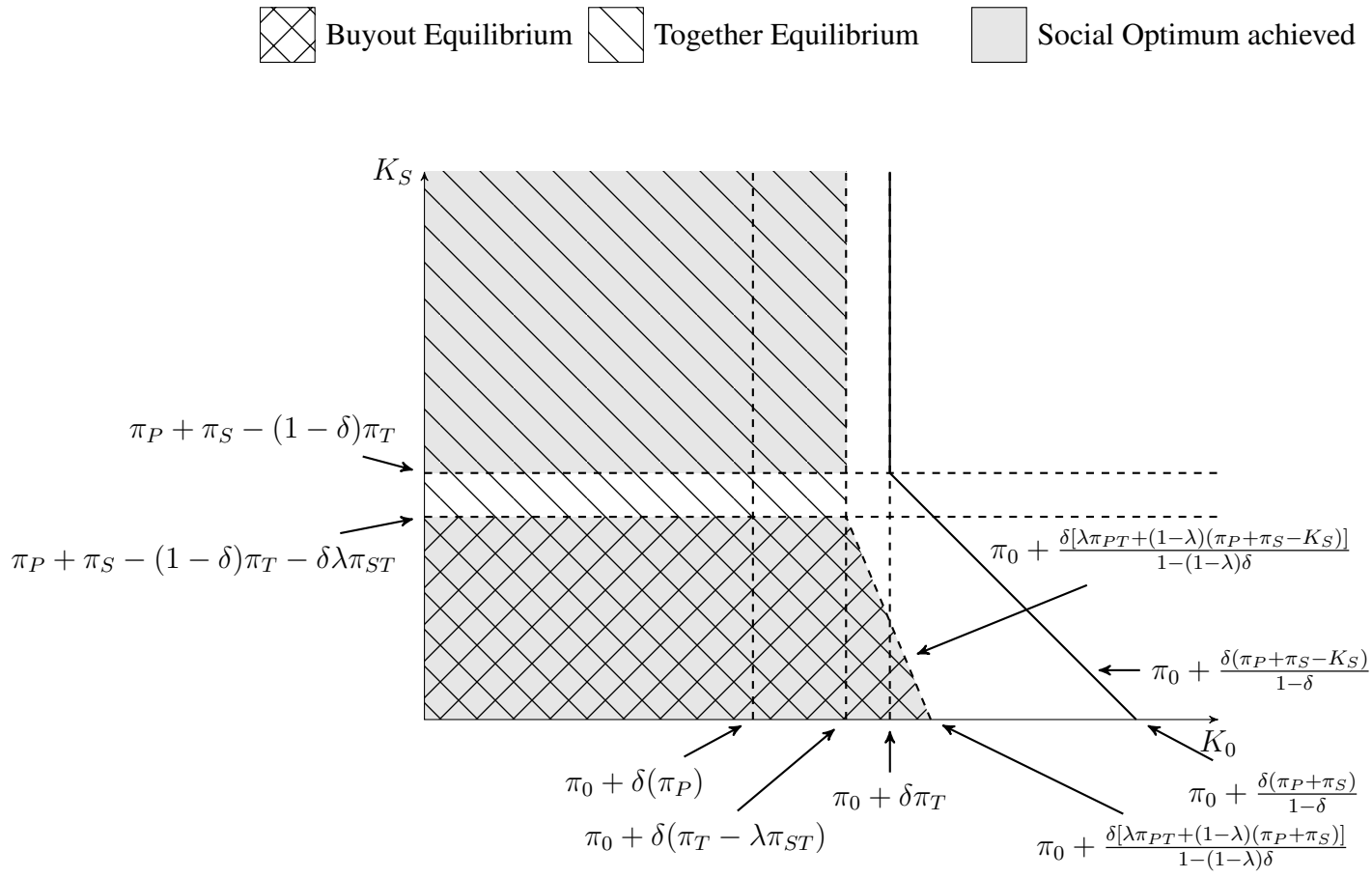

Figure 2.2: Equilibria and social optimum with enforcement of non-compete contracts

Note that, in the buyout equilibrium, the original firm is able capture a share of the net profits generated by the entry of *all* future spinoffs, even though it only negotiates with the first-generation spinoff. We can see this by examining $[\lambda\pi_{PT} + (1-\lambda)(\pi_P + \pi_S - K_S)]/[1-(1-\lambda)\delta]$, the earnings the original firm anticipates in the period following its entry. As λ approaches zero so that the employer has all the bargaining power in negotiations with the employee, this expression approaches $(\pi_P + \pi_S - K_S)/(1-\delta)$, the discounted sum of net profits generated by entry of all future spinoffs.[18] This occurs because all future spinoffs are brought into the negotiations implicitly through the continuation value of the employee in a Markov perfect equilibrium. The result is analogous to "Ricardian equivalence" in an overlapping generations model with bequests (Barro 1974), that is, overlapping generations of consumers in such a model can generate behavior equivalent to that of an infinitely-lived consumer.

We alluded in the Introduction to the findings of Garmaise (2011) that compensation of executives in U.S. states was negatively associated with strength of state enforcement of non-compete agreements, both cross-sectionally and over time. These earnings were observed for executives who were still employees rather than entrepreneurs. Garmaise suggested that the impact of the executives' greater incentives to invest in their general human capital when non-compete enforcement is weak dominated the impact of the employers' greater incentives to invest in the executives' firm-specific human capital when non-compete enforcement is strong. In our model, we observe the earnings of the employee with an idea for a new activity when he is still with his original firm (hence still an employee) in the together equilibrium when non-competes are enforced and in the no-spinoff equilibrium when non-competes are not enforced. In the next proposition we show that his earnings are weakly greater when non-competes are not enforced: equal when his best action in the event of separation is to take another job, and strictly greater when his best action is to found a spinoff firm. Moreover, the employee's earnings in the no-spinoff equilibrium are a decreasing function of K_S, the cost to him of starting his own firm. Lower K_S can be interpreted as the result of an employee's investment in his general human capital. Thus our model is consistent with the idea that an employee's investment in his general human capital, which reduces his cost of starting his own firm, increases his employee compensation more when non-compete agreements are not enforced than when they are enforced.

[18] Low λ clearly encourages original firm entry when K_S is low, but its effect is ambiguous when K_S is high because it discourages employee effort, so that the incumbent firm is getting a larger share of a smaller net profit generated by internal implementation of the employee's idea.

We have seen that in the together equilibrium the employee earns $\lambda\pi_{ST}$.[19] We now compare this to the earnings of the employee in the no-spinoff equilibrium:

Proposition 3.4. *When $K_S \geq \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$, the earnings of the employee in the no-spinoff equilibrium (without enforcement of non-competes) and the together equilibrium (with enforcement of non-competes) are equal. When $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$, the employee earns more in the no-spinoff equilibrium than in the together equilibrium, and his earnings are decreasing in K_S.*

Proof. As shown in the proof of Proposition 2.1, in the no-spinoff equilibrium the best action for the employee in the event of separation is to found a spinoff if $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$ and to take another job otherwise. If he takes another job his threat point is zero and the surplus from agreement is π_{ST}. His earnings are then $\lambda\pi_{ST}$, exactly as in the together equilibrium. If his best action in the event of separation is to found a spinoff his earnings are $\pi_S + \delta v_{NS} - K_S + \lambda(\pi_T - \pi_P - \pi_S - \delta v_{NS} + K_S)$. Since the borderline value of K_S is determined by $\pi_S + \delta v_{NS}$, at this borderline the value of employee earnings equals $\lambda(\pi_T - \pi_P) = \lambda(\pi_{PT} - \pi_P + \pi_{ST}) > \lambda\pi_{ST}$. Finally, straightforward computation shows that $\pi_S + \delta v_{NS} - K_S + \lambda(\pi_T - \pi_P - \pi_S - \delta v_{NS} + K_S)$ is decreasing in K_S. □

The intuition for Proposition 3.4 is that the bargaining power of the employee with the employer is greater when non-compete agreements are not enforced, provided that the employee has a credible threat to start his own firm. The greater are his potential earnings with his own firm, the greater is this effect.

5 Equilibria and social welfare with non-compete enforcement and binding employee finance constraints

Enforcement of non-compete contracts supports entry of both original firms and spinoff firms when high entry costs prevent their entry without such enforcement. The key to these improved outcomes is the ability of employers to extract transfers from employee-entrepreneurs to release them from their non-compete agreements. Of the various equilibria we have considered in the previous two sections, only in the buyout equilibrium are payments made by employees to employers.

[19] This implies that, in the together equilibrium depicted in Figure 2.1, $\tau_1 = (1 - \lambda)e^*_{ST}$.

It is reasonable to assume that the contract buyout must be made in cash. Paying the employer by working for free after informing the employer of his intention to resign is likely to cause the employee to forfeit his business opportunity, leaving him worse off (or at least no better off) than if he agreed to stay together with the employer.

There are several barriers that limit the ability of the employee to make a monetary transfer to his employer.[20] First, workers typically do not have the resources to internally (out of pocket) finance a large payment. Second, external financing generally is limited due to informational asymmetries between the employee and outside lending institutions. If profits from the future spinoff are not verifiable, the (former) employee can hide his income and declare that his new firm has failed. Similarly, promises by the employee to pay his employer in the future, after earning the profits from his new firm, may not be enforceable.

In this section we will explore the implications of the assumption that employees in our model are finance constrained. The finance-constraint assumption is consistent with the stories that workers tell.[21] Industry observers with whom I have spoken agree that buyouts of non-compete contracts are rare except at the highest level, such as star CEOs. Unfortunately, I am unaware of any survey data on the subject.

It is easily shown that a worker finance constraint would never be binding and would not affect our analysis when non-compete agreements are not enforced. We therefore confine our analysis in this section to the case where non-compete agreements are enforced. In this case, as we saw in the previous section, the employer (incumbent) has the power to unilaterally compel disagreement and obtain π_{PT}. Since the incumbent earns π_P when an employee spinoff enters, the employee will have to transfer at least $\pi_{PT} - \pi_P$ to get the employer to release him from his non-compete contract.[22] If the employee's wealth is smaller than that amount, he will do better to stay together

[20] Some of the discussion in this paragraph and the next is based on Rauch and Watson (2015).

[21] Workers I have interviewed do not consider borrowing to buy out their non-compete contracts to be a viable option. Several workers with a major international market research firm, disgruntled with a change in management following a merger, told me they thought they could better serve their clients by setting up their own firms but felt "trapped" by their non-competes and "lacked the cash" to buy them out.

[22] It is easy to show that the employee always pays at least $\pi_{PT} - \pi_P$ to the employer in the buyout equilibrium. The transfer from the employee to the employer in the buyout equilibrium equals the difference between the incumbent firm's payoff v_B and π_P, which is given by $[\lambda\pi_{PT} + (1-\lambda)(\pi_P + \pi_S - K_S)]/[1-(1-\lambda)\delta] - \pi_P$. This expression is decreasing in λ and in K_S, so it reaches its minimum when $\lambda = 1$ and $K_S = (\pi_P - \pi_T) + \pi_S + \delta(\pi_T - \lambda\pi_{ST})$ (at this value of K_S the parties switch from the buyout to the together equilibrium). In fact, the expression equals $\pi_{PT} - \pi_P$ for $\lambda = 1$ regardless of the value of K_S. For $\lambda < 1$ and $K_S = (\pi_P - \pi_T) + \pi_S + \delta(\pi_T - \lambda\pi_{ST})$, the expression reduces to $\pi_{PT} + (1-\lambda)\pi_{ST} - \pi_P$. Thus for either the maximal value of λ or the maximal value of K_S the transfer from the employee to the employer in the buyout equilibrium allows the latter to exactly reach the payoff he obtains in the together equilibrium.

with the employer and earn $\lambda\pi_{ST}$ instead of zero. As mentioned in subsection 2.2, the incumbent firm can finance this payment out of retained earnings.

It follows that when an employee with little wealth cannot borrow against future income, the buyout equilibrium of the previous section ceases to exist, and the together equilibrium of the previous section becomes the unique Markov perfect equilibrium regardless of the value of K_S. We have thus established

Proposition 4.1. *Consider an environment with enforcement of non-compete contracts in which the employee cannot borrow against future income. Assume entry of the original firm in period 0. If the employee has wealth $< \pi_{PT} - \pi_P$, then for any value of K_S a unique Markov perfect equilibrium exists in which the employer and employee agree to stay together in period 1 (and would agree to stay together in every subsequent period if the game continued).*

From Proposition 4.1 it follows that, when employees are finance constrained, an original firm that enters can always anticipate earning $\pi_0 + \delta(\pi_T - \lambda\pi_{ST}) - K_0$. We thus have

Proposition 4.2. *Consider an environment with enforcement of non-compete contracts in which the employee cannot borrow against future income. If the employee has wealth $< \pi_{PT} - \pi_P$, the original firm enters if and only if $\pi_0 + \delta(\pi_T - \lambda\pi_{ST}) > K_0$.*

The same reasoning that led to Propositions 2.3 and 3.3 then yields

Proposition 4.3. *Consider an environment with enforcement of non-compete contracts in which the employee cannot borrow against future income. If the employee has wealth $< \pi_{PT} - \pi_P$, the social optimum is achieved only when $K_0 < \pi_0 + \delta(\pi_T - \lambda\pi_{ST})$ and $K_S \geq \pi_P + \pi_S - (1-\delta)\pi_T$.*

Since finance constraints prevent employee spinoffs, the social optimum can only be achieved when the original firm enters and spinoffs are not socially profitable.

Propositions 4.2 and 4.3 are illustrated in Figure 3. The interesting comparison is between Figure 3 and Figure 1.2, both of which illustrate outcomes that are weakly inferior to those obtained when non-compete contracts are enforced without finance constraints. If we were to restrict our attention to consideration of original firms with $K_0 < \pi_0 + \delta\pi_P$, we could state that the combinations of original firm and spinoff entry costs for which the social optimum is achieved with enforcement of non-compete contracts and binding finance constraints is a strict subset of those combinations for which the social optimum is achieved without enforcement of non-competes.

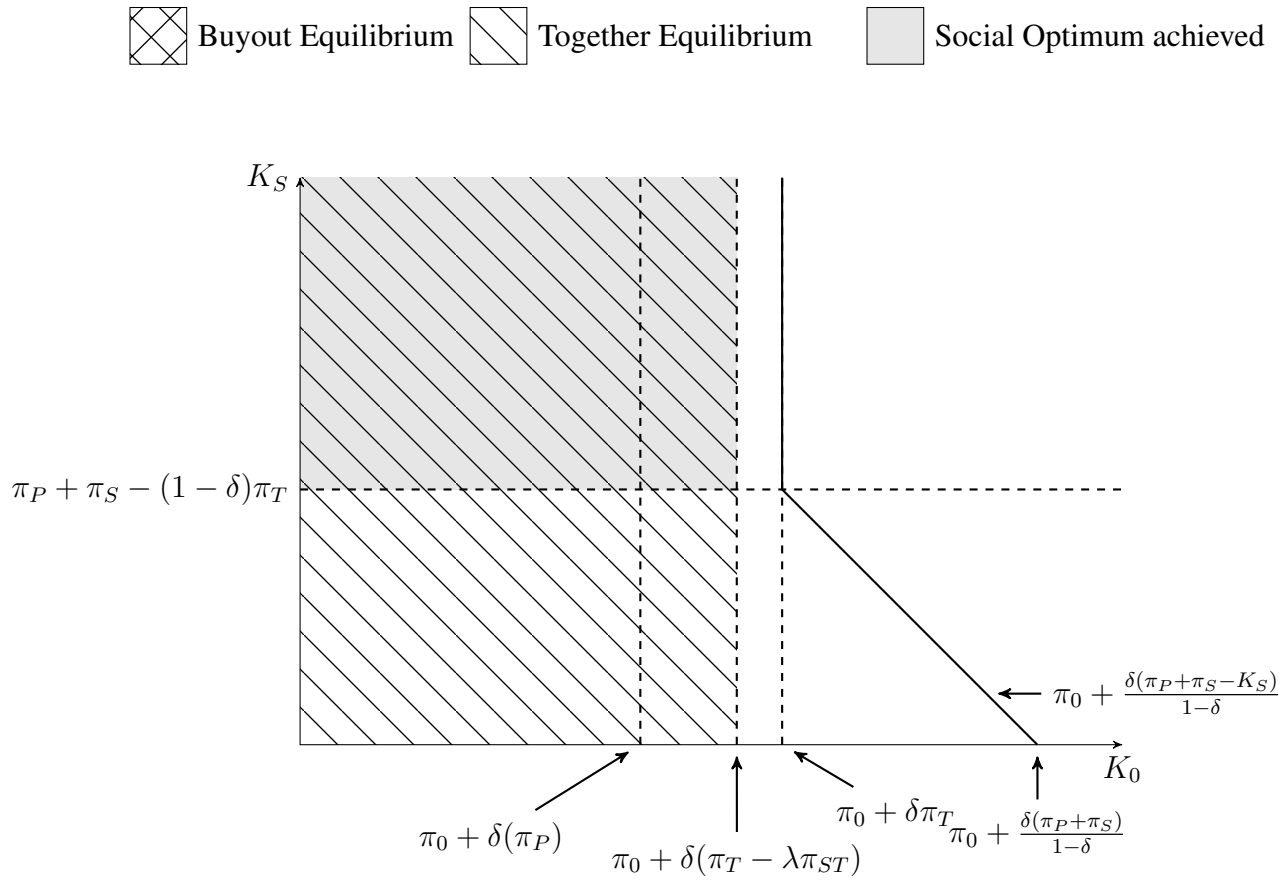

Figure 3: Equilibria and social optimum with enforcement of non-compete contracts and finance constraints

This occurs because lack of enforcement allows profitable spinoff entry to follow entry of a profitable original firm. We would then have an example of the theory of the second best: eliminating one distortion (inability to enforce non-compete contracts) in the presence of another (finance constraints) makes society worse off. However, because $\pi_T - \lambda\pi_{ST} > \pi_P$, when K_S is low some marginally profitable original firms enter with enforcement of non-compete contracts and binding finance constraints that do not enter without enforcement of non-compete contracts. Thus we cannot say that non-enforcement weakly dominates enforcement with binding finance constraints for all combinations of original firm and spinoff entry costs.

6 Conclusions

As new data reveal the ubiquity of employee spinoffs as a mode of entry, the importance of understanding the impact of policy on entry of both parent and spinoff firms becomes increasingly evident. Since spinoffs can and do become parents themselves, we have taken a dynastic (overlapping generations) modeling approach to this investigation, focusing on enforcement of non-compete agreements as the key policy specific to spinoff entry. We find that, without finance constraints, enforcement of non-compete agreements unambiguously improves social welfare outcomes. Indeed, enforcement not only encourages original (parent) firm entry but even stimulates spinoff entry, because each spinoff generation is able to capture some of the profit of the next generation when the entrepreneurial employee is forced to buy out his non-compete contact. However, if employees are unable to buy out their non-compete contracts due to finance constraints, enforcement of these agreements shuts down entry of socially profitable spinoff firms. Non-enforcement sacrifices entry of original firms that would be marginally profitable in the absence of employee spinoffs, but otherwise clearly improves social welfare outcomes over enforcement in the presence of binding finance constraints, by allowing entry of socially profitable spinoff firms.

Since enforcement of non-competes increases the rate of spinoffs from original firms without finance constraints but non-enforcement of non-competes increases the spinoff rate with finance constraints, the impact of non-compete enforcement on spinoff entrepreneurship can provide indirect evidence regarding the relevance of finance constraints. In what they claim is the first study of the impact of non-compete enforcement on entry, Starr et al. (2015) find evidence that entrance of within-industry employee spinoffs (those likely to compete with their parents) is reduced in U.S. states with stronger non-compete enforcement. The same is not true for non-within-industry spinoffs.

If, as the evidence suggests, finance constraints do indeed prevent employees from buying out their non-compete agreements, is the appropriate policy response to stop enforcing non-competes, as in California?[23] Given our result that enforcement of non-competes dominates non-enforcement in the absence of finance constraints, it is tempting to recommend that the government loan employee-entrepreneurs the funds necessary to buy out their non-compete contracts. However, if the government is not any better at verifying the profits of spinoff firms than private lenders, it will make

[23] Here we refer to enforcement regarding new entrants, the case studied in this paper. Finance constraints are likely to be far less relevant to non-compete enforcement regarding employees who move to another existing firm.

losses that have to be financed by (presumably distortionary) taxation. These losses could be exacerbated by collusion between employees and employers to extract resources from the government by setting up unprofitable spinoff firms. Finding a mix of policies that yields an unambiguous improvement relative to non-enforcement of non-compete contracts is challenging at best.

References

ACS, Z. J., E. L. GLAESER, R. E. LITAN, L. FLEMING, S. J. GOETZ, W. R. KERR, S. KLEPPER, S. S. ROSENTHAL, O. SORENSON, AND W. C. STRANGE (2008): "Entrepreneurship and Urban Success: toward a Policy Consensus," *Ewing Marion Kauffman Foundation*.

ACS, Z. J., P. BRAUNERHJELM, D. B. AUDRETSCH, AND B. CARLSSON (2009): "The Knowledge Spillover Theory of Entrepreneurship," *Small Business Economics*, 32(1), 15-30.

BACCARA, M., AND R. RAZIN (2009): "Innovation and Corporate Conservatism," NYU Stern School of Business Working Paper.

BARRO, R. J. (1974): "Are Government Bonds Net Wealth?," *The Journal of Political Economy*, 82(6), 1095–1117.

BERTRAND, M, AND A. SCHOAR (2006): "The Role of Family in Family Firms," *Journal of Economic Perspectives*, 20(2), 73-96.

BESSEN, J., AND E. MASKIN (2009): "Sequential Innovation, Patents, and Imitation," *The RAND Journal of Economics*, 40(4), 611–635.

DJANKOV, S., R. LA PORTA, F. LOPEZ DE SILANES, AND A. SHLEIFER (2002): "The Regulation of Entry," *Quarterly Journal of Economics*, 117(1), 1–37.

DUNNE, T., M. J. ROBERTS, AND L. SAMUELSON (1988): "Patterns of Firm Entry and Exit in U.S. Manufacturing Industries," *RAND Journal of Economics*, 19(4), 495–515.

ERIKSSON, T., AND J. M. KUHN (2006): "Firm Spin-Offs in Denmark 1981-2000: Patterns of Entry and Exit," *International Journal of Industrial Organization*, 24(5), 1021–1040.

FALLICK, B., C. A. FLEISHMAN, AND J. B. REBITZER (2006): "Job-Hopping in Silicon Valley: Some Evidence Concerning the Midro Foundations of a High-technology Cluster," *Review of Economics and Statistics*, 80(3), 472–481.

FOSFURI, A., AND T. ROENDE (2004): "High-tech Clusters, Technology Spillovers, and Trade Secret Laws," *International Journal of Industrial Organization*, 22(1), 45-65.

FRANCO, A. M., AND D. FILSON (2006): "Spin-Outs: Knowledge Diffusion through Employee Mobility," *RAND Journal of Economics*, 37(4), 841–860.

FRANCO, A. M., AND M. F. MITCHELL (2008): "Covenants Not to Compete, Labor Mobility, and Industry Dynamics," *Journal of Economics and Managemnet Strategy*, 17, 581–606.

GARMAISE, M. J. (2011): "Ties That Truly Bind: Noncompetition Agreements, Executive Compensation, and Firm Investment," *Journal of Law, Economics, and Organization*, 27, 376–425.

GILSON, R. J. (1999): "The Legal Infrastructure of High Technology Industrial Districts: Silicon Valley, Route 128, and Covenants Not To Compete," *New York University Law Review*, 74(3), 575–629.

HIRAKAWA, O., M. A. MUENDLER,, AND J. E. RAUCH (2010): "Employee Spinoffs and Other Entrants: Stylized Facts from Brazil," National Bureau of Economic Research Working Paper No. 15638.

HVIDE, H. K. (2009): "The Quality of Entrepreneurs," *Economic Journal*, 119(539), 1010–1035.

KLEPPER, S., AND S. SLEEPER (2005): "Entry by Spinoffs," *Management Science*, 51(8), 1291–1306.

KRÄKEL, M., AND D. SLIWKA (2009): "Should You Allow Your Employee to Become Your Competitor? On Noncompete Agreements in Employment Contracts," *International Economic Review*, 50, 117–141.

LAFFONT, J.-J., AND D. MARTIMORT (2001): *The Theory of Incentives: The Principal-Agent Model*. Princeton University Press.

MARX, M., D. STRUMSKY, AND L. FLEMING (2009): "Mobility, Skills, and the Michigan Non-Compete Experiment," *Management Science*, 55, 875–889.

MOTTA, M., AND T. ROENDE (2002): "Trade Secret Laws, Labour Mobility, and Innovations," Discussion Paper No. 3615, Centre for Economic Policy Research.

MUENDLER, M. A., AND J. E. RAUCH (2014): "What Do Employee Spinoffs Learn from Their Parents? Evidence from International Trade," University of California, San Diego, unpublished manuscript.

MUENDLER, M. A., J. E. RAUCH, AND O. TOCOIAN (2012): "Employee Spinoffs and Other Entrants: Stylized Facts from Brazil," *International Journal of Industrial Organization*, 30(5), 447–458.

PHILLIPS, D. J. (2002): "A Genealogical Approach to Organizational Life or Chances: The Parent-progeny Transfer Among Silicon Valley Law Firms, 1946-1996," *Administrative Science Quarterly*, 47(3), 474–506.

RAUCH, J. E., AND J. WATSON (2015): "Client-Based Entrepreneurship," *Journal of Law, Economics, and Organization*, 31(1), 30–60.

SHIEH, G. (1992): *"Boss" island: The subcontracting network and microentrepreneurship in Taiwan's development*. Peter Lang, New York.

STARR, E., N. BALASUBRAMANIAN AND M. SAKAKIBARA (2015): "Enforcing Covenants Not to Compete: The Lifecycle Impact on New Firms," US Census Bureau Center for Economic Studies Working Paper, #14-27.

STONE, K. V. (2002): "Knowledge at Work: Disputes over the Ownership of Human Capital in the Changing Workplace," *Connecticut Law Review*, 34, 721-763.

STREITFELD, D (2014): "Court Rejects Deal on Hiring in Silicon Valley," *New York Times*, August 9, p. A1.

WATSON, J. (2013): *Strategy: An Introduction to Game Theory*. W. W. Norton and Company, New York, third ed.

Appendix: Proof of Proposition 2.1

Proof. Given the stationary environment, without enforcement of non-compete contracts only three Markov perfect equilibria are possible. In the no-spinoff equilibrium, the employer and employee stay together in period 1, and would agree to stay together in every subsequent period if the game continued. In the spinoff equilibrium, the employer and employee separate in period 1 and the employee founds a spinoff firm; this repeats in every subsequent period. In the other possible equilibrium, the employer and employee separate in period 1 and the employee takes a job with another firm; this would occur in every subsequent period if the game continued. Proposition 2.1 states that, following entry of the original firm in period 0, the spinoff equilibrium is the unique Markov perfect equilibrium when $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P$ and the no-spinoff equilibrium is the unique Markov perfect equilibrium when $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta\pi_P$.

First consider the spinoff equilibrium. In the text, it was shown that in the case $K_S < \pi_S + \delta\pi_P$, the threat point of the employee is $\pi_S + \delta\pi_P - K_S$, and the threat point of the employer is π_P. If the two parties stay together, their combined payoff is π_T. Let us provisionally restrict our attention to the case $K_S < \pi_S + \delta\pi_P$. In this case, the two parties fail to agree (separate) if $\pi_P + \pi_S + \delta\pi_P - K_S > \pi_T$, or $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P < \pi_S + \delta\pi_P$, since $\pi_T > \pi_P$. This establishes the existence of the spinoff equilibrium given $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P$.

Next consider the no-spinoff equilibrium. In the text, it was shown that if the employee founds a spinoff firm when the parties separate, the threat point of the employer is π_P, and the threat point of the employee is $\pi_S + \delta v_{NS} - K_S$, where $v_{NS} = [\lambda\pi_P + (1-\lambda)(\pi_T - \pi_S + K_S)]/[1 + (1-\lambda)\delta]$. If the employee takes another job when the parties separate, his threat point is zero, and the threat point of the employer is π_{PT}.

It is easily seen that $\pi_S + \delta v_{NS} - K_S$ decreases with K_S. It follows that, for K_S high enough, the employee's best action after separation is to take another job. For K_S in this range, a Markov perfect equilibrium in which the two parties always agree to stay together clearly exists: staying together yields a joint payoff of π_T and separation yields a joint payoff of π_{PT}. Does this equilibrium exist for lower values of K_S, for which the employee's best action after separation is to found a spinoff? The employee founds a spinoff after separation if $\pi_S + \delta v_{NS} - K_S > 0$, or $K_S < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$. The surplus from agreement in this case is $\pi_T - \pi_P - \pi_S - \delta v_{NS} + K_S$, which is nonnegative if $K_S \geq (1+\delta)\pi_P + \pi_S - \pi_T$. Simple manipulation then shows that $(1+\delta)\pi_P + \pi_S - \pi_T < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$ follows from $\pi_T > \pi_P$. We conclude that a Markov perfect equilibrium exists in which the employer and employee agree to stay together for all $K_S \geq (1+\delta)\pi_P + \pi_S - \pi_T$. This establishes the existence of the no-spinoff equilibrium given $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta\pi_P$.

Having established existence of the spinoff and no-spinoff equilibria in the specified, mutually exclusive and exhaustive ranges for K_S, we complete the proof of Proposition 2.1 by showing for each of these equilibria that existence of either of the other two equilibria in the specified range for K_S leads to a contradiction.

We first prove that the spinoff equilibrium is the unique equilibrium when $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P$. Consider the equilibrium in which the employee takes a job with another firm. It is sequentially rational for the employee to take another job rather than found a spinoff firm after separation only if $K_S \geq \pi_S + \delta\pi_P$. But this contradicts the parameter values for the spinoff equilibrium, since $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P < \pi_S + \delta\pi_P$. Now consider the equilibrium in which the employer and employee agree to stay together. Since $(\pi_P - \pi_T) + \pi_S + \delta\pi_P < \pi_S + \delta[\pi_T - \lambda(\pi_T - \pi_P)]$, the threat point for their negotiations is determined by the employee founding a spinoff firm. It follows that they would divide the surplus

$\pi_T - \pi_P - \pi_S - \delta v_{NS} + K_S = [K_S + \pi_T - (1+\delta)\pi_P - \pi_S]/[1 + (1-\lambda)\delta]$. But simple manipulation shows this to be negative if $K_S < (\pi_P - \pi_T) + \pi_S + \delta\pi_P$, hence agreement to stay together (the no-spinoff equilibrium) leads to a contradiction for the parameter values under which the spinoff equilibrium obtains.

We next prove that the no-spinoff equilibrium is the unique equilibrium when $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta\pi_P$. Under these parameter values, if the parties always disagree the employee will found a spinoff firm if $K_S < \pi_S + \delta\pi_P$, and will take another job otherwise. In the former case the spinoff equilibrium obtains, and in the latter case the equilibrium in which the employee takes a job with another firm obtains. In the spinoff equilibrium, the joint payoff to the two parties is $\pi_P + \pi_S + \delta\pi_P - K_S$. Were the two parties to agree, their joint payoff would be π_T. It follows immediately from $K_S \geq (\pi_P - \pi_T) + \pi_S + \delta\pi_P$ that there is a nonnegative surplus from agreement, hence existence of the spinoff equilibrium leads to a contradiction for these parameter values. If the equilibrium in which the employee takes another job obtains, the joint payoff to the two parties is π_{PT}. Were the two parties to agree, their joint payoff would again be π_T. There is a positive surplus from agreement given by π_{ST}, hence existence of an equilibrium in which the two parties disagree (separate) and the employee takes a job with another firm leads to a contradiction. □