Poachers Welcome: A Theory of High Wages*

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Abstract

A firm with modest commitment power optimally pays its worker more than she produces. By committing to an expensive contract that future poachers must match, firm and worker jointly price her services like a non-discriminating monopolist. Limited commitment caps what the firm can promise; when the constraint binds, the wage premium reflects commitment power, and cyclical poaching intensity generates bonus cycles. The firm collects anticipated proceeds through the initial wage; when a wage floor limits this collection, the firm claws back in work: juniors are inefficiently overworked, effort declining with tenure, as in up-or-out careers in professional services and academia.

JEL classifications: D86, J31, J33, J63

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1 Introduction

Why would a firm commit to paying a worker more than she will ever produce for it? Because the promise is charged to a third party. A poacher must match the value of the worker's current contract to hire her away; the wage path is therefore a price. By committing to wages

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above her productivity, the firm raises what any future poacher must pay, and it collects the anticipated proceeds at the start, through the initial wage – which the worker may pay rather than receive. Even minimal commitment power suffices: what the firm can credibly promise is bounded by what reneging would cost it,[1] but any positive bound sustains wages strictly above marginal product, resulting in negative continuation profits. The high wage is not a retention or incentive device but a posted price: the incumbent firm does not fear the poacher; it welcomes him, and prices accordingly.

The canonical model of poaching rules out such a contract. In the sequential-auction framework of Postel-Vinay and Robin (2002a,b), incumbent and poacher bid for the worker once contact is made, and a firm never pays above the worker's marginal product – precisely because that would mean negative continuation profits – with wages rising in response to outside offers. We show that with even minimal commitment power the incumbent can do better by paying above marginal product. Unable to condition the contract on who arrives, the incumbent-worker pair acts as a *non-discriminating monopolist*: it posts a single "price" and trades the size of the payment against the chance that a poacher will clear it. The wage path alone implements this, so no legal instrument is needed. Give the worker a share in the bargain with the poacher, as in Cahuc et al. (2006), and the framework also delivers the wage gains on job-to-job moves that the literature documents.

The idea that contracting parties can tax a third party who arrives later originates with Diamond and Maskin (1979), whose matched pairs write breach compensation into contracts, and Aghion and Bolton (1987), whose incumbent seller prices entry. In labour markets the instrument has so far been legal: excessive damage clauses (Mühlheusser, 2007; Feess et al., 2015), football transfer fees (Feess and Mühlheusser, 2003; Terviö, 2006), and non-compete agreements (Shi, 2023). Shi (2023) is closest to us: in her model, built on Postel-Vinay and Robin (2002a), a poacher can buy out a non-compete clause; by setting the length of the clause optimally this acts as a monopoly markup.[2] Commitment to an unconditional wage path needs no enforcement against the worker: the buyout is prepaid through the initial wage and collected from the poacher through the matched wages. The observable implications split three ways: fee-based mechanisms predict inter-firm transfers, ours wages above marginal product; non-competes *tend to reduce* backloading in her model, while in ours backloading *is*

[1] Its sources are legal – severance, notice pay, litigation risk – and reputational; the latter is in the tradition of Holmström (1981) that sustains outcomes strictly between the myopic and full-commitment ones.

[2] When the non-compete clause is enforceable in her model, this is similar to our full commitment model with constant arrival probabilities. The clause is essential there, as workers would renege on paying damages.

the extraction; and her mechanism dies where non-competes are unenforceable, ours persists there.

Backloaded pay is common across industries and tenure levels (Altonji and Shakotko, 1987; Topel, 1991), and standard accounts – incentives, human capital, insurance – charge the promise to the worker herself: any late excess merely returns her own earlier underpayment, so the firm loses nothing on the package. As in our paper, in Lazear (1979) the flow wage does go above marginal product, but this happens in order to incentivise the worker's effort; no poaching is present. In Lazear the firm must then force retirement on a worker who clings to her overpaid job; ours welcomes the poacher.

Section 2 sets out the model. Because the initial wage does not affect poaching, it can meet the worker's participation constraint on its own, leaving the later wages free to maximise the joint surplus – so the contract problem reduces to choosing the value a poacher must match. Section 3 introduces limited commitment in reduced form: the firm honours any contract whose expected continuation profits stay above a threshold $-c < 0$, where c is what reneging costs it. We show that, following the initial period, for any $c > 0$ (whether or not limited commitment binds) the present value of the wages exceeds that of the remaining output. Two allocative results follow: monopoly pricing excludes some productivity-enhancing matches, and firms accept matches that production alone would not justify. Section 4 specialises to a constant arrival probability. Whenever commitment is insufficient for the full-commitment solution, that constraint binds in every positive period, delivering a closed-form wage and sharp comparative statics.

Section 5 asks what happens when a wage floor stops the initial wage from falling far enough. The charge must then be recovered differently, and the firm takes it in effort. Deferred-pay accounts would also predict some junior over-work; but here it is greater, as the contract being bought exceeds the worker's lifetime product. Effort declines with tenure until pay jumps to the full extraction level. The resulting career profile – overworked, modestly paid juniors ahead of highly paid seniors – is characteristic of professions such as consulting, banking, law, and academic tenure tracks. Executive pay shows the same structure, deferred equity raising the cost of poaching a senior (Edmans et al., 2017).

2 The model

Time is discrete, $t = 0, 1, \ldots$. There is a worker, W, and a firm, the incumbent, I, both risk neutral and with common discount factor δ. The match between I and W has productivity p. If I hires W, it makes profits $p - w_t$ in period t where w_t is the wage, W's payoff in the period. I operates with constant returns, and so values the match with W on its own merits, however many other workers it already employs. Poaching, in turn, is open to entry – any firm may search for workers already employed elsewhere – so before a firm has found a worker and learned its productivity with her, searching is worth no more than it costs: I's continuation upon losing W is zero. $\underline{U}$ is W's – known and fixed – outside option, available to W at each date. At $t = 0$ I makes W a take-it-or-leave-it offer of a wage schedule $\{w_t\}_{t\geq 0}$. We write $w^t = (w_t, w_{t+1}, \ldots)$ for the wage sequence from period t onwards, and $U_t = \sum_{\tau=t}^{\infty} \delta^{\tau-t} w_\tau$ for the corresponding discounted wage stream.

In each positive period while the worker remains matched with I, a poacher, P, with match productivity $p' > p$ and the same discount factor, may arrive.[3] The probability that a poacher arrives in period t is $1 - q_t \in (0, 1)$ for $t > 0$. Capturing a matching friction, the poacher cannot arrive in period zero: $q_0 = 1$.[4] Sections 4 and 5 specialise to a constant $q_t \equiv q$ $(t > 0)$; the Supplemental Appendix returns to the general case.

p' is *ex ante* uncertain, an independent random draw from a distribution $F(.)$ on $(p, \overline{p}]$. Our general analysis assumes that F has a continuously differentiable density $f(.) > 0$ satisfying the monotone hazard rate (MHR) property: $f/(1 - F)$ is non-decreasing. Our applications take p' to be a known constant instead.

If a poacher arrives in period τ he can tempt W away by offering a take-it-or-leave-it[5] wage schedule $w'^{\tau} = \{w'_t\}_{t\geq\tau}$. The current wage contract is observable to the poacher.[6] If W accepts, she moves immediately and production and payment occur at the poacher; if not, she stays with I, the failed poacher exits, and the arrival process continues.

By the above, a poacher matches the continuation value of the original contract, whenever

[3]For simplicity, a poached worker cannot be poached again; relaxing this only raises the value a poacher places on W, strengthening our results (Supplemental Appendix).

[4]Period zero may in practice be longer: it can stand for an entire apprenticeship, the later periods being much shorter, with appropriate adjustments to p and w_0.

[5]Neither allocation of bargaining power is essential: absent a binding floor, a share for W in the surplus with I shifts only w_0, and a share against P is moot when p' is known, the optimum leaving them no surplus to divide. Section 4.1 takes up the random-p' case.

[6]W would choose to disclose: since a matched offer increases in the value of the standing contract, non-disclosure is bad news and the market unravels to full disclosure.

this is no more than the value of the discounted stream of production. Thus, a poacher arriving at t will poach if and only if $p' \geq (1-\delta)U_t$.[7] Then, the probability of W staying with I at t is

$$\widehat{q}_t\left(U_t\right) = q_t + (1-q_t)F\left((1-\delta)U_t\right). \tag{1}$$

The surplus generated between I and W is the loss of $\underline{U}$, plus p per period while W is with I, and following poaching it is the discounted wage stream. Thus, denoting the (random) arrival time of a successful poacher *by* $\widetilde{t}$, the discounted expected surplus in period 0 is

$$S_0 = E_{\widetilde{t}}[p\sum_{s=0}^{\widetilde{t}-1}\delta^s + \delta^{\widetilde{t}}U_{\widetilde{t}}] - \underline{U}. \tag{2}$$

w_0 does not appear in (2): paid before any poacher arrives, it does not affect his behaviour. Consequently, w_0 is just a transfer between I and W, so it can serve to ensure that W's participation constraint is met, while the other wages can be used exclusively for maximising S_0. Thus, denoting the surplus maximising discounted wage stream from period $t > 0$ on by $\widehat{U}_t$, the optimal initial wage can be written as

$$\widehat{w}_0 = \underline{U} - \delta\widehat{U}_1. \tag{3}$$

3 High wages and limited commitment

The known-p' benchmark. To build intuition, suppose the productivity of the poachers were known to be a constant $p' > p$ – we return to this case in our applications. A wage stream then leads to poaching if and only if $U_t \leq \frac{p'}{1-\delta}$. Therefore, since S_0 is increasing in U_t for all $t > 0$, I would wish to promise W the highest wage stream that would not discourage the poachers from luring her away: $\widehat{U}_t = \frac{p'}{1-\delta}$ for $t \geq 1$, which implies $w_t = p'$. As $p' > p$, I would be paying a wage above W's productivity, leading to a loss in every positive period while W stayed with I. As we will see, uncertainty about p' does not eliminate this feature; what it adds is a genuine pricing problem, since the posted wage now excludes the poachers who value W least.

[7] Committing to a single "price" is not restrictive here: with p' unobservable, it is the optimal selling mechanism (Riley and Zeckhauser, 1983), and their logic carries directly over to our context.

Limited commitment. Paying W above her marginal product tempts I to renege. We therefore parameterise I's commitment power by a constant $c \geq 0$: I can credibly promise any contract whose expected continuation profits *never* fall below $-c$, and will renege – or at least, is expected to renege – on any contract that violates this bound. Full commitment is the limiting case $c = \infty$, while $c = 0$ requires I not to expect a loss at any date; an intermediate c is *limited commitment* (LC). What supports c? Most directly, the law prices I's reneging – severance, notice pay, litigation risk of dismissal without cause[8] – at c. This makes c a measured object, not a free parameter: where employment protection is statutory, dismissal-cost schedules price it directly (Section 6 calibrates the implied premium). In addition, for a repeat-hiring employer, the commitment franchise is the collateral – a fixed point characterised in the Supplemental Appendix, which also shows why no poacher need observe c. Note that, unlike in Shi (2023), W commits to nothing: she is free to leave at any point with no restrictions on what she does afterwards.

We evaluate the LC constraint *after* it is learned that the poaching has not occurred (P did not arrive or the price was too high) but before the wage has been paid, as this is the binding case.[9] Let π_t denote the expected payoff of I from period t, conditional on no poaching in that period. We have

$$\pi_t = p - w_t + \delta \widehat{q}_{t+1} \pi_{t+1} = p - w_t + \sum_{\tau=t+1}^{\infty} (p - w_\tau) \prod_{i=t+1}^{\tau} (\delta \widehat{q}_i) . \tag{4}$$

Limited commitment means that we restrict attention to contracts satisfying

$$\pi_t \geq -c \tag{LC}$$

for all t. By (4), the effective discount factor of I from period t to $t+1$ is $\delta \widehat{q}_{t+1} < \delta$: because I loses the match with positive probability each period, it is effectively more "impatient" than W. This asymmetry in effective patience is what creates the incentive to backload wages.

[8]Whether c is a deadweight loss or a transfer to W is immaterial: either way there is no reneging on path, and no severance is ever paid. Observed dismissals of expensive seniors with severance paid are therefore not evidence against the mechanism: the premium never exceeds what exit costs, so dismissal cannot profitably shed it.

[9]If the period payoff $p - w_t$ is negative, the LC constraint is stricter once it is revealed that the poacher has not arrived. If $p - w_t$ is positive, the constraint can only be violated at t if it is also violated at $t + 1$, so checking the constraint at t is unnecessary.

A recursive characterisation. Define the joint ongoing surplus between W and I from period $t \geq 1$, before it is known whether a poacher will poach at t, recursively:

$$S_t\left(w^t\right) = \left(1 - \widehat{q}_t\left(U_t\right)\right) U_t + \widehat{q}_t\left(U_t\right)\left(p + \delta S_{t+1}\left(w^{t+1}\right)\right). \tag{5}$$

Either poaching occurs – with probability $1 - \widehat{q}_t\left(U_t\right)$ – and they earn (only) the discounted wages, or it does not, and production takes place before they move on to the next period (wage is just a transfer).

Lemma 1 *Let $\widetilde{w}^t = \left(\widetilde{w}_t, \widetilde{w}^{t+1}\right)$ be a maximiser of $S_t\left(w^t\right)$, subject to (LC) from t onwards. Then $\widetilde{w}^{t+1}$ is a maximiser of $S_{t+1}\left(w^{t+1}\right)$, subject to (LC) holding from $t+1$ onwards, and*

$$\widetilde{w}_t \in \arg\max_{w} S_t\left(w, \widetilde{w}^{t+1}\right) \text{ subject to } \pi_t\left(w, \widetilde{w}^{t+1}\right) \geq -c. \tag{6}$$

Since any change in w_τ affects $\widehat{q}_t$ and the LC constraints at all $t < \tau$, backwards induction is not obvious; but as both the surplus upon poaching and the continuation probability at t depend only on U_t, any change in future wages can be "neutralised" by a wage change at t.[10]

Hence our main characterisation:

Proposition 1 *When $c > 0$, from any $t > 0$ on the discounted wage stream exceeds I's discounted production.*

Proposition 1 confirms that I wishes to commit to an expected loss in all periods where a poacher might arrive – now with random productivity, and with commitment power that need only be positive rather than complete.

Remark 1 *The contract is renegotiation-proof: by Lemma 1, at every date the continuation maximises the pair's joint surplus subject to (LC), with w_t an internal transfer, so no bilateral renegotiation is Pareto-improving. In particular, upon a poacher's arrival the pair jointly prefers separation: retention is worth $\pi_t + U_t < U_t$, as $\pi_t < 0$ by Proposition 1.*

The following two observations illustrate the differences with respect to the set-up of Postel-Vinay and Robin (2002a).

[10] Proofs omitted from the text are collected in the Appendix.

Observation 1 *Sometimes W would produce more with the poacher but continues with I.*

The welfare reading is unclear: with no repeat poaching, a move destroys the option of a better match later. In the absence of a general equilibrium model, we eschew a full welfare analysis.

Observation 2 *I is happy to hire a worker with an outside option (slightly) above* $\frac{p}{1-\delta}$.

The extraction from the poacher is thus a hiring subsidy: the rent I anticipates collecting from poachers is worth paying for at the hiring stage, so matches that are unprofitable in production alone are formed. Reading $\underline{U}$ as the value of unemployment, the prospect of poaching may raise employment.

We have an immediate result on the relationship between wages and arrival probabilities.

Corollary 1 *The optimal wage in period* t *is independent of* q_s *for* $s \leq t$ *and varies inversely with* q_{t+1}.

An anticipated poaching wave at T thus raises w_{T-1} and leaves wages from T onwards untouched; under mild regularity the earlier wages also dip, with geometrically damped impact (Supplemental Appendix). Recurring waves generate bonus cycles. Let the arrival probability be $1 - q_e$ in even periods and $1 - q_o$ in odd ones, with even periods the poaching season ($q_e < q_o$), and let $p' > p + c$ be known. Then (LC) binds in every period – the pair would price up to $p'/(1-\delta)$, which c forbids – and $\pi_t = -c$ pins each wage one period ahead of the risk:

$$w_o = p + c\,(1 - \delta q_e), \qquad w_e = p + c\,(1 - \delta q_o) :$$

a base wage $p + c(1 - \delta q_o)$ in every period, plus a bonus $\delta c\,(q_o - q_e)$ on the eve of each poaching season – the timing Van Wesep and Waters (2022) document for banking and law. Random p' preserves the ranking (Supplemental Appendix).

4 Constant arrival probability

When the probability that a poacher arrives does not change over time, the recursive characterisation of Lemma 1 can be explicitly solved for a constant optimal wage (for $t > 0$).

Before characterising the solution with limited commitment, let us derive the unconstrained solution. With a constant wage we can (re)define retention with the wage, rather than U_t, as its argument: $\widehat{q}(w) = q + (1-q)F(w)$.

Proposition 2 *In the full-commitment model with $q_t \equiv q$, there exists a constant wage solution $w_t \equiv \widehat{w}$ (for $t > 0$) that maximises*

$$S(w) = \frac{(1-\widehat{q}(w))\frac{w}{1-\delta} + \widehat{q}(w)p}{1-\widehat{q}(w)\delta}, \tag{7}$$

uniquely solving the first-order condition

$$f(w)(1-\delta)(w-p) = (1-\delta(q+(1-q)F(w)))(1-F(w)). \tag{8}$$

W is hired by I if and only if

$$\underline{U} \leq \frac{\delta\frac{\widehat{w}}{1-\delta}(1-\widehat{q}(\widehat{w})) + p}{1-\widehat{q}(\widehat{w})\delta}. \tag{9}$$

Proof. By Lemma 1 the date-t problem depends on the future only through S_{t+1}, and with $q_t \equiv q$ it is the same problem at every $t > 0$. Selecting the same maximiser at each date is then optimal, and a constant U_t is a constant wage. Substituting a constant wage into (5), noticing that $S_t = S_{t+1} = S$ and solving for S yields (7). To see that the solution is interior, note that the derivative of (7) with respect to w has the same sign as $(1-\widehat{q}(w)\delta)(1-\widehat{q}(w)) - \widehat{q}'(w)(1-\delta)(w-p)$. As $\widehat{q}'(w) > 0$, when $w \leq p$ this is positive, while when $w = \bar{p}$, $\widehat{q}(w) = 1$ and thus the derivative is negative. Substituting in for $\widehat{q}(w)$ and noticing that $(1-q)$ factors out of the right-hand side of the first-order condition gives us (8). By MHR, (8) has a unique solution and S is single-peaked; see the Appendix. The upper bound on W's outside option is a straightforward consequence of the need for a non-negative surplus at time zero. By (2) and (7) this means $0 \leq p + \delta\frac{(1-\widehat{q}(\widehat{w}))\frac{\widehat{w}}{1-\delta} + \widehat{q}(\widehat{w})p}{1-\widehat{q}(\widehat{w})\delta} - \underline{U}$, which is equivalent to (9). □

The full-commitment wage $\widehat{w}$ is the benchmark against which we compare limited commitment: it is attainable when it is cheap enough to be credible, while otherwise the LC constraint binds.

Proposition 3 *i) If $\widehat{w}$ satisfies $\widehat{w} \leq p + c(1-\delta\widehat{q}(\widehat{w}))$, then the LC constraint is satisfied in every period and the solution is the same as with full commitment.*

ii) Otherwise, the constrained optimal wage is lower than $\widehat{w}$ and the LC constraint is binding in every positive period: $\pi_t = -c$ for all $t \geq 1$. Consequently, the optimal wage is the unique solution of $w^* = p + c(1 - \delta\widehat{q}(w^*))$. W is hired if and only if $\underline{U} \leq p + \frac{\delta w^*}{1-\delta} - c\delta\widehat{q}(w^*)$.

Proof. Since expected profits are the same from any period on, (4) simplifies to

$$\widehat{\pi} = \frac{p - \widehat{w}}{1 - \delta\widehat{q}(\widehat{w})},$$

where $\widehat{\pi}$ is full-commitment profits. Thus (LC) is satisfied – in each period – when $\widehat{w} \leq p + c(1 - \delta\widehat{q}(\widehat{w}))$. In contrast, when the optimal wage is higher, the LC constraint is violated. By stationarity and Lemma 1, attention can be restricted to constant wages, and $w - p - c(1 - \delta\widehat{q}(w))$ is strictly increasing ($\widehat{q}$ non-decreasing), so the feasible set is an interval: single-peakedness of S (see proof in Appendix) makes the smaller of $\widehat{w}$ and that interval's upper endpoint optimal, and the constraint binds from $t > 0$ on whenever $\widehat{w}$ does not satisfy it. Finally, $\pi_1 = -c$ and, by (5), $S_1 = U_1 + \widehat{q}(w^*)\,\pi_1 = \frac{w^*}{1-\delta} - c\widehat{q}(w^*)$; the hiring condition is $S_0 = p + \delta S_1 - \underline{U} \geq 0$. □

Corollary 2 Ceteris paribus *the optimal wage is increasing in δ until it hits the LC constraint and it is decreasing from then on. The optimal wage is decreasing in q, irrespective of whether the LC constraint is binding.*

The intuition: by (7) the benefit from backloading is increasing in δ, so higher δ raises the wage; and lower q – a higher probability of a poacher arriving – raises that benefit too. However, when (LC) binds, higher δ or q raise the wage bill, so the wage must fall.

Note that as $c \to 0$, $w^* = p + c(1 - \delta\widehat{q}(w^*)) \to p$, poaching occurs exactly when $p' \geq p$, and I's payoff coincides with that of Postel-Vinay and Robin (2002a), whose wage path is indeterminate under risk neutrality (Shi, 2023). Our protocol resolves the indeterminacy.

4.1 Bargaining with the poacher: wage gains upon a switch

So far the poacher's take-it-or-leave-it offer exactly matches U_t, so a switching worker gains nothing. Suppose instead that W captures a share $\beta \in [0, 1]$ of the surplus from poaching. What she gives up by switching is this period's wage and her continuation – the remaining wage stream *and* the prospect of bargaining with later poachers: writing B_{t+1} for the discounted value of those future gains, her disagreement value is $D_t := w_t + \delta\left(U_{t+1} + B_{t+1}\right)$, and P hires her if and only if $p'/(1-\delta) \geq D_t$: the pair posts the "price" $v_t := (1-\delta)D_t$.

At a constant price v, the pie of a single bargain is a stock – the parties divide lifetime values – of expected size $E^+(v) := \int_v^{\overline{p}} \frac{p'-v}{1-\delta} dF$, the integral running over the poachers who clear v. W's bargaining gains are then a perpetuity: whether retained or poached, next period's option remains hers – kept outright in the first case, priced into the bargain through her disagreement value in the second. Thus

$$B = (1-q)\beta E^+(v) + \delta B \quad \Longrightarrow \quad B = \frac{(1-q)\beta E^+(v)}{1-\delta}.$$

We focus on full commitment or, equivalently, on c large enough that (LC) is slack.[11] The pair chooses the price, and its surplus is (7) evaluated at v plus the pie flow over the match's life, $S(v;\beta) = S(v) + \beta G(v)$, where $G(v) := (1-q)E^+(v)/\left(1-\delta\widehat{q}(v)\right)$ is the expected number of bargaining draws over the match's life times the pie of each, the poacher settling the remainder of W's perpetuity through the price. Again, a constant price is optimal – poaching depends on the contract only through the worker's continuation value – so differentiating gives, at any interior optimum $\widehat{v}(\beta)$,

$$\underbrace{(1-\beta)\left(1-F\right)\left(1-\delta\widehat{q}\right)}_{\text{diluted gain on successful poachers}} + \underbrace{\beta\delta(1-\delta)(1-q)fE^+}_{\text{option value of retention}} = \underbrace{(1-\delta)f\cdot(v-p)}_{\text{exclusion cost}}, \tag{10}$$

which is (8) at $\beta = 0$. For $v \leq p$ the right-hand side is non-positive while the left is positive, so $\widehat{v}(\beta) > p$: the price exceeds marginal product at every β.

At $\beta = 1$, dividing (10) by $(1-\delta)f$ leaves $\delta(1-q)E^+(v) = v - p$: the pair posts its *reservation* value, its premium over marginal product exactly the capitalised option value of future bargains. Extraction happens entirely through W's bargain, and no monopoly markup remains: poachers with p' between p and the reservation price are still turned away, as in Observation 1, but only because those moves would destroy bargaining options worth more.

By $v = w + \delta(1-\delta)B$, $\widehat{w} = \widehat{v} - \delta\beta(1-q)E^+(\widehat{v})$. Rearranging (10), $\widehat{w} - p = (1-\beta)\left(1-F\right)\left(1-\delta\widehat{q}\right)/\left[(1-\delta)f\right]$: wages exceed marginal product at every $\beta < 1$, while at

[11] When (LC) binds, bargaining power enters the firm's books through retention: a stationary binding solution has $w = p + c\left(1-\delta\widehat{q}(v)\right)$ jointly with $v = w + \delta\beta(1-q)E^+(v)$, so a higher β raises the posted price and retention, and *lowers* the wage. The wage is independent of β only where retention is locally fixed, as with a known p'. We leave the constrained optimum under bargaining open.

$\beta = 1$ the wage is exactly p and pay upon a switch exactly p' – the competitive benchmark. Note that the sharing rule of Cahuc et al. (2006) appeals to a different disagreement point: theirs is the losing firm's ceiling, ours the existing contract, which the pair chooses. Their β therefore only divides a surplus – moves occur whenever $p' > p$ – while ours also prices it, moving the posted price monotonically (Appendix) from the monopoly level at $\beta = 0$ to the pair's reservation value at $\beta = 1$, and the wage with it, from that level down to p: as in theirs, pay then equals marginal product at both employers.

Upon a switch the worker's pay jumps by $(\widehat{v} - \widehat{w}) + \beta\,(p' - \widehat{v})$ – non-negative, strictly positive for $\beta > 0$, and increasing in β and in p'.[12] The pair's willingness to hire also expands – its surplus now includes the bargaining gains, reinforcing Observation 2.

5 Wage floors and effort: the young professional

The analysis so far assumed that I could extract any amount from W in period zero. While this fits applications where W "buys" her job (say, a law-firm partnership), in most real situations W must earn at least some $\underline{w} < p$ – a floor – in every period. Shi (2023) assumes a wage constraint of this kind slack; Proposition 4 characterises the optimum when it binds. The overpaid senior of Proposition 1 is unaffected as a mechanism: to tax poachers optimally, the pair must still commit to an expensive contract. What the floor changes is how that commitment is *paid for* – and, once effort is a margin too, the two together reproduce the junior half of an up-or-out career. The clawback exceeds what deferred pay would require: the contract she buys is worth more than her lifetime product.

We work in the known-p' benchmark, with a constant q and c high enough that the LC constraint is slack. The floor constrains the *timing* of pay: I can no longer charge W up front through a low w_0 for the wages it back-loads, so it must lower the wages paid when the poacher may arrive, diminishing the amount it can extract from P.

This reduction is optimally taken at the start of W's tenure: I maximises back-loading subject to W's indifference and the floor. Recalling that absent a binding floor $w_0 = w_0^* := \underline{U} - \frac{\delta p'}{1-\delta}$ and $w_t = p'$ for $t > 0$:

Proposition 4 *If $w_0^* \geq \underline{w}$, then the wage floor does not constrain the optimal wage schedule. If $\underline{w} \in (w_0^*, (1-\delta)\underline{U})$, then the optimal wage schedule is $w_t = \underline{w}$ for $t < n$, $w_n \in (\underline{w}, p']$, and*

[12]Under the wage floor of Section 5 pay rises on a switch even at $\beta = 0$, as the poacher requires more effort in the long run and compensates the worker for it.

$w_t = p'$ for $t > n$, where $n > 0$ and w_n are the unique solution to

$$\frac{1-\delta^n}{1-\delta}\underline{w} + \delta^n w_n + \delta^{n+1}\frac{p'}{1-\delta} = \underline{U}.$$

Finally, if $\underline{w} \geq (1-\delta)\underline{U}$ (recall $\underline{w} < p$), then the optimal wage schedule is $w_t = \underline{w}$ for all t.[13]

The floor raises w_0; with W held to $\underline{U}$, the wages that follow must fall to compensate. I's loss is P's gain: the arriving poacher now pays strictly less than his valuation. The poacher may also arrive while wages are below p, so I earns a positive period profit – in contrast with Proposition 1. Random poacher productivity or limited commitment would only change the final (and middle) wage and the number of periods at $\underline{w}$: maximal back-loading, while keeping W indifferent, continues to be the key.

Unable to extract through the initial wage, I needs another instrument. We therefore add *contractible* effort, which absent the floor would have no qualitative effect, being chosen efficiently and compensated for.

Thus, assume that W's effort $e_t \geq 0$ scales output to pe_t at I and $p'e_t$ at P, at private cost $\psi(e_t)$, with ψ increasing and convex, $\psi(0) = \psi'(0) = 0$ and $\psi'(e), \psi(e) \to \infty$ as $e \to \bar{e}$. Effort is contractible, thus I (and P) offer the stream (w_t, e_t) to W; W's period payoff is $w_t - \psi(e_t)$. Let $\omega(x) := \max_e\{xe - \psi(e)\}$ denote the efficient period surplus at productivity x, and let $\widehat{e}$ and $\widehat{e}'$ denote the efficient effort levels at I and P respectively. As before, a poacher arrives with probability $1-q$ in each period ($q_0 = 1$), re-optimises effort, and values W at $\bar{U} := \omega(p')/(1-\delta)$. Matching W's continuation payoff if she stayed with I

$$U_t = \sum\nolimits_{s \geq t} \delta^{s-t}\left(w_s - \psi(e_s)\right),$$

he poaches if and only if $U_t \leq \bar{U}$. P matches the payoff, not the wage: he will ask for more effort, compensating W for her additional utility cost. Therefore, the optimal (constant) wage after poaching is $w\left(U_t\right) = (1-\delta)U_t + \psi\left(\widehat{e}'\right)$. In the absence of a floor, I would want to make P indifferent, so the optimal wage in the original contract would be $\bar{w} := \omega\left(p'\right) + \psi\left(\widehat{e}\right)$ for $t > 0$ and $w_0^* = \underline{U} - \frac{\delta\bar{w} - \psi(\widehat{e})}{1-\delta} = \underline{U} - \frac{\delta\omega(p')}{1-\delta} + \psi\left(\widehat{e}\right)$.

[13] The middle case of Proposition 4 follows from the proof of Proposition 5 with the effort margin shut down: with $\psi \equiv 0$ (formally outside that proposition's assumptions on ψ) the dichotomy, absorbing-ceiling and multiplier arguments apply verbatim, and the transition occurs in w_n alone. The first case is immediate, the unconstrained schedule being feasible; in the last, participation is slack and back-loading is unrecoverable, so every wage above the floor is a pure cost.

I maximises

$$\Pi = \sum\nolimits_{t \geq 0} \delta^t q^t \left(p e_t - w_t \right) \tag{11}$$

subject to $w_t \geq \underline{w}$, $U_t \leq \bar{U}$, and $U_0 = \underline{U}$.

Proposition 5 *Suppose $\underline{w} \in (w_0^*, \bar{w})$. Then there exists a number $z > 0$ – the* effective length of the clawback phase *– such that, writing $m := \lceil z \rceil$ for its calendar length, the optimal contract is: for $t < m$*

$$w_t = \underline{w}, \qquad \psi'(e_t) = q^{t-z} p > p, \tag{12}$$

$e_m = \widehat{e}$ with $w_m \in [\underline{w}, \bar{w}]$, and $(w_t, e_t) = (\bar{w}, \widehat{e})$ for $t > m$. The transition wage is interior only if $z = m$. As $e_0 > e_1 > \cdots > e_{m-1} > \widehat{e}$, $U_0 < U_1 < \cdots < U_m \leq U_{m+1} = \bar{U}$. The number z and, when it is an integer, the wage w_z are uniquely determined by $U_0 = \underline{U}$.

Figure 1 illustrates. Contractible effort thus gives I a second instrument against the floor: unable to claw back in cash, it claws back in work. W is exactly compensated for the extra effort, but with current wages at the floor the compensation is necessarily deferred. Her payoff is unchanged; what rises is the U_t an arriving poacher must match. Poachers arriving in this phase therefore bear both the transfer and the deadweight loss from over-work.

With random p' the qualitative features carry over, and the faster back-loading acquires an allocative dimension. A move to a poacher of productivity p' raises output whenever $p' > p$, but occurs only if $\omega(p')/(1 - \delta) \geq U_t$. The floor itself lowers early U_t, admitting poachers whom the premium of Section 4 excludes; the deferred compensation for over-work works the other way, raising early U_t and with it the productivity threshold a poacher must clear, so some productivity-improving moves are excluded while the floor binds, alongside the inefficiency of over-work.

6 Discussion

Allowing P to be poached in turn leaves the analysis intact: it makes P an extractor too, raising the value he places on W and hence the ceiling on what I extracts. Poaching still depends on the contract only through U_t, the sole property Lemma 1 uses, so the recursive characterisation, and with it Propositions 1 and 3, survives. The Supplemental Appendix

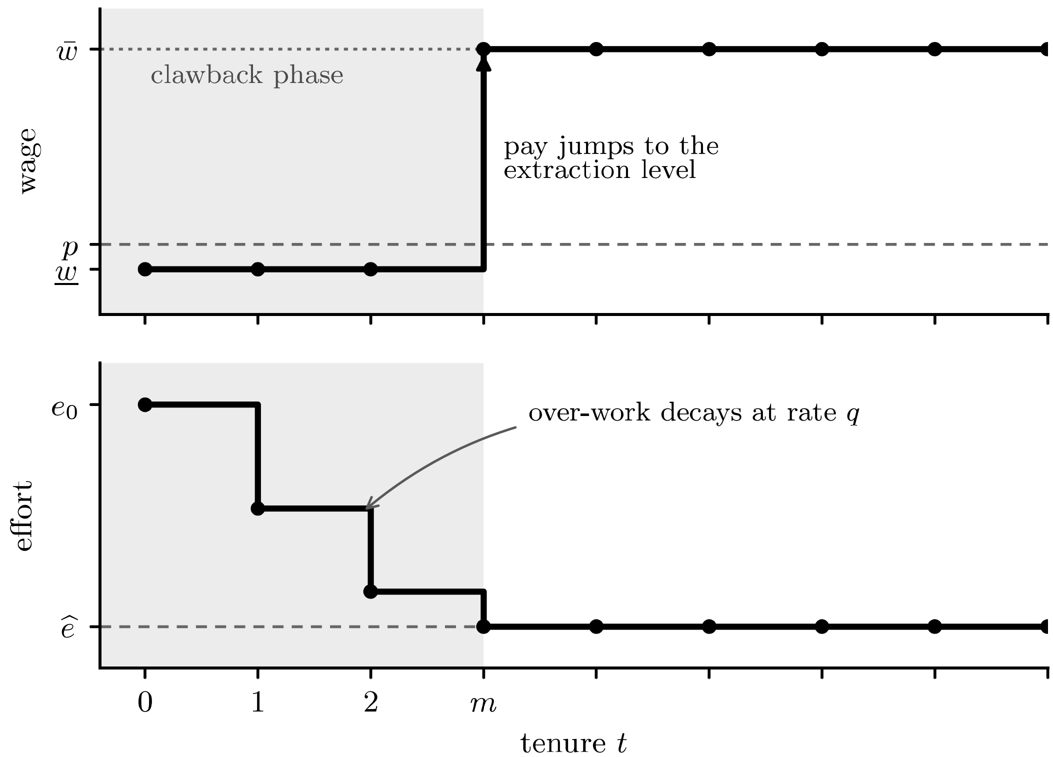

Figure 1: The young professional. During the clawback phase ($t < m$) the wage sits at the floor $\underline{w} < p$ and effort exceeds $\widehat{e}$, with $\psi'(e_t)$ declining geometrically at rate q by (12); at m pay jumps to $\bar{w}$ and the firm earns $p\widehat{e} - \bar{w} < 0$. W's *ex ante* value is $\underline{U}$, but her continuation value U_t – the price a poacher must match – rises through the phase. Parametrisation: $\psi(e) = e^2/2$, $p = 1$, $p' = 1.6$, $\delta = 0.9$, $q = 0.8$, $\underline{w} = 0.9$, $z = 2.5$, so $m = 3$, $\bar{w} = 1.78$ and $\underline{U} \approx 8.86$.

develops this formally and contains the reputational foundation for c of Section 3 – with its fixed point and the observability argument.

Four predictions separate the model from existing theories. (i) The wage steps up at a date fixed in advance, and pay peaks on the eve of anticipated poaching waves (Van Wesep and Waters, 2022) – timed to the risk, not to documented outside offers, unlike insurance and offer-matching models (Harris and Holmström, 1982; Postel-Vinay and Robin, 2002a). (ii) A poached senior relieves the incumbent of a committed loss, so firm value should *rise* on departure, where retention and human-capital theories predict a fall; deferred compensation (Lazear, 1979) agrees here, but not on (iv). (iii) Fee-based extraction mechanisms predict inter-firm transfers,[14] whereas ours predicts wages above marginal product, which should *in-*

[14] These may involve a transfer by the poacher to the worker to buy out a non-compete clause, as in Shi (2023).

crease where non-compete clauses are banned (Federal Trade Commission, 2024), consistent with the enforceability evidence (Johnson et al., 2025; Shi, 2023). (iv) The premium over marginal product is determined by poaching risk, by commitment institutions, and by their interaction, the institutional loading vanishing where poaching risk is nil – an interaction no incentive or human-capital account delivers.[15]

APPENDIX: OMITTED PROOFS

Proof of Lemma 1: Suppose that $\widetilde{w}^{t+1}$ is not a maximiser of $S_{t+1}\left(w^{t+1}\right)$. We improve on it with $(w_t', \widehat{w}^{t+1})$, where $\widehat{w}^{t+1}$ maximises S_{t+1} subject to (LC) from $t+1$ onwards and w_t' leaves U_t unchanged:

$$w_t' = U_t\left(\widetilde{w}^t\right) - \delta U_{t+1}\left(\widehat{w}^{t+1}\right).$$

Then $S_t\left(w_t', \widehat{w}^{t+1}\right) > S_t\left(\widetilde{w}^t\right)$, by (5), as U_t is unchanged and the coefficient $\delta\widehat{q}_t > 0$ on S_{t+1}, while $S_{t+1}\left(\widehat{w}^{t+1}\right) > S_{t+1}\left(\widetilde{w}^{t+1}\right)$ by the definition of $\widehat{w}^{t+1}$. (LC) holds at all later dates by construction. At t, if W is not poached the ex-post joint surpluses are

$$p + \delta S_{t+1}\left(\widehat{w}^{t+1}\right) = \pi_t\left(w_t', \widehat{w}^{t+1}\right) + U_t\left(w_t', \widehat{w}^{t+1}\right)$$

and

$$p + \delta S_{t+1}\left(\widetilde{w}^{t+1}\right) = \pi_t\left(\widetilde{w}^t\right) + U_t\left(\widetilde{w}^t\right).$$

As $S_{t+1}\left(\widehat{w}^{t+1}\right) > S_{t+1}\left(\widetilde{w}^{t+1}\right)$, and U_t is by construction unchanged, $\pi_t\left(w_t', \widehat{w}^{t+1}\right) > \pi_t\left(\widetilde{w}^t\right)$. As $\pi_t\left(\widetilde{w}^t\right) \geq -c$ by assumption, (LC) holds, contradicting the optimality of $\widetilde{w}^t$. (6) follows. $\square$

Proof of Proposition 1: (a) Consider

$$G_t(x, y) := (1 - q_t)(1 - F(x))\,x + (q_t + (1 - q_t)F(x))y.$$

[15] A back-of-the-envelope calibration suggests the premium is not small. With monthly periods, the binding-LC wage of Proposition 3 exceeds marginal product by $c(1-\delta\widehat{q}) \approx c\,(r+\lambda)$, where r is the monthly interest rate and $\lambda = 1 - \widehat{q}$ the monthly job-to-job transition rate; take $\lambda = 2\%$ (Fallick and Fleischman, 2004) and $r = 0.4\%$. The commitment c is whatever escaping the contract costs the firm, and by footnote 8 its incidence is irrelevant. Where employment protection is statutory, c can be calculated directly: in Spain, dismissal without valid cause costs 33 days' pay per year of service (capped at 24 months), so six years' tenure gives $c \approx 6.6$ monthly wages and, solving $w^* = p + c(r+\lambda)$ with c in wage units, $w^*/p \approx 1.19$. Contractual protection of say six months severance – routine at senior US professional levels – supports a comparable premium (roughly 17 per cent). Reputational costs are likely to be largest for large, repeat-hiring employers in high-poaching markets – exactly where the up-or-out and bonus-cycle evidence sits. The premium requires both: it vanishes if either commitment or poaching risk is absent – prediction (iv) in miniature.

Suppose that $y \in [p, \overline{p})$ and let $x_t^* \in \arg\max_x G_t(x, y)$ subject to $x \leq y + c(1-\delta)$. For $x \leq y$, $G_t(x, y) \leq y$, for $x \geq \overline{p}$, $F(x) = 1$ so $G_t(x, y) = y$, and for $x \in (y, \overline{p})$, $G_t(x, y) > y$ as $(1 - F(x)) > 0$, so by continuity a solution $x_t^* > y$ exists.

(b) Let $y_t = (p + \delta S_{t+1}(\widehat{w}^{t+1}))(1-\delta)$; then $G_t(x_t^*, y_t) = S_t(\widehat{w}^t)(1-\delta)$ and $x_t^* = U_t(\widehat{w}^t)(1-\delta)$, by (1), (5) and Lemma 1, given (LC) at t, verified below.

Setting $w_{t'} = p$ for all $t' \geq t+1$ yields a surplus of $p/(1-\delta)$ and satisfies (LC), so $S_{t+1}(\widehat{w}^{t+1}) \geq p/(1-\delta)$ and hence $y_t \geq (p + \delta p/(1-\delta))(1-\delta) = p$. Also $y_t < \overline{p}$: every realisation of the surplus is production $p < \overline{p}$ until poaching plus a matched value of at most $\overline{p}/(1-\delta)$ thereafter, so $S_{t+1} < \overline{p}/(1-\delta)$ and $y_t < (1-\delta)p + \delta\overline{p} < \overline{p}$.

As $y_t \in [p, \overline{p})$, part (a) applies at $y = y_t$, and as $c > 0$ every $x \in (y_t, \overline{p})$ satisfies the constraint. Hence $x_t^* \in (y_t, \overline{p})$ and $G_t(x_t^*, y_t) > y_t \geq p$, so $U_t(\widehat{w}^t)(1-\delta) = x_t^* > p$.

Finally, the constraint in (a) gives $U_t(\widehat{w}^t) \leq (p + \delta S_{t+1}(\widehat{w}^{t+1})) + c$, i.e. $\pi_t(\widehat{w}^t) = p + \delta S_{t+1}(\widehat{w}^{t+1}) - U_t(\widehat{w}^t) \geq -c$. □

Proof of Corollary 1: Independence is immediate: neither the first-order condition below nor the binding wage $p + c(1 - \delta\widehat{q}_{t+1}(U_{t+1}))$ involves any q_s, $s \leq t$. For the comparative static, hold $\widehat{w}^{t+1}$ constant, as Lemma 1 permits; the first-order condition from (5) for U_t is

$$p + \delta S_{t+1}\left(\widehat{w}^{t+1}\right) = U_t - \frac{1 - F(U_t(1-\delta))}{(1-\delta) f(U_t(1-\delta))}.$$

Under MHR, $(1-F)/f$ is non-increasing, so the right-hand side is globally strictly increasing in U_t and the interior solution is unique, while the left-hand side falls with q_{t+1}: $\partial S_{t+1}/\partial\widehat{q}_{t+1} = p + \delta S_{t+2} - U_{t+1} = \pi_{t+1} < 0$ by Proposition 1. Therefore U_t, and with it w_t, is decreasing in q_{t+1}. If instead (LC) binds at t, then

$$w_t = p + c + \delta\widehat{q}_{t+1}\pi_{t+1},$$

and the result again follows from $\pi_{t+1} < 0$. □

Proof of uniqueness and single-peakedness in Proposition 2: Computing, $S'(w) = \frac{(1-q)\varphi(w)}{(1-\delta)(1-\delta\widehat{q}(w))^2}$, where

$$\varphi(w) := (1 - F(w))(1 - \delta\widehat{q}(w)) - f(w)(1-\delta)(w-p),$$

so that (8) is $\varphi = 0$. For $w \leq p$, $\varphi > 0$. On $(p, \overline{p})$,

$$\frac{\varphi(w)}{1-F(w)} = 1 - \delta\widehat{q}(w) - \frac{f(w)}{1-F(w)}(1-\delta)(w-p)$$

is strictly decreasing: the first term is decreasing while, by MHR, the second is increasing (strictly, as $w-p$ is). Since $\varphi(\overline{p}) = -f(\overline{p})(1-\delta)(\overline{p}-p) < 0$, φ crosses zero once, from above: (8) has a unique solution and S is single-peaked. $\square$

Proof of Corollary 2: Write

$$\varphi(w, \delta, q) := (1 - F(w))\,(1 - \delta\widehat{q}(w)) - (1-\delta)\,(w-p)\,f(w),$$

so that (8) reads $\varphi(w^*, \delta, q) = 0$. Below we suppress the argument w^* of F, f, f' and $\widehat{q}$. Using $\widehat{q}' = (1-q)f$, implicit differentiation in δ gives

$$\frac{dw^*}{d\delta} = \frac{(w^*-p)\,f - \widehat{q}\,(1-F)}{D}, \qquad D := (1-\delta)\,(w^*-p)\,f' + 2f\,(1-\delta\widehat{q})\,.$$

By (8), $1-\delta\widehat{q} = (1-\delta)\,(w^*-p)\,f/\,(1-F)$. Substituting, the numerator becomes $\delta^{-1}[(w^*-p)f - (1-F)]$, while

$$D = \frac{(1-\delta)\,(w^*-p)}{1-F}\left(f'\,(1-F) + 2f^2\right), \tag{13}$$

so that $dw^*/d\delta$ has the same sign as

$$\frac{\dfrac{f}{1-F} - \dfrac{1}{w^*-p}}{\dfrac{1}{(1-F)^2}\,(f'\,(1-F)+2f^2)}. \tag{14}$$

By (8), $w^* - p = \frac{1-\delta\widehat{q}(w^*)}{1-\delta} \cdot \frac{1-F(w^*)}{f(w^*)} > \frac{1-F(w^*)}{f(w^*)}$, since $\widehat{q}\,(w^*) < 1$, so the numerator of (14) is positive; the denominator is positive since MHR gives $f'\,(1-F) + f^2 \geq 0$.

Similarly, differentiating (8) in q yields, with the same denominator D,

$$\frac{dw^*}{dq} = -\frac{\delta\,(1-F)^2}{D} < 0,$$

again by MHR and (13).

When the LC constraint binds, $w^* = p + c(1 - \delta\widehat{q}(w^*))$; implicit differentiation gives

$$\frac{dw^*}{d\delta} = -\frac{c\,\widehat{q}(w^*)}{1 + c\delta\widehat{q}'(w^*)} < 0 \quad \text{and} \quad \frac{dw^*}{dq} = -\frac{c\delta\,(1 - F(w^*))}{1 + c\delta\widehat{q}'(w^*)} < 0,$$

both denominators being positive as $\widehat{q}' \geq 0$. $\square$

The bargaining optimum (Section 4.1): Under full commitment Lemma 1 applies with D_t in place of $U_t - w_t$ still shifts D_t one for one, and there is no (LC) step – so attention can be restricted to constant prices. At a constant price the pair collects $v/(1-\delta) + \beta(p' - v)/(1-\delta)$ from each clearing poacher, so $S = \widehat{q}(v)(p + \delta S) + (1 - \widehat{q}(v))\frac{v}{1-\delta} + \beta(1-q)E^+(v)$, i.e. $S(v;\beta) = S(v) + \beta G(v)$. Differentiating, $S_v = (1-q)f\varphi_\beta / \left[(1-\delta)(1-\delta\widehat{q})^2\right]$, where

$$\varphi_\beta(v) := (1-\beta)\frac{1-F}{f}\,(1 - \delta\widehat{q}) + \beta\delta(1-\delta)(1-q)E^+ - (1-\delta)(v-p),$$

so that (10) is $\varphi_\beta = 0$. By MHR, φ_β is strictly decreasing; it is positive just above p (at $\beta = 1$ because $E^+(p) > 0$) and negative at $\overline{p}$. Hence $\widehat{v}(\beta)$ exists, is unique and interior, and S is single-peaked in v.

Since $S_{v\beta} = G'$, $\operatorname{sign}\widehat{v}'(\beta) = \operatorname{sign}G'(\widehat{v})$. With $E^{+\prime} = -(1-F)/(1-\delta)$ and $\widehat{q}' = (1-q)f$, G' has the sign of $\delta(1-\delta)(1-q)fE^+ - (1-F)(1-\delta\widehat{q})$; and since MHR bounds the mean residual life by the inverse hazard, $(1-\delta)E^+ = \int_v^{\overline{p}}(1-F) \leq (1-F)^2/f$, that expression is at most $\delta(1-q)(1-F)^2 - (1-F)(1-\delta\widehat{q}) = -(1-\delta)(1-F) < 0$. The price thus falls strictly in β. Substituting $\varphi_\beta = 0$ into $\widehat{w} = \widehat{v} - \delta\beta(1-q)E^+(\widehat{v})$ leaves $\widehat{w} - p = (1-\beta)\,(1-F)\,(1-\delta\widehat{q})\,/\,[(1-\delta)f]$; and $d\widehat{w}/d\beta = \widehat{v}'\,[1 + \delta\beta(1-q)(1-F)/(1-\delta)] - \delta(1-q)E^+ < 0$. $\square$

Proof of Proposition 5: Using $w_t = U_t - \delta U_{t+1} + \psi(e_t)$ to substitute wages out of (11) and summing by parts,

$$\Pi + \underline{U} = \sum_{t\geq 0} \delta^t q^t\,(pe_t - \psi(e_t)) + (1-q)\sum_{t\geq 1}\delta^t q^{t-1}U_t. \tag{15}$$

Each U_t ($t \geq 1$) has a positive coefficient, so I pushes each U_t up until either $w_{t-1} = \underline{w}$ or $U_t = \bar{U}$; and $e_t < \widehat{e}$ is never optimal (raising it to $\widehat{e}$ raises (15) and relaxes the floor), so $\psi(e_t) \geq \psi(\widehat{e})$.

The ceiling is absorbing: if $U_t = \bar{U}$ and $w_t = \underline{w}$, then $U_{t+1} = (\bar{U} - \underline{w} + \psi(e_t))/\delta > (\bar{U} - \bar{w} + \psi(\widehat{e}))/\delta = \bar{U}$, using $\underline{w} < \bar{w} = (1-\delta)\bar{U} + \psi(\widehat{e})$ – a contradiction; hence $w_t > \underline{w}$ and, by the dichotomy, $U_{t+1} = \bar{U}$. While the ceiling binds the floor is slack, so e_t enters (15) only through $pe_t - \psi(e_t)$: $e_t = \widehat{e}$ and $w_t = \bar{w}$. The floor thus binds on an initial interval $\{0, \ldots, m-1\}$, $m \leq \infty$, with $U_t < \bar{U}$ there, and the contract is $(\bar{w}, \widehat{e})$ from $m+1$. (If $U_m = \bar{U}$, w_{m-1} is undetermined by the dichotomy, but the floor binds there too: $\mu_{m-1} = \delta^{m-1}(q^{m-1} - q^z) > 0$ when $z > m-1$.) ($m \geq 1$: floor slack at 0 would give $U_1 = \bar{U}$, $e_0 = \widehat{e}$, hence $w_0 = w_0^* < \underline{w}$.)

Attaching multipliers $\mu_t \geq 0$ to $w_t \geq \underline{w}$ and $\nu_t \geq 0$ to $U_t \leq \bar{U}$, the first-order conditions are

$$\psi'(e_t) = \frac{\delta^t q^t}{\delta^t q^t - \mu_t}\, p, \qquad \mu_t = \delta \mu_{t-1} + \nu_t - (1-q)\delta^t q^{t-1}. \tag{16}$$

On the floor $\nu_t = 0$ and $\mu_t = \delta^t(q^t - K)$. If $m = \infty$, then $\mu_t \geq 0$ for all t forces $K \leq 0$, making the first condition in (16) impossible; hence $m < \infty$. At m the floor multiplier vanishes, $\mu_m = 0$ – by complementary slackness if $w_m > \underline{w}$, by continuity at the junctions below if $w_m = \underline{w}$ – so $e_m = \widehat{e}$, while $\nu_m = \delta^m(K - q^m) \geq 0$ and $\mu_{m-1} \geq 0$ give $K \in [q^m, q^{m-1}]$. Setting $z := \log_q K$ delivers (12); if $U_m < \bar{U}$ then $\nu_m = 0$, so $z = m$ and $w_m = U_m - \delta\bar{U} + \psi(\widehat{e})$ is interior, and otherwise $w_m = \bar{w}$; the boundary $z = m-1$ coincides with the integer representation at $m-1$, so $m = \lceil z \rceil$. Since $\delta^t q^t - \mu_t = \delta^t q^z > 0$, the Lagrangian is concave in (e, U) here, so these conditions are sufficient.

By (12), $e_0 > \cdots > e_{m-1} > \widehat{e}$. On the floor, subtracting consecutive accounting identities, $U_t - U_{t-1} = \delta(U_{t+1} - U_t) + \psi(e_{t-1}) - \psi(e_t)$, and $U_m \geq \underline{w} - \psi(\widehat{e}) + \delta\bar{U}$ gives $U_m - U_{m-1} \geq \delta(\bar{w} - \underline{w}) + \psi(e_{m-1}) - \psi(\widehat{e}) > 0$; backward induction yields $U_{t-1} < U_t$ for all $t \leq m$. Finally, U_0 is continuous and strictly decreasing along this one-dimensional family – in z over non-integer stretches, in falling w_z at integer z, with values coinciding at the junctions – and spans $\big(-\infty, \underline{w} - \psi(\widehat{e}) + \delta\bar{U}\big) \ni \underline{U}$, by $\underline{w} > w_0^*$ and $\psi(e_0) \to \infty$ as $z \to \infty$. Hence $U_0 = \underline{U}$ pins down z and, at integer z, w_z. $\square$

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