

UP-OR-OUT CONTRACTS:
A SIGNALLING PERSPECTIVE

by

Michael Waldman
Department of Economics
UCLA
Los Angeles, CA 90024

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ABSTRACT

A firm typically will gather information concerning its own workers which is more accurate than information gathered by other potential employers. In turn, other potential employers will attempt to reduce this information asymmetry by observing the actions of the initial employer (see Greenwald (1979,1986) and Waldman (1984)). The present paper argues that such a process can be important in environments characterized by Up-or-Out contracts. The logic is that the retention decision serves as a signal of a worker's productivity, and thus helps reduce the information asymmetry between the firms. The paper investigates the implications of this argument in two environments: (i) a setting where Up-or-Out contracts are employed because they provide the worker with an incentive to accumulate general human capital; and (ii) a setting where Up-or-Out contracts emerge because they are preferred by those more likely to be of high productivity.

I. Introduction

Numerous labor market contracts can be characterized as "Up-or-Out" contracts. That is, if a worker is not promoted within some fixed interval of time, the worker must be fired. Examples of labor market settings characterized by such contracts include the academic environment, and a variety of other professional employment settings such as law partnerships. This paper considers environments characterized by Up-or-Out contracts, and focuses on the potential role that signalling can play when Up-or-Out contracts are present.

In labor market settings it is typical that during an individual's working lifetime information about his productivity will gradually be revealed to firms in the economy. Most early studies which considered this issue assume either that the information is revealed in a public manner (see e.g., Ross, Taubman and Wachter (1981), Harris and Holmstrom (1982), and MacDonald (1982)), or that the information is only revealed to the firm employing the worker (see e.g., Prescott and Visscher (1980)). More recently, however, attention has focused on an intermediate and more realistic case. That is, that information is directly revealed only to the firm employing the worker, but other firms observe the actions of the initial employer and in this way reduce the information asymmetry between the firms. For example, Greenwald (1979,1986) shows that a worker's decision to switch employers can serve as a signal of productivity, while Waldman (1984) considers how other firms can partially infer a worker's productivity by considering his task assignment.¹

This paper argues that a similar process can be important in environments characterized by Up-or-Out contracts. The logic is that the retention decision serves as a signal of a worker's productivity, and thus helps reduce

the information asymmetry between the firms. The paper investigates the implications of this argument in two environments: (i) a setting where Up-or-Out contracts are employed because they provide the worker with an incentive to accumulate general human capital; and (ii) a setting where Up-or-Out contracts emerge because they are preferred by those workers more likely to be of high productivity.²

II. Kahn and Huberman (1988)

I begin by considering the analysis of Kahn and Huberman (1988) which is also concerned with why firms might offer Up-or-Out contracts. Kahn and Huberman define an Up-or-Out contract as a contract which satisfies two conditions. First, the contract is such that if a worker is not promoted within some fixed interval of time, the worker must be fired. Second, the contract specifies the wage the worker will receive if he is retained. Given this definition, they show that such a contract may be used to overcome a potential moral hazard problem. The logic is as follows. Suppose the worker has the opportunity to invest in specific human capital, where the level of investment is not publicly observable - but the firm does get to privately observe the worker's post-investment productivity. If the worker were to sign a contract which did not include the possibility of the worker being fired, but rather specified that the worker could be retained at either a high wage or a low wage, then a problem arises. With this contract the firm would always have an incentive to claim that the worker was of low productivity, and hence deserved the lower retention wage. In turn, this moral hazard problem on the part of the firm would then eliminate any incentive for the worker to invest in specific capital. In contrast, suppose the worker were to sign an

Up-or-Out contract. The firm could now provide the worker with an incentive to invest in specific capital by setting the retention wage above the worker's opportunity cost. The reason the above moral hazard problem is no longer an issue is that, given an Up-or-Out contract, the firm will not have an incentive to always claim that the worker is of low productivity, because the firm does not retain the services of low productivity workers.

The above story is probably an accurate representation of why Up-or-Out contracts are used in some settings. However, certain aspects of the story are clearly troubling if one wants to interpret their approach as a general theory for the use of Up-or-Out contracts. There are two related predictions of their model which are problematic. First, the retention wage is set above a retained worker's next best alternative wage, i.e., a retained worker's wage is not the outcome of a bidding process between the initial employer and other potential employers. Second, since the retention wage is set above the next best alternative, voluntary moves should be rare for workers who have been retained. Or another way to look at this second point is that, since retained workers have accumulated significant specific human capital, retained workers should rarely move.

Although these predictions may be consistent with some settings in which Up-or-Out contracts are employed, they are clearly not consistent with all such settings. In particular, casual observation of the academic environment, especially of the academic market for economists, provides evidence which is problematic for the Kahn and Huberman theory. Everyone knows of many instances in which an economist has switched universities immediately after achieving tenure. Further, even when a move does not occur, outside offers play a clear and important role in bidding up salaries. In this paper I

consider environments where the accumulation of specific human capital is not a significant factor, and simultaneously focus on the signalling properties of the retention decision. What I show is that there are reasons other than the accumulation of specific human capital for why Up-or-Out contracts may be employed. Further, due to the signalling aspects of the retention decision, these other settings are consistent with the stylized facts of the academic market which seem so troubling for Kahn and Huberman's original story.

III. Up-or-Out Contracts and the Accumulation of General Human Capital

In sections III and IV I show that a slight variation of Kahn and Huberman's original story results in the emergence of Up-or-Out contracts in an environment where workers accumulate general rather than specific human capital. Further, as already indicated, this case has the advantage of being consistent with the stylized facts of the academic market discussed earlier.

The description of the model follows. Within the economy there is only one good produced and the price of this good is normalized to one. Workers live for two periods, and in each period labor supply is perfectly inelastic and fixed at one unit for each worker. During their first period of employment workers will be referred to as young, while workers who are in their second period of employment will be referred to as old. A young worker produces an amount X , and while young the worker accumulates general human capital. It is further assumed that the amount accumulated depends on the worker's investment in human capital, where the worker's choice of an investment level is private information to the worker. The worker can make either of two choices. He can invest zero in the accumulation of human capital, in which case his productivity when old equals $X+G$ with probability

q and $X+F$ with probability $(1-q)$, where $G>F$. Alternatively, he can invest an amount I , in which case his productivity when old equals $X+G$ with probability p and $X+F$ with probability $(1-p)$, where $p>q$. It is assumed that $(p-q)(G-F)>I$, i.e., investing is socially efficient. Also, only the first period employer gets to observe the realization of a worker's second period productivity, and this observation takes place at the end of the first period.³

There are two types of firms, denoted types A and B, where there is free entry for each type. The two types of firms do not differ in terms of their production functions, but rather differ in terms of their working environments. There are also two types of workers denoted types A and B. For a type A worker there is a probability δ that the worker prefers to work at a type A firm and a probability $(1-\delta)$ that he prefers to work at a type B firm, $1/2<\delta<1$, while for a type B worker there is a probability δ that he prefers to work at a type B firm and a probability $(1-\delta)$ that he prefers to work at a type A firm. If a worker works at the type of firm he prefers then he receives no disutility from work. If he works at the "wrong" type of firm then he receives disutility which expressed in dollars is denoted D . Further, because we want to focus on the underincentive for workers to accumulate general human capital and not focus on the welfare losses due to individuals working at the "wrong" type of firm, it is assumed that D is positive but very small.^{4,5}

Upon entering the labor market a worker only knows his own type, and not the realization of which type of firm he actually prefers. During his first period of employment, however, he learns what this realization is. It is also assumed that workers and firms are risk neutral and have a zero rate of discount. Hence, when coming into the labor market a young worker will attempt

to maximize his expected lifetime income minus any disutility he expects to derive from working and any cost incurred in the accumulation of human capital.

IV. Analysis

A) Contracting Environment

In the analysis three types of contracts are considered - two variants of Up-or-Out contracts and what will be referred to as a standard spot market contract. I will begin by describing the latter. A standard spot market contract simply specifies the wage the worker will receive while young, denoted W^Y . If a worker accepts a standard spot market contract, the worker's second period wage and firm are then determined by the following process. Following Greenwald (1986), Lazear (1986), and Milgrom and Oster (1987), it is assumed that this is an environment where the first period employer can make counter-offers. That is, at the end of the first period, firms other than the initial employer have an opportunity to make wage offers. This is then followed by the first period employer having an opportunity to make counter-offers. Further, it is assumed that if at the beginning of the second period the worker is indifferent between moving and staying then he stays.⁶

The first type of Up-or-Out contract considered is that put forth by Kahn and Huberman. This will be referred to as a simple Up-or-Out contract. There are two important characteristics of this type of contract. First, at the end of the first period the firm makes a decision concerning whether to retain or fire the worker. Second, in addition to specifying W^Y , the contract specifies a retention wage which is offered to all workers who are retained. Notice that if a firm offers a simple Up-or-Out contract, then for retained workers the wage setting process is exactly the opposite of what is

the case for the standard spot market contract. That is, the initial employer first offers a wage, and then other firms have the opportunity to make their own wage offers.

The second type of Up-or-Out contract is only a slight variation on the first. A retention wage is still specified in the contract. However, after other firms have made their wage offers to old workers, the initial firm now has the opportunity to make counter-offers. This contract will be referred to as a counter-offer Up-or-Out contract.

Finally, one additional restriction is imposed on the contracting process. Firms are restricted from offering contracts where wages are contingent on output. This is already implicit in the contracts offered to young workers. Thus, I am here simply extending the restriction to the contracts offered to old workers by firms other than the first period employer, and to the counter-offers made by the first period employer. The restriction can be justified by assuming that only aggregate output is publicly verifiable, and that there are economies of scale, although not modeled, such that firms hire many workers.^{7,8}

B) Results

We begin by considering the equilibrium which results when firms can only offer standard spot market contracts to young workers. Because of the symmetry of the model, the statements of the propositions only refer to workers of type A. Note further, all proofs are relegated to the Appendix.

Proposition 1: Suppose only standard spot market contracts can be offered. Then the employment history of a representative worker of type A is described by the following.

- i) While young he works at a type A firm at wage $W^Y = X + q(G - F - D)$ and invests zero in human capital.
- ii) With probability q , he stays at his initial employer when old and receives a wage $X + F + D$.
- iii) With probability $(1 - q)\delta$, he stays at his initial employer when old and receives a wage $X + F$.
- iv) With probability $(1 - q)(1 - \delta)$, the worker switches to a type B firm when old and receives a wage $X + F$.

Intuitively, what is happening in proposition 1 is as follows. As discussed by Milgrom and Oster, since a worker's productivity remains private information to the first period employer, other firms will only be willing to bid what the lowest productivity worker would produce after a move. If such a firm were to bid more then, because the initial employer has the opportunity to make counter-offers, this other firm would find that it only employs the worker when he produces less than he is being paid. The result is that, when the worker is of low productivity the initial employer will simply match the outside offers just described (this explains conditions iii) and iv)), while when he is of high productivity the initial employer will offer the lowest wage which guarantees the worker will not move (this explains condition ii)). Finally, W^Y is determined by a zero expected profit constraint, and the incentive for the accumulation of general human capital is small enough that young workers decide not to invest.

The interesting aspect of the above described equilibrium is the last one

mentioned. Specifically, even though it is socially efficient for investment to take place, i.e., $(p-q)(G-F) > I$, workers decide not to invest. The reason is as follows. Suppose a worker were to invest and in fact change his productivity from low to high. The result would be that, rather than having his wage increase by an amount $G-F$, it would only increase by an amount D . Further, given that D is assumed to be very small, the private incentive to investing is sufficiently small that workers decide not to invest. Notice that this inefficiency is similar to the inefficiency pointed out originally by Kahn and Huberman. That is, in both cases there is an inefficiency due to the fact that the potential change in the post-investment wage does not reflect the potential increase in productivity. The difference between the two stories is that Kahn and Huberman show that this factor can lead to underinvestment in an environment where human capital is specific, while I demonstrate that assuming human capital is specific is not at all crucial. Rather, underinvestment can arise just as easily in a world where human capital is general.

As with the inefficiency identified by Kahn and Huberman, the above inefficiency can be avoided if Up-or-Out contracts are available. We will begin by considering the simple Up-or-Out contract.⁹

Proposition 2: Suppose both standard spot market contracts and simple Up-or-Out contracts can be offered. First, all young workers will sign simple Up-or-Out contracts for which $W^Y = X$ and the retention wage specified in the contract will equal $X+G$. Second, the employment history of a representative worker of type A is described by the following.

- i) While young he works at a type A firm and invests I in human capital.
- ii) With probability $p\delta$, he stays at his initial employer when old and

receives a wage $X+G$.

- iii) With probability $p(1-\delta)$, he voluntarily moves to a type B firm when old and receives a wage $X+G$.
- iv) With probability $(1-p)\delta$, he is not retained by his initial employer when old and he moves to a type A firm where he receives a wage $X+F$.
- v) With probability $(1-p)(1-\delta)$, he is not retained by his initial employer when old and he moves to a type B firm where he receives a wage $X+F$.

In proposition 2, the firm avoids the inefficiency identified earlier by offering an Up-or-Out contract where the retention wage is set equal to the output of a high productivity worker. The reason the contract avoids the potential inefficiency is as follows. With this contract the initial employer will have an incentive to retain high productivity workers and fire low productivity workers. This means that the worker's productivity, whether high or low, is perfectly signalled to other potential employers. In turn, this yields the following three results. First, an old worker is always employed at the type of firm he prefers. Second, an old worker's wage is always equal to his productivity. Third, because wages for old workers now reflect productivity, workers while young have an incentive to invest in human capital.

The main difference between the above result and that of Kahn and Huberman is in terms of the first stylized fact of the academic market discussed earlier. That is, as opposed to the Kahn and Huberman analysis, it is now the case that some old workers leave their initial employer even when they have been retained. This did not happen in the Kahn and Huberman analysis because their story focused on specific human capital, and hence after achieving "tenure" other potential employers were not good substitutes for the initial employer.¹⁰

Although proposition 2 is consistent with the first stylized fact of the academic market discussed earlier, it is not consistent with the second. That is, the wage paid to old workers who are retained and decide to stay is not the outcome of a bidding process between the firms. As shown in proposition 3, however, this drawback can be remedied by considering the counter-offer Up-or-Out contract rather than the simple Up-or-Out contract.

Proposition 3: Suppose both standard spot market contracts and counter-offer Up-or-Out contracts can be offered. First, all young workers will sign counter-offer Up-or-Out contracts for which $W^Y = X$ and the retention wage specified in the contract will fall in the interval $(X+F, X+G]$. Second, workers will be indifferent across all contracts in this class. Third, the employment history of a representative worker of type A is described by i) through of v) of proposition 2.

Proposition 3 tells us that the counter-offer Up-or-Out contract yields exactly the same final equilibrium as the simple Up-or-Out contract. What is of interest, however, is that the retention wage specified in the contract need no longer be equal to the actual retention wage paid. Rather, all that is required is that the retention wage specified be in the interval $(X+F, X+G]$. The logic here is that, for any retention wage in this interval, the initial employer will have an incentive to retain high productivity workers and fire low productivity workers, and thus the retention decision will serve as a perfect signal of a worker's productivity. The result is that, even if the retention wage specified in the contract is less than $X+G$, the bidding of other firms will cause the actual wage paid to be equal to $X+G$. Or in other words, when counter-offer Up-or-Out contracts are available it is possible for

the equilibrium to be consistent with both stylized facts of the academic market discussed earlier.

One point to note is that the story just told concerning counter-offer Up-or-Out contracts would not work in the setting considered by Kahn and Huberman. In their setting, even if the retention decision served as a perfect signal of a worker's productivity, other firms would not be willing to bid up a high productivity worker's wage because the worker has accumulated specific rather than general human capital. Hence, even if counter-offer Up-or-Out contracts were available in the environment they consider, equilibria would still not be consistent with the second stylized fact of the academic market discussed earlier.

V. A Stronger Result Based on Diffuse Information

In the previous section I demonstrated how a variation of the Kahn and Huberman analysis results in the employment of Up-or-Out contracts in a setting consistent with the stylized facts of the academic market discussed earlier. Sections IV and V move away from the Kahn and Huberman approach to explore other aspects of the use of Up-or-Out contracts.

One drawback of the analysis of the previous section is that to some extent the results are only weakly consistent with the second stylized fact of the academic market. That is, there are equilibrium contracts where the retention wage paid is the outcome of a bidding process between the firms, but there is also an equilibrium contract where the retention wage paid equals the retention wage specified in the contract. I will now demonstrate that, given a somewhat different specification for how information is revealed to firms, this drawback disappears.

It is no longer assumed that a worker's first period employer directly observes the worker's second period productivity, and that other potential employers receive no direct information concerning productivity. Rather, the initial employer now receives noisy information concerning productivity, and the market also receives noisy information. Let z_e denote the noisy information received by the initial employer and z_m denote the noisy information received by the market. To keep the analysis simple, the following structure is imposed on these noisy pieces of information. z_e equals 1 with productivity one when the worker's true productivity is high, while it equals 1 with probability s and 0 with probability $(1-s)$ when the worker's true productivity is low, $0 < s < 1$. On the other hand, z_m equals 0 with probability one when the worker's true productivity is low, while it equals 1 with probability t and 0 with probability $(1-t)$ when the worker's true productivity is high, $0 < t < 1$. Further, it is assumed that the market does not observe the realization of z_e and the initial employer does not observe the realization of z_m .¹¹

We will now consider the nature of equilibrium given this change in the environment, and assuming that both standard spot market contracts and counter-offer Up-or-Out contracts are available. Also, in some sense to bias the model against exhibiting the second stylized fact of the academic market discussed earlier, it is assumed that there is an infinitesimally small but positive cost for an initial employer to make a counter-offer which is different than the retention wage specified in the contract. If this assumption had been imposed in the previous section, then in proposition 3 the retention wage specified in the contract would have equalled the actual retention wage paid, i.e., the analysis would not have been at all consistent with the second

stylized fact of the academic market. Note, below $\bar{X}(z_e, z_m)$ denotes the expected value of a worker's productivity as a function of the realizations of z_e and z_m , and given that the worker chooses to invest in human capital.¹²

Proposition 4: Suppose both standard spot market contracts and counter-offer Up-or-Out contracts can be offered. There exists a critical value \bar{I} , $0 < \bar{I} < (p-q)(G-F)$, such that if $I < \bar{I}$, then the following describes the equilibrium. First, all young workers will sign counter-offer Up-or-Out contracts for which $W^Y = X$ and the retention wage specified in the contract equals $\bar{X}(1,0)$, where $\bar{X}(1,0) < X+G$. Second, the employment history of a representative worker of type A is described by the following.

- i) While young he works at a type A firm and invests I in human capital.
- ii) With probability $pt\delta$, he stays at his initial employer when old and receives a wage $\bar{X}(1,1) = X+G$.
- iii) With probability $pt(1-\delta)$, he voluntarily moves to a type B firm when old and receives a wage $\bar{X}(1,1) = X+G$.
- iv) With probability $[p(1-t)+(1-p)s]\delta$, he stays at his initial employer when old and receives a wage $\bar{X}(1,0)$.
- v) With probability $[p(1-t)+(1-p)s](1-\delta)$, he voluntarily moves to a type B firm when old and receives a wage $\bar{X}(1,0)$.
- vi) With probability $(1-p)(1-s)\delta$, he is not retained by his initial employer when old and he moves to a type A firm where he receives a wage $X+F$.
- vii) With probability $(1-p)(1-s)(1-\delta)$, he is not retained by his initial employer when old and he moves to a type B firm where he receives a wage $X+F$.

Although propositions 3 and 4 are quite similar, there is one interesting difference. In proposition 3 the initial employer received perfect information about a worker's productivity, and it was an equilibrium for the firm to set the retention wage equal to the high value for productivity. In contrast, now the initial employer receives noisy information concerning productivity and the market also receives noisy information. What this means is that, if the initial employer observes $z_e = 1$, there are two potential values for what the worker's expected productivity will be after the market's information is taken into account. If the market also receives positive information then expected productivity will be relatively high, while if it receives negative information then it will be relatively low. The question which therefore arises is whether the firm will set the retention wage in the contract equal to the lower value or to the higher value. The interesting result in proposition 4 is that the wage is set equal to the lower value. That is, consistent with the second stylized fact of the academic market, the retention wage specified in the contract is set low, and if the market receives positive information then the wage is increased through the bidding of other firms.

What drives the above result is that, when information is revealed in the diffuse fashion considered in this sub-section, then the initial employer faces a winner's curse type problem. Suppose the firm were to set the retention wage in the contract above the lowest possible value for what expected productivity will be after the market's information is taken into account. The firm would find that some of the workers who decide to stay will be those whom the firm has overvalued, i.e., for these workers the retention wage specified in the contract exceeds the final realization for the worker's

expected productivity. On the other hand, the others who decide to stay will have their wage bid up to this final realization. The overall result would be that the average productivity of retained workers who decide to stay would be below the average retention wage paid, which in turn implies that the initial employer would be unwilling to retain any workers. By having the contract specify a low retention wage and having the actual retention wage frequently be determined by a bidding process, firms avoid this winner's curse type problem.

VI. Up-or-Out Contracts When Workers Have Prior Information

In this section I show that if workers have some prior information concerning their own productivity, Up-or-Out contracts can emerge even if the accumulation of human capital is not a significant factor. Further, again due to the signalling aspects of the retention decision, this case also has the advantage of being consistent with the stylized facts of the academic market.

The model considered is a slight variation of the model presented in section III. Let everything be the same as in that model except for the following changes. First, there is no accumulation of human capital. Second, workers vary in terms of their productivity, where a high productivity worker produces X^H and a low productivity worker produces X^L , $X^H > X^L$. Third, young workers before beginning their work careers have some private information concerning whether they are of high or low productivity. In particular, a worker in group 1 knows that with probability r_1 he is of high productivity and with probability $(1-r_1)$ he is of low productivity, while a worker in group 2 knows that with probability r_2 he is of high productivity and with probability $(1-r_2)$ he is of low productivity, $r_1 > r_2$. It is assumed here

that for each of type A and B, the proportion of workers who are in group 1 equals v and the proportion in group 2 equals $(1-v)$. Further, firms do not initially know a worker's group, but at the end of the first period the initial employer privately observes the worker's actual productivity.

We start the analysis by considering what happens when firms can only offer standard spot market contracts.

Proposition 5: Suppose only standard spot market contracts can be offered. Then the employment history of a representative worker of type A is described by the following.

i) While young he works at a type A firm at wage

$$W^Y = [r_1 v + r_2 (1-v)] [2X^H - (X^L + D)] + [(1-r_1)v + (1-r_2)(1-v)] X^L.$$

ii) If he is in group 1 (group 2), then with probability r_1 (r_2) he stays at his initial employer when old and receives a wage $X^L + D$.

iii) If he is in group 1 (group 2), then with probability $(1-r_1)\delta$ ($(1-r_2)\delta$) he stays at his initial employer when old and receives a wage X^L .

iv) If he is in group 1 (group 2), then with probability $(1-r_1)(1-\delta)$ ($(1-r_2)(1-\delta)$) he switches to a type B firm when old and receives a wage X^L .

Proposition 5 mimics proposition 1, and this is so especially in terms of the behavior of old workers. That is, every high productivity old worker stays at his initial employer, while a low productivity old worker will switch employers if he finds himself at the "wrong" type of firm.

The problem with this equilibrium is that from an ex ante perspective group 1 workers are subsidizing group 2 workers. This is true in that the wage differential between high productivity and low productivity old workers

equals D rather than $X^H - X^L$, and because group 1 and group 2 workers receive the same first period wage. What this implies is that group 1 workers would prefer a contract which promises a larger compensation for high productivity as opposed to low productivity workers. Based on the analysis of the previous sections, this is exactly what an Up-or-Out contract can accomplish.

Proposition 6 considers the nature of equilibrium when both standard spot market contracts and counter-offer Up-or-Out contracts are available.¹³

Proposition 6: Suppose both standard spot market contracts and counter-offer Up-or-Out contracts can be offered. First, all young workers will sign counter-offer Up-or-Out contracts for which $W^Y = [r_1 v + r_2 (1-v)] X^H + [(1-r_1)v + (1-r_2)(1-v)] X^L$ and the retention wage specified in the contract will fall in the interval $(X^L, X^H]$. Second, workers will be indifferent across all contracts in this class. Third, the employment history of a representative worker of type A is described by i) through v) below.

- i) While young he works at a type A firm.
- ii) If he is in group 1 (group 2), then with probability $r_1 \delta$ ($r_2 \delta$) he stays at his initial employer when old and receives a wage X^H .
- iii) If he is in group 1 (group 2), then with probability $r_1 (1-\delta)$ ($r_2 (1-\delta)$) he voluntarily moves to a type B firm when old and receives a wage X^H .
- iv) If he is in group 1 (group 2), then with probability $(1-r_1)\delta$ ($(1-r_2)\delta$) he is not retained by his initial employer when old and moves to a type A firm where he receives a wage X^L .
- v) If he is in group 1 (group 2), then with probability $(1-r_1)(1-\delta)$ ($(1-r_2)(1-\delta)$) he is not retained by his initial employer when old and moves to a type B firm where he receives a wage X^L .

The logic behind proposition 6 builds on the discussion above. The Up-or-Out contract promises a larger return for high productivity as opposed to low productivity workers, and thus is the type of contract preferred by individuals in group 1. Notice, however, that although less severe than for the equilibrium found in proposition 5, the equilibrium in proposition 6 still has group 1 workers subsidizing group 2 workers (this can be seen by considering the expression for W^Y). This is why the proposition states that group 2 workers decide to also sign Up-or-Out contracts rather than separate themselves by signing standard spot market contracts.

From an overall perspective, the lesson of proposition 6 is that if workers have prior information concerning their own productivity, then Up-or-Out contracts may be employed even if the accumulation of human capital is not a significant factor. Further, when Up-or-Out contracts are employed due to this alternative rationale, then the equilibrium can easily be consistent with the stylized facts of the academic market discussed earlier. First, workers may switch employers even after achieving "tenure". Second, the retention wage specified in the contract need not equal the actual retention wage paid. Rather, the actual retention wage paid can be the outcome of a bidding process between the firms.

VII. Conclusion

A firm typically will gather information concerning its own workers which is more accurate than information gathered by other potential employers. In turn, other potential employers will attempt to reduce this information asymmetry by observing the actions of the initial employer. In the present paper I have argued that such a process can be important in environments

characterized by Up-or-Out contracts. The logic is that the retention decision serves as a signal of a worker's productivity, and thus helps reduce the information asymmetry between the firms. The paper investigated the implications of this argument in two environments: (i) a setting where Up-or-Out contracts are employed because they provide the worker with an incentive to accumulate general human capital; and (ii) a setting where Up-or-Out contracts emerge because they are preferred by those more likely to be of high productivity.

Appendix

Due to space considerations, proofs are somewhat abbreviated.

Proof of Proposition 1: A type A worker while young will clearly choose to go to a type A firm. Given this, we can consider the wage setting process for old workers.

Due to competition, the market's wage offer for old workers will be the highest wage offer consistent with a zero expected profit constraint. Given this, consider the following. If the market were to bid higher than $X+G$ for old workers, the initial employer would never be willing to match the offer. Hence, such an offer would attract all old workers, and would lead to negative expected profits. If the market were to bid in the interval $(X+F, X+G]$, the initial employer would only match or exceed the market's offer for high productivity workers. Further, given $D < [(1-p)(1-\delta)(G-F)] / (1-\delta p)$ (see footnote 4), such an offer would also lead to negative expected profits. Suppose the market offer were equal to $X+F$. If the worker's productivity is $X+G$, an initial employer of type A has two options. He can offer $X+F+D$ and receive expected profits of $G-F-D$, or he could offer $X+F$ and receive profits of $\delta(G-F)$. Given $D < [(1-p)(1-\delta)(G-F)] / (1-\delta p)$, the firm will choose to offer $X+F+D$. On the other hand, if the worker's productivity is $X+F$, the initial employer will offer $X+F$ and keep workers who prefer the type A firm. If the worker's productivity is $X+F$ and he prefers a type B firm, he will clearly move to such a firm. Hence, a market offer equal to $X+F$ leads to zero expected profits, and is thus the market offer.

Now consider the worker's choice concerning whether to invest in human capital. Given the above, by investing a worker increases his expected

second period wage by the amount $(p-q)D$. Since $D < I/(p-q)$ (see footnote 4), the worker will choose not to invest. Combining this result with those above we have now proven ii), iii) and iv). Finally, W^Y must satisfy a zero expected profit constraint, i.e.,

$$(A1) \quad W^Y + q(X+F+D) = X + q(X+G),$$

or

$$(A2) \quad W^Y = X + q(G-F-D).$$

This proves i).

Proof of Proposition 2: A type A worker while young will clearly choose to go to a type A firm. If the equilibrium is that workers sign standard spot market contracts then the equilibrium is that described by proposition 1. Hence, for workers to sign simple Up-or-Out contracts there must be a zero expected profit Up-or-Out contract which results in higher expected utility for workers.

Let \tilde{U} denote the expected utility of a worker who signs the standard spot market contract described in proposition 1. \tilde{U} is given by

$$(A3) \quad \tilde{U} = X + q(G-F-D) - (1-\delta)D + X + F + qD - q(1-\delta)D,$$

or

$$(A4) \quad \tilde{U} = 2X + F + q(G-F) - (1+q)(1-\delta)D.$$

Consider a simple Up-or-Out contract for which the retention wage, denoted W^R , is above $X+G$. For such a contract the initial employer will not retain anyone, and thus the retention decision will not serve as a signal of productivity. In turn, this implies the second period wage would not depend on a worker's productivity and subsequently workers would not invest

in human capital. The result is a level of expected utility equal to $\bar{U}+q(1-\delta)D$. This rules out the possibility that workers sign standard spot market contracts. Consider a simple Up-or-Out contract for which $W^R \leq X+F$. For this case and in later steps a trembling hand type assumption is imposed (see footnote 8). It is assumed that if the initial employer is indifferent between retaining and not retaining the worker because for example the worker is bid away with probability one if he is retained, the firm acts as if the market sometimes errs and does not make an offer to the worker. What this implies is that, given $W^R \leq X+F$, the initial employer will try to retain everyone, and thus the retention decision will not serve as a signal of productivity. The result is again a level of expected utility equal to $\bar{U}+q(1-\delta)D$.

Now consider a simple Up-or-Out contract for which $X+F < W^R \leq X+G$. With this contract the firm would retain high productivity workers and not retain low productivity workers. Hence, in this case the retention decision would serve as a perfect signal of productivity. What this means is that the market offer will be $X+G$ for retained workers and $X+F$ for workers not retained, and in the second period a worker will necessarily wind up at the type of firm he prefers. Because he stays at the initial employer more often when $W^R = X+G$, if this type of contract is the equilibrium contract then the equilibrium contract will be characterized by $W^R = X+G$ (see footnote 9).

Given this contract, the expected return to investing in human capital equals $(p-q)(G-F)$, and hence this contract leads to the worker investing. Given the zero expected profit constraint, the value for W^Y for such a contract must equal X , which means the expected utility associated with such a contract equals $\bar{U}+(p-q)(G-F)-I+q(1-\delta)D$. Thus, given $(p-q)(G-F) > I$, this is the

equilibrium contract which proves the proposition.

Proof of Proposition 3: A standard spot market contract works just as in proposition 2. Further, a counter-offer Up-or-Out contract where $W^R \geq X+G$ works exactly the same as a simple Up-or-Out contract with the same retention wage and the same value for W^Y . Thus, if the contracts just mentioned were the only contracts available, the equilibrium contract would be a counter-offer Up-or-Out contract for which $W^Y = X$ and $W^R = X+G$.

Consider a counter-offer Up-or-Out contract for which $W^R \leq X+F$. Because of the assumption concerning specific capital in footnote 8, in this case the firm would attempt to retain everyone. Hence, the retention decision would not serve as a signal of productivity, which implies that such a contract would work just like a spot market contract. This in turn yields that counter-offer Up-or-Out contracts for which $W^R \leq X+F$ are dominated by counter-offer Up-or-Out contracts where $W^R = X+G$.

Now consider a counter-offer Up-or-Out contract for which $X+F < W^R < X+G$. Because of the trembling hand type assumption discussed in the previous proof and in footnote 8, in this case the firm would retain high productivity workers and not retain low productivity workers. This means the retention decision would serve as a perfect signal of productivity. Thus, low productivity workers would be offered $X+F$ by the market, while high productivity workers would be offered $X+G$ by the market. Further, when the worker is of high productivity, the initial employer would make a counter-offer of $X+G$. In other words, such a contract would work exactly the same as a contract where $W^R = X+G$. Hence, workers will be indifferent between any contract for which $W^Y = X$ and $X+F < W^R \leq X+G$. This proves the proposition.

Proof of Proposition 4: We begin by considering how a spot market contract would work in this environment. Consider the wage setting process for old workers. If $z_m = 1$ the market knows that with probability one the worker's productivity is high, and thus the market's offer will equal $X+G$ and the worker will be employed at a wage $X+G$ at the type of firm he prefers. Suppose $z_m = 0$. If D is sufficiently small (see footnote 4), then we can employ the same logic as in the first step of the proof of proposition 1. We thus have the following. First, the market wage offer equals $X+F$. Second, if $z_e = 0$ the counter-offer equals $X+F$ and the worker switches firms if he prefers a different type of employer. Third, if $z_e = 1$ the counter-offer equals $X+F+D$ and the worker does not switch firms even if he prefers a different type of employer. Because of the zero expected profit constraint, the expected sum of a worker's wage over his lifetime must be less than or equal to $2X+pG+(1-p)F$. Combining this with the third result above we have that the expected utility associated with spot market contracting is less than $2X+pG+(1-p)F-I-(1-\delta)D$.

We now consider counter-offer Up-or-Out contracts. In particular, consider counter-offer Up-or-Out contracts for which $W^R = \bar{X}(1,0) > X+F$. If $z_e = 0$ the firm knows the worker's productivity is $X+F$ and the firm will thus not retain the worker. If $z_e = 1$ then the lowest "final" value for expected productivity is $\bar{X}(1,0)$, and the firm will thus retain the worker. What this means is that the retention decision serves as a perfect signal of the initial employer's information, and for a worker who is not retained the market will offer $X+F$ and he will go to the type of firm he prefers.

We now consider the retained worker case in more detail. Suppose $z_m = 1$. Then the market knows the worker's true productivity is high and will bid $X+G$ for the worker. The initial employer would then make a counter-offer equal

to $X+G$, and the worker would move if he prefers a type B firm. Suppose $z_m=0$. A market bid above $\bar{X}(1,0)$ would obviously lose money and is thus not the market bid. Suppose the market bids $\bar{X}(1,0)$. Then the initial employer would know expected productivity equals $\bar{X}(1,0)$ and would thus not make a counter-offer. The result would be that the worker switches firms if he prefers a type B firm. Hence, a market bid of $\bar{X}(1,0)$ earns zero expected profits and is thus the market bid.

Now consider the worker's decision concerning whether to invest in human capital. The return to investing equals either $(p-q)[[t(X+G)+(1-t)\bar{X}(1,0)] - [s\bar{X}(1,0)+(1-s)(X+F)]]$, or an alternative expression where $\bar{X}(1,0)$ is defined in terms of the worker not investing. Let \bar{I} equal the smallest of these two values. Since $I < \bar{I}$, the worker will decide to invest. Given the zero expected profit constraint, the expected sum of a worker's wage over his lifetime equals $2X+pG+(1-p)F$. Combining this with the description of the wage setting process for old workers above we have that expected utility equals $2X+pG+(1-p)F-I-(1-\delta)D$. Thus, this Up-or-Out contract dominates the spot market contract previously described.

The final step of the proof is to demonstrate that this contract dominates any other Up-or-Out contract. Suppose $W^R > X+G$. No worker would ever be retained and thus this contract is dominated by the previous one (see footnote 12). Suppose $W^R = X+G$. If a worker were retained, then with some probability the initial employer would employ the worker at the wage $X+G$ even though his expected productivity is less than $X+G$. This implies that if $W^R = X+G$ no worker would ever be retained, and thus this contract is dominated by the contract where $W^R = \bar{X}(1,0)$. Suppose $\bar{X}(1,0) < W^R < X+G$. The

worker clearly would not be retained if $z_e=0$, but suppose he is retained when $z_e=1$. If $z_m=1$ then the worker's final value for expected productivity equals $X+G$, and his final wage will be bid up to $X+G$, i.e., the initial employer will break even on such a worker. Suppose $z_m=0$. Then the worker's final value for expected productivity equals $\tilde{X}(1,0)$, but the wage if the worker stays exceeds $\tilde{X}(1,0)$, i.e., the initial employer loses money on such a worker if the worker remains at the firm. This again implies no worker would ever be retained and thus this contract is dominated by the contract where $W^R=\tilde{X}(1,0)$. Suppose $W^R \leq X+F$. Now the worker will be retained with probability one, and as stated in the proof of proposition 3 such a contract works just like a spot market contract. Thus, this case can be ruled out using the same arguments as previously. Suppose $X+F < W^R < \tilde{X}(1,0)$. In this case the firm would not retain the worker when $z_e=0$ and would retain the worker when $z_e=1$. Using the logic from the case $W^R=\tilde{X}(1,0)$, for a retained worker if $z_m=0$ then the wage is bid up to $\tilde{X}(1,0)$, while if $z_m=1$ then the wage is bid up to $X+G$. In other words, this case works exactly the same as the case $W^R=\tilde{X}(1,0)$ except now the initial employer will make a counter-offer even if $z_m=0$. However, given that there is now a positive cost of making a counter-offer, this case is also dominated by the case $W^R=\tilde{X}(1,0)$.

Proof of Proposition 5: The proof of this proposition follows along the same lines as the proof of proposition 1 and is therefore omitted.

Proof of Proposition 6: Suppose all young workers sign counter-offer Up-or-Out contracts for which $W^Y=[r_1v+r_2(1-v)]X^H+[(1-r_1)v+(1-r_2)(1-v)]X^L$ and $X^L < W^R \leq X^H$. Using the same logic as in the proof of proposition 2, this contract would result in zero expected profits and the employment history of a representative

worker of type A would be described by i) through v) of the proposition.

Further, the expected utility for this contract for a group 1 worker, denoted \hat{U}_1 , equals $\bar{X} + r_1 X^H + (1-r_1)X^L$, where $\bar{X} = [r_1 v + r_2(1-v)]X^H + [(1-r_1)v + (1-r_2)(1-v)]X^L - (1-\delta)D$, while the expected utility for this contract for a group 2 worker, denoted \hat{U}_2 , equals $\bar{X} + r_2 X^H + (1-r_2)X^L$.

The first step of the proof is to demonstrate that having all workers sign such a contract is an equilibrium, i.e., there is no other available contract associated with non-negative profits which would "break" this equilibrium.

Given the manner in which spot contracts work in this environment (see proposition 5), a zero expected profit spot contract which just attracts group 2 workers would give group 2 workers expected utility less than $2[r_2 X^H + (1-r_2)X^L] - (1-\delta)D$, which is less than \hat{U}_2 . Hence, such a contract would not break the posited equilibrium. A zero expected profit spot contract which attracts both groups of workers would give group 1 workers expected utility less than $2\bar{X} + (1-\delta)D + (r_1 - r_2)D$. For D sufficiently small this value is less than \hat{U}_1 , and thus such a contract does not break the posited equilibrium. Finally, we can rule out the last case concerning spot market contracts by simply pointing out that a spot contract with W^Y sufficiently high to attract group 1 workers would also attract group 2 workers, and we have already ruled out spot contracts which attract both groups of workers.

We now consider other Up-or-Out contracts. One such contract is to leave W^R in the same interval but increase W^Y . Such a contract would attract both groups of workers but would clearly earn negative profits. Another possibility is Up-or-Out contracts where $W^R \leq X^L$. A worker who signs such a contract would be retained with probability one, and as stated in the proof of proposition 3

such a contract works just like a spot contract. Thus, this case can be ruled out using the same arguments as previously. The last case is an Up-or-Out contract for which $W^R > X+G$. In this case no one is retained and the retention decision does not serve as a signal of productivity. A zero expected profit contract of this sort which just attracts group 2 workers would give group 2 workers expected utility equal to $2[r_2 X^H + (1-r_2) X^L] - (1-\delta)D$, which is less than \hat{U}_2 . Hence, such a contract would not break the posited equilibrium. A zero expected profit contract of this sort which attracts both groups of workers would give group 1 workers expected utility equal to $2\bar{X} + (1-\delta)D$. This value is less than \hat{U}_1 , and thus such a contract does not break the posited equilibrium. Finally, we can rule out the last case by simply pointing out that a contract of this sort with W^Y sufficiently high to attract group 1 workers would also attract group 2 workers, and we have already ruled out contracts of this sort which attract both groups of workers. This completes step 1.

The second step is to show that no other equilibrium exists. The way to demonstrate this is basically to show that, starting from any other potential equilibrium, the posited equilibrium can be broken by a counter-offer Up-or-Out contract for which $W^Y = [r_1 v + r_2 (1-v)] X^H + [(1-r_1)v + (1-r_2)(1-v)] X^L$ and $X^L < W^R \leq X^H$. Since to a great extent this entails a simple reversal of the arguments above, this second step is omitted.

Footnotes

¹See also Laing (1987), Milgrom and Oster (1987), Borland and Prendergast (1988), Ricart i Costa (1988), and Novos (1988).

²In a recent paper Laing (1987) also considers the signalling aspects of the retention decision. However, the focus of his paper is quite different than that of the current paper. Rather than showing how this type of signalling can be important for the employment of Up-or-Out contracts, Laing demonstrates how this type of signalling can lead to involuntary layoffs in a standard implicit contract model.

³The assumption that there are only two investment levels is not at all crucial for the results to be derived, but rather is imposed for expositional clarity. The assumption that there are only two realizations for productivity is also not crucial, except for the finding that Up-or-Out contracts lead to first best results.

⁴For the analysis of section IV the specific assumption required is that $D < \min\left(\frac{(1-p)(1-\delta)(G-F)}{(1-\delta p)}, I/(p-q)\right)$. For the analyses of sections V and VI the specific assumptions required are difficult to derive. However, for each case it can be shown that there is a critical value for D strictly greater than zero such that, if D is less than this critical value, then spot market contracts work in an analogous fashion to how they work in section IV. For both section V and section VI it is assumed that D is less than the appropriate critical value.

⁵See Novos (1988) for a similar specification in a paper which focuses on an adverse selection rationale for why firms are composed of multiple tasks.

⁶This is similar to an assumption that workers face an infinitesimally small but positive cost of moving between firms.

⁷One paper which allows contingent contracting in a model of this sort is Ricart i Costa (1988).

⁸There are also two minor assumptions imposed on the contracting process. First, a trembling hand type assumption is imposed for the Up-or-Out contract cases. That is, if the initial employer is indifferent between retaining and not retaining a worker because for example the worker is bid away with probability one if he is retained, the firm acts as if the market sometimes errs and does not make an offer to the worker. Second, if a firm is indifferent between retaining and not retaining a worker because the retention wage equals the worker's productivity, it is assumed the firm tries to retain him. An equivalent way of putting this last assumption is that workers accumulate an infinitesimally small but positive amount of firm specific human capital.

⁹There are actually multiple contracts consistent with equilibrium in the environment analyzed in proposition 2. I focus on the contract where the probability of a worker remaining at his first period employer while old is the highest. This is the equilibrium contract consistent with the assumption that workers face an infinitesimally small but positive cost of moving between firms (see footnote 6).

¹⁰To be precise, there was no post-tenure movement in the Kahn and Huberman analysis, but there was also never a reason for a worker to move if the initial employer matched the wage offers of other potential employers. However, even if such a "reason" for moving were added to their model (say by assuming the type A/B structure of firms assumed here), because human capital is specific in their set-up there would still be no post-tenure movement.

¹¹It is not necessary to assume that every firm in the "market" receives

z_m . Rather, it is only necessary to assume that at least two firms of each type receive z_m .

¹²For I sufficiently small, there are actually multiple contracts consistent with equilibrium in the environment analyzed in proposition 4. As for proposition 2, I focus on the contract where the probability of a worker remaining with his first period employer while old is the highest. Again, this is the equilibrium contract consistent with the assumption that workers face an infinitesimally small but positive cost of moving between firms (see footnote 6).

¹³Due to space considerations I have chosen not to include a proposition concerning simple Up-or-Out contracts. It is clear, however, that such a proposition would mimic proposition 2, i.e., assuming the availability of simple Up-or-Out contracts would make the model consistent with the first stylized fact of the academic market but not with the second. I have also chosen not to include a proposition concerning the case of diffuse information. A proposition along these lines would mimic proposition 4, i.e., assuming information is diffuse would make the results more strongly consistent with the second stylized fact of the academic case.

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