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Mediocrity in Talent Markets

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Abstract

A model of a labor market is proposed where the level of individual talent can only be learned on the job and where job positions are scarce. Inability to commit to long-term contracts leaves firms with insufficient incentives to hire novices, causing them to bid excessively for the pool of revealed talent instead. This causes the market to be plagued with too many mediocre workers and inefficiently low output levels, while simultaneously raising the wages for high talents. This problem is most severe where information about talent is initially very imprecise but revealed relatively quickly on the job. I argue that high incomes in professions such as entertainment, team sports, and entrepreneurship, may at least partly be explained by the nature of the talent revelation process in those markets. I suggest historical episodes that could be used to identify the inefficiency and the excessive talent rents predicted by the model.

JEL codes J31, D30.

1 Introduction

This paper presents a model of a talent market where industry-specific talent can only be revealed on the job and publicly. The two crucial features of the model are that individuals have finite lives and that output has finite demand. This results in a scarcity of both revealed talent and of job slots. The market price of output has an important role in determining wages: it must adjust to accommodate the hiring of novices, without which the industry would run out of workers. I show that, when output and information about worker productivity are jointly produced, then typical labor market imperfections yield an artificial scarcity of known talent, too little exit from the industry, and artificially high talent rents.

When individuals cannot commit to long-term wage contracts, the value of information accrues as rents to those who turn out to be high talents and see their wages bid up, while the firms that hired them do not get rewarded for the discovery. Unless individuals are able to pay for the opportunity to reveal their talent, firms will only take into account their expected talent for the near term and ignore the upside potential of previously untried individuals. Firms then prefer to hire someone who is known to be even slightly above the population mean to hiring a novice of unknown type. There is thus an inefficiently low level of exit from the industry, especially by relatively inexperienced workers. If talent is revealed relatively quickly, then most of the active workforce may consist of "mediocre" types who would exit the industry in the efficient solution. Instead they stay in the industry, producing output that crowds out entry by novices. The industry as a whole has what is in effect an up-or-out rule, but this rule is unduly lenient.[1]

If individuals were risk neutral and had sufficient funds, then previously untried individuals would be able to pay for the chance to find out their talent level, up to the expected value of their lifetime talent rents. This would lead to an efficient solution, where even relatively high talents exit the industry if their job slots have higher social value in trying to discover even higher talent. With uncertain return to such talent (i.e. when talent rents mostly accrue to a minority of very successful individuals) the willingness of young individ-

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[1]Efficient up-or-out rules are possible when information is match-specific; see e.g., O'Flaherty and Siow (1995). For a signalling perspective to up-or-out rules see Waldman (1990) or Kahn and Huberman (1988).

uals to pay for future rents can be much below the expected value. Credit constraints or even moderate levels of risk aversion can cause the market outcome to deviate considerably from full efficiency.

Perhaps surprisingly, the opportunity to save aggravates the inefficiency caused by a credit constraint. Saving by "has-been" individuals who perform well early in their career, but who fall below population mean in expected talent later, allows them to outbid credit constrained novices. Their incentive to pay for job slots is the chance of more talent rents in the future: since talent is only revealed over time, the has-beens still retain some upside potential, albeit less than the novices. However, after sufficiently bad performance even the has-beens exit, regardless of their savings.

This paper provides a plausible explanation for high and skewed wages in many industries that appear to have high talent rents. As an explanation, it is complementary to theories based on scale effects[2] (see, e.g.,Lucas 1978 and Rosen 1982) and superstar economics (Rosen 1981), even though less benign in the sense that it is associated with possibly dramatic ineffi-ciencies. These papers are concerned with the efficient allocation of capital (and consumers) to known talent, whereas the focus here is on the discovery process of talent. For example, we might wonder why some alternative manager wouldn't be nearly as good as the current CEO with his exorbitant compensation, scale effects notwithstanding. This paper shows how the supply of talent, as observed in the market, can be very scarce even when it is not so in the population; and, more importantly, revealed talent can be much more scarce than it need be due to the twin imperfection of spot contracts and credit-constrained (or risk averse) individuals.

This paper also provides predictions about what kind of talents and industries could be expected to exhibit high and uneven wages. Inasmuch as a talent market fits the assumptions of the model, it can be expected to be flooded by too many mediocre workers. Such a market would react to certain exogenous changes, particularly to individual commitment ability and to access to credit, in ways that could be used to identify and quantify the inefficiencies described in the model. The benefit from ameliorating market imperfections comes through

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[2]With a scale effect or "scale-of-operations effect" differences in talent are accentuated when higher talent is matched with more productive complementary resources, such as capital.

higher exit rates for young workers, a prediction at odds with standard training and human capital models. Higher exit rates would in turn show up as increased productivity, lower wages and decreased wage dispersion.

In this paper talent corresponds to level of output. Jobs within an industry are homogeneous, as if all workers operated identical "machines." To say that one individual is twice as talented as another means that he produces twice as much output (possibly in expectation, or in quality-adjusted "hedonic" units). The economic value of talent is endogenous and depends on the equilibrium price of output. Under this definition of talent, it is meaningful to consider a thought experiment where the distribution of talent is the same in two industries.

In order to focus on learning, several commonly studied features of labor markets are assumed away in this paper. There is no on-the-job training or learning-by-doing, so experience per se is not economically valuable. Neither are there any frictions such as hiring or firing costs, nor any organizational capital to speak of. Information is symmetric at all times: there are no effort problems, career concerns, or adverse selection. The homogeneity of job slots rules out any problems with job assignment within the industry.

The inefficiency described here could, in principle, be identified given a suitable natural experiment. An exogenous change in individuals' commitment ability would be ideal. For example, the end of the studio system in the motion picture industry in the 1940s is a change that the model predicts would lead to rehiring of mediocre talent. Under the studio system, young actors were able to commit to long-term contracts with motion picture companies. Available stylized facts of decreased revenue and output, as well as the casual evidence of increased wages, are consistent with the predictions of the model. However, contemporaneous changes, in particular the advent of television, make it difficult to draw strong conclusions.

The joint production problem of output and information about worker quality has been well understood since Johnson (1978) and Jovanovic (1979). The social planner's solution in this type of problems draws on the "bandit" literature (see, e.g., the treatise by Gittins, 1989, and Miller, 1984, who uses the bandit approach in a multi-sector setting). MacDonald (1988) presents a stochastic version of Rosen's superstars model, where superstars are selected based on earlier performance. These papers solve for the efficient equilibrium; the focus here is on how the market handles the discovery of talent under the constraints to individual

credit and commitment ability. In this way, the model is analogous to setups where firms should give training in general skills but don't have sufficient incentives, due to the same standard labor market imperfections. This literature uses additional imperfections, typically asymmetric information (proposed by Greenwald 1986), to give firms incentives to train (see, e.g., Acemoglu and Pischke, 1998).

The plan of the paper is as follows. In Section 2, a numerical example is used to illustrate the basic ingredients of the model. Section 3 presents the basic model of a talent market, with the simplest possible revelation process: individual talent is initially unknown, and then becomes public knowledge after one period on the job. Mediocrity and the loss associated with inefficient hiring are defined in an empirically quantifiable way. Section 4 extends the model to many periods, with talent revealed gradually over time. This makes it possible to study the effects of saving. Section 5 discusses the relevance of the findings for real-world talent markets, and suggests possible natural experiments to identify and quantify the welfare cost of mediocrity. Section 6 concludes the paper.

2   Example: A Simple Talent Market

Consider a competitive industry that combines workers with capital (machines for producing output). There is free entry by firms, which each need one worker to operate one machine that has a rental cost of \$4 million.[3] All units of output are identical, and the amount of output that a firm produces depends solely on the talent of its worker (later in the paper it will be more natural to interpret talent as affecting quality, and the market price as being for hedonic "quality-adjusted" units of output). There is an unlimited supply of potential workers with an outside wage of zero (outside meaning outside the industry). A novice is equally likely to produce anywhere between zero and one hundred units.[4] The talent of a novice worker is unknown (including to himself), but becomes public knowledge after one period of work. Careers are finite and last at most 16 periods. Workers cannot commit to decline higher outside wage offers in the future. Industry output faces a downward-sloping

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[3] All numbers in this example are chosen for convenience.

[4] For example, the machine could have a capacity for one hundred units per period, and talent could determine the proportion of successfully completed units.

demand curve, and the number of firms is "large," so that firms take the market price as given and there is no aggregate uncertainty. Finally, for simplicity, there is no discounting.

How does this talent market work? That depends crucially on whether aspiring workers can pay for the opportunity to work. There are two extreme cases to consider. In the first, individuals are constrained to take a non-negative wage. This is the inefficient, but at the same time also the more straightforward case. In the second case, individuals are risk neutral and not credit-constrained. Due to the absence of imperfections, this is, not surprisingly, the efficient benchmark.

The purpose of the example is to compare the distribution of talent and wages in the industry under these two cases. Only the steady state is considered, where the number of entering and exiting workers is constant over time.

Constrained Individuals

In this case, all workers who turn out to be above the population mean (i.e., those who were able to make 50 units or more) will stay in the industry until they retire. These veterans create more revenue than a novice in expectation, so they can always outcompete them for a job in this industry.

The market price of output must be such that novice-hiring firms break even. Since potential novices are not scarce, they will always be paid zero. A novice is expected to make 50 units, so an output price of ($4 million)/(50 units)= $80,000 ($80K) per unit is needed to cover the capital cost. At this price there is no entry or exit of firms from the industry.

Veteran workers are always scarce. Due to free entry, firms cannot make positive profits and will bid up the wages of veteran workers, who get the difference between their revenue-generating capacity and that of a novice as a Ricardian rent. In particular, the highest type produces 50 more units than a novice or an average type. Therefore at the price of $80K per unit, top veterans get $50 \times \$80K = \$4$ million per period. The average wage of veterans is $2 million (since talent is uniformly distributed).

Because production cost per worker is fixed, the efficiency at which the demand for output is satisfied depends solely on the average talent of workers in the industry. The average output by veterans is 75 units; the average for the whole industry must be lower

since it includes the novices (it is in fact 72).[5] A novice has a fifty-fifty chance of being retained in the industry, in which case he will make in expectation the average veteran wage of $2 million for 15 periods; hence the expected lifetime rents are $0.5 \times 15 \times \$2$ million= $15 million.

Unconstrained Individuals

Now suppose that aspiring workers are risk neutral and have access to unconstrained credit. They are then willing to bid for the opportunity to work in this industry, up to the expected value of future talent rents. The inability to commit to long-term contracts does not cause any problems when individuals can in effect buy the firm. I will now show that this will increase the exit/retention threshold and the average talent of workers in the industry up to the efficient level, while dramatically decreasing the talent rents.

Start by simply assuming that novices are offering $1.5 million to firms for the chance to work (we will see shortly that this is in fact the unique equilibrium). Then at the output price P, a novice-hiring firm will in expectation generate $50 \times \$P$ in revenue, and have a net cost of $2.5 million (i.e., a negative novice wage of $1.5 million plus a capital cost of $4 million). For firms to break even, the equilibrium price of output must then be $P = (\$2.5$ million$)/(50$ units$) = \$50K$/unit.

When novices pay to work, then veterans of average talent will not be hired into the industry. They have no incentive to pay for a job, because they have no chance of getting higher wages in the future. The lowest type veteran to work will do so at the outside wage of zero. The lowest types to stay in the industry (i.e., the threshold types) are those making 80 units per period. They generate enough more revenue than novices in expectation to just offset the novice payment of $1.5 million.

Veterans who are better than the threshold type collect rents. For example, the highest type makes 20 units more than the threshold type who is available at zero wage; therefore, at the output price $50, the very best workers get a rent of $20 \times \$50K = \$1$ million per period. The average wage of veterans is $0.5 million (again by the uniformity assumption).

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[5]The formula that relates the fraction of novices to the rehiring threshold and the length of career is derived in the next section.

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Finally, to show that this is the equilibrium, calculate the expected lifetime rents. A novice has a 20% chance of turning out to be above the 80 unit threshold, in which case his expected wage is the average veteran wage of $0.5 million for the last 15 periods. Expected lifetime rents are then $0.2 \times 15 \times \$0.5$ million= $1.5 million, which was the assumption we started from. This is also the unique equilibrium, because higher offers by novices increase the exit threshold and thus decrease the expected rents.

The average output of veteran workers is 90 units (because veteran talent is uniform between 80 and 100). The industry average is lower, because some workers are novices; in fact it must be exactly 80 units per worker. That the optimal (i.e., maximal) average talent level of workers is the same as the optimal exit threshold is a general result (in this limiting case of a zero discount rate). Intuitively, if at the optimum some level of talent gets discarded from the industry then it must be pulling down the industry average, while a talent that is retained must be increasing it.

Table 1. Summary of the example.		
	Constrained	Unconstrained
Output price	$80K	$50K
Threshold talent	50 units	80 units
Average talent	72 units	80 units
Top wages	$4 million	$1 million

Comparison

When novices cannot pay the expected value of future talent rents, then two things happen. First, the exit threshold in the industry is too low. As a result, many job slots are taken over by mediocrities who reduce average talent in the industry, compared to if their job slots were used to discover new talents. Here the workers who make between 50 and 80 units per period are mediocrities in this sense; in fact, most workers in the industry fall under this category. Second, the rents to talent are higher; here the top wage goes up from $1 million to $4 million. The talent rents accrue to the advantage in output that veterans have over the threshold type, so a reduction in the threshold increases the rents of all retained types. The inability of novices to pay for the job increases the price of output, because it must be high

enough to cover the cost of production at novice-hiring firms. This increased price further magnifies the rents to retained talent.

3 The Basic Model

This section introduces the basic model of a competitive talent market. Here I will solve for the equilibrium distribution of talent, wages, and tenure, with and without the presence of standard labor market imperfections.

Model assumptions

1. Each firm employs one individual per period, has production cost c, and output equal to the talent of the worker, θ.

2. There is an unlimited supply of individuals with unknown talent, willing to work at outside wage w_0.

3. A worker's talent level becomes public after one period in the industry. He can then work in the industry up to T more periods $(1 + T$ periods in total).

4. Talent is drawn from a distribution with a continuous and strictly increasing cumulative distribution function, $F(\bullet)$, with support $[\theta_{\min}, \theta_{\max}]$.

5. There is no discounting. Firms are infinitely lived and maximize average per-period profits.

6. There is free entry by firms.

7. The number of firms I is treated as a continuous variable (measure).

8. Industry output faces a downward-sloping demand function $Q^d(P)$.

   The first assumption describes the technology. The firms are identical; all differences in output are caused by the talent of the worker.

   Assumptions 2 and 3 describe the information structure. That all uncertainty about talent is resolved after one period of work is a simplification of the idea that information about

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the talent of a novice is much less precise than that of experienced individuals. Information is symmetric at all points in time: firms (as well as individuals themselves) view all novices as identical, so they are expected to have the mean talent level $\bar{\theta}$. After one period of work, an individual's output (i.e. his talent) becomes public.

Assumptions 4 and 5 are not essential but are made for technical and notational convenience. Assumptions 6 and 7 result in a competitive industry that is "large" in the sense that there is no uncertainty about the realization of the distribution of talent. Assumption 8 closes the model.

The assumed labor market imperfections are standard:

A. Individuals cannot commit to long-term contracts.

B. Individuals cannot take a wage below some $w_0 \geq 0$.

The case with both two assumptions is the more realistic case in most industries and will be referred to as the case of "*constrained individuals.*" In terms of missing markets, assumption A means that individuals cannot sell their future labor. Assumption B approximates the idea that the ability of novices to pay for future talent rents is small compared to their expected value. This could result from a credit constraint, or from individual risk aversion coupled with the inability to insure against realizations of one's own talent level. Removal of either assumption would allow the industry to operate efficiently. The case with assumption A, but without B, will be referred to as the case of "*unconstrained individuals,*" because it allows individuals in effect to "buy the firm" and thus bypasses the problem of commitment. On the other hand, in the absence of Assumption A novices would sign up to lifelong contracts at the outside wage w_0 (with firms retaining the right to fire the worker).

Preliminaries

The equilibrating variable is the exit threshold ψ; it will be shown later that the measure of jobs I will be determined mechanically given the threshold. Those who turn out to have a talent level below the threshold leave the industry after just one period. Vacancies left by novices who were not good enough to make the grade and by those retiring must be filled by new novices. In this preliminary section I derive the relation of the exit threshold, the equilibrium fraction of novices, and the average level of talent in the industry. With a given

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exit threshold, this is just a matter of equating the flows of entry and exit.

Denote the fraction of novices by i. When dealing with the distribution of talent, we can without loss of generality think of the industry as consisting of a unit mass of jobs. Consider only the steady state, where i is constant over time. Each period, the talents of i new workers are revealed, and of these a fraction $F(\psi)$ exit. The remaining $1 - i$ jobs in the industry must be held by veterans; of these the oldest cohort, a fraction $\frac{1}{T}$ of all veterans, retires each period. Equating exit and entry yields

$$iF(\psi) + \frac{1}{T}(1 - i) = i \Longrightarrow$$

(1) $$i(\psi) = \frac{1}{1 + T(1 - F(\psi))}.$$

The exit threshold further determines the average talent of workers in the industry. Denote the average talent in the industry by

(2) $$A \equiv i\bar{\theta} + (1 - i)\mathrm{E}[\theta|\theta > \psi].$$

Clearly A will be above the population mean $\bar{\theta}$, because types above the threshold will work for longer than the below-threshold types. Only if there were no filtering at all would the industry average be equal to the population mean. Substituting the equilibrium fraction of novices (1) into (2) yields the industry average as a function of the exit threshold.

(3) $$A(\psi) = \frac{1}{1 + T(1 - F(\psi))}\bar{\theta} + \frac{T(1 - F(\psi))}{1 + T(1 - F(\psi))}\mathrm{E}[\theta|\theta > \psi]$$

Note that total industry output is the measure of firms times the average level of talent in the industry.

Social Planner's Problem

Consider the problem of maximizing social surplus

(4) $$S(I, \psi) = \int_0^{IA(\psi)} P(q)\mathrm{d}q - I(w_0 + c),$$

where $P(q)$ is the inverse of the demand function $Q^d(P)$ and I the level of employment (measure of firms). Social surplus is the consumer surplus from total output, minus the opportunity cost of the factors of production. The problem of choosing the efficient exit

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threshold is independent of the size of the industry: for any I, the threshold ψ should be chosen to maximize the average level of talent A in the industry. This will minimize average costs, because cost per job is constant $w_0 + c$. The level of employment should then be chosen to equate total output with demand at the minimized average cost, so that $P(IA) = (w_0 + c)/A$. The industry as a whole has constant returns to scale: to double the output, the amount of novices hired and total costs would both be doubled; this would (eventually) double the number of veterans as well.

To maximize the average talent (3), take the first-order condition:

$$\frac{\partial}{\partial \psi} A(\psi) = \frac{\partial}{\partial \psi} \left(\frac{1}{1 + T(1 - F(\psi))} \left\{ \bar{\theta} + T \int_{\psi}^{\theta_{\max}} a f(a) \mathrm{d}a \right\} \right) = 0$$

$$\implies \frac{T f(\psi)}{(1 + T(1 - F(\psi)))^2} \left\{ \bar{\theta} + T(1 - F(\psi)) \mathrm{E}[\theta | \theta > \psi] \right\}$$

$$- \frac{T \psi f(\psi)}{1 + T(1 - F(\psi))} = 0$$

(5) $$\implies \bar{\theta} + T(1 - F(\psi)) \mathrm{E}[\theta | \theta > \psi] = \psi (1 + T(1 - F(\psi))) .$$

The first order condition (5) can be rearranged to yield the following condition:

(6) $$\psi - \bar{\theta} = T(1 - F(\psi)) (\mathrm{E}[\theta | \theta > \psi] - \psi) .$$

Denote the solution henceforth by A^*.[6] To interpret (6), think of the decision to hire a novice over a veteran of above-average talent as an investment. The LHS gives the immediate loss in expected output from hiring a novice instead of the threshold veteran. The RHS shows the expected future gain, assuming that ψ is also kept as the rehiring threshold in the future. The trade-off is that a higher threshold results in higher-quality veterans, but also in a larger fraction of the workforce being novices.

It is useful to notice that the maximizer of (3) is also its unique fixed point in the support of θ.

Proposition 1 $\max_{\psi} A(\psi) = \arg\max_{\psi} A(\psi) > \bar{\theta}$.

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[6]For example, the uniform $[0,1]$ distribution used in the example of Section 2 yields the solution

(7) $$A^* = \frac{1}{T} \left(1 + T - \sqrt{1 + T} \right) .$$

Proof. First, to see that the solution to (6) is a fixed point of A, solve the linear term in ψ and then divide both sides by $1 + T(1 - F(\psi))$. This reproduces the objective function (3). Second, to see that the solution exists, is unique, and strictly greater than $\bar{\theta}$, notice that the LHS of (6) is strictly increasing, and equal to zero at $\psi = \bar{\theta}$. The RHS is decreasing, starts from positive $T(\bar{\theta} - \theta_{\min})$ at $\psi = \theta_{\min}$ and reaches zero at $\psi = \theta_{\max}$.$\square$

In other words, the optimal exit threshold is also the maximum attainable average level of talent in the industry: $A^* = A(A^*)$. Intuitively, discarding a worker above the optimal threshold must decrease the average, as must retaining a worker below the threshold.[7] The optimal level of employment equates supply IA^* with demand at average cost $(w_0 + c)/A^*$, so $I^* \equiv \frac{1}{A^*} Q^d(\frac{w_0 + c}{A^*})$.

Definition 1. Mediocre types: *$\theta \in (\bar{\theta}, A^*)$. These are the talent levels above the population mean, but below the optimal rehiring threshold.*

In other words, "mediocrities" are people are better than average but who should not be working in the industry.

Market Equilibrium

Like the social planner's allocation, market equilibrium can also essentially be described by the exit threshold ψ. The level of equilibrium threshold will depend on the presence of market imperfections, but, for a given threshold, we can already deduce the equilibrium wages, output price, and employment. In any case, the individual inability to commit to long-term contracts means that wages are determined on a spot market. Equilibrium wages must therefore keep firms indifferent between hiring any worker in the industry for the next period. This means that (expected) differences in talent translate into corresponding differences in wages, and into Ricardian rents for inframarginal talents. At the same time, the price of output must adjust to allow the hiring of novices into the industry, while free entry keeps profits at zero.

Proposition 2 $w(\psi) = w_0$.

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[7]With discounting the maximizer would be below the maximum. Reducing the rehiring threshold amounts to a reduction in investment (the amount of experimentation with new talent), which leads eventually to a lower average level of talent in the industry.

Proof. Since veterans have no future payoffs to think about, their decision to stay depends solely on whether the wage they can get inside the industry is more than the outside wage. With a continuum of types, the lowest type veteran to work in the industry must be indifferent and therefore paid exactly the outside wage. □

Proposition 3 *Given an equilibrium exit threshold ψ, the price of output is $P = (w_0 + c)/\psi$.*

Proof. Due to free entry firms must make zero profits. In particular, a firm employing a veteran of the threshold type ψ gets revenue $P\psi$ and has costs $w_0 + c$. The equilibrium price sets these equal. □

The combination of free entry by firms and a binding outside wage for veterans of threshold type pins down the price of output.

Proposition 4 *Given an equilibrium exit threshold ψ, wages are*

$$(8) \qquad w(\theta) = (w_0 + c)\left(\frac{\theta}{\psi} - 1\right) + w_0.$$

Proof. For firms to be indifferent between a threshold type ψ and any other talent θ, the difference in wages must just offset the difference in revenue generated. Hence for any θ

$$(9) \qquad w(\theta) - w(\psi) = P(\theta - \psi) = \left(\frac{w_0 + c}{\psi}\right)(\theta - \psi).$$

Combining this with Proposition 2 completes the proof. □

Proposition 5 *Given an equilibrium threshold ψ, employment is*

$$(10) \qquad I(\psi) = \frac{1}{A(\psi)}Q^d\left(\frac{w_0 + c}{\psi}\right).$$

Proof With threshold ψ and employment I the supply of output is $IA(\psi)$, that is, the measure of workers times their average output. Set the supply equal to demand $Q^d(P)$, substituting in the output price from Proposition 3, and solve for I. □

Constrained Individuals The wage equation from Proposition 4 must also apply to novice wages: from the firms' point of view, novices are just workers with talent equal to population mean $\bar{\theta}$. In the constrained case, novices must always get paid exactly w_0. They cannot get more, because they are not scarce, and they cannot subsist on less by assumption. However, workers that have been revealed to be above the population mean are necessarily scarce; they are earning rents and have no reason to exit. In terms of the wage equation (8) we have the exit threshold at $\psi = \bar{\theta}$. And, as we know from Proposition 1, the population mean is an inefficiently low rehiring threshold: average talent in the industry is not maximized at $A(\bar{\theta})$.

If a firm hires a novice that turns out to be above average, his wage will be bid up by other firms. Therefore firms only care about the expected ability of a worker for the current period. They fail to take into account the upside potential of young individuals, who themselves are not able to pay for the chance to make talent rents in the future.

Unconstrained Individuals If individuals are risk neutral and have access to sufficient funds, then they will bid for the chance to enter the industry up to the expected value of talent rents. By offering to pay for the chance to work, unconstrained novices provide firms with the right hiring and firing incentives. Firms will now hire novices instead of mediocre veterans who have no incentives to offer such payments—whatever wage they could get in one period, they will get for the rest of their career. As is intuitive, the payments by unconstrained novices raise the exit threshold to the efficient level. The role of the firm is reduced to financing the production cost c in return of a certain market rate of return (set at zero here).

The efficient exit threshold could also be derived by solving for the market equilibrium in the unconstrained case, which we know must be efficient. In equilibrium, workers and firms take the output price P and the exit threshold ψ as given. Since veterans of threshold type are available at the outside wage, novices have to pay $P(\psi - \bar{\theta})$ for their first period job slot.[8] This payment exactly compensates a novice-hiring firm for the one-period revenue loss that it expects compared to hiring the threshold type. At the same time, the novice payment must

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[8]So the first period wage is $\underline{w} - P(\theta^* - \bar{\theta})$, which could be much below zero.

be equal to expected lifetime rents: with threshold ψ, a novice has a probability $1 - F(\psi)$ of being retained, in which case he gets the excess revenue $P(\theta - \psi)$ as a rent on each of the T remaining periods of his career. This equality is the market equilibrium condition:

$$(11) \qquad P(\psi - \bar{\theta}) = (1 - F(\psi))\, TP\, (\mathrm{E}[\theta|\theta > \psi] - \psi)\,.$$

The market price P cancels out of the equilibrium condition, which is therefore just the first-order condition (6) in the social planner's problem and yields the optimal threshold A^* as a solution. In addition, the distribution of wages is now also determined. Wages are given by equation (8), with the exit threshold at $\psi = A^*$.[9] Recalling Proposition 3, the price of output is therefore equal to minimized average cost $P^* = (w_0 + c)/A^*$.

Discussion

To summarize, the main effect of the constraint on novices' ability to pay for jobs is that the standard of performance required for an individual to be retained in the industry is too low. Just as a matter of accounting, the inefficiently low exit rates mean that careers are too long on average and that the proportion of young workers is too low. Older workers are not as talented as they could be. The inefficient hiring policy increases talent rents in two ways. First, rents accrue to the difference in units of output that an individual makes compared to the threshold type; this is higher for any retained type in the constrained case since the exit threshold is lower. Second, the value of this advantage is proportional to the price of output, which is higher in the constrained case: when novices cannot pay for the opportunity to work, it takes a higher output price to allow novice-hiring firms to break even.

The real curse of mediocrity upon society comes not just from the loss in average output per workers, $A^* - A(\bar{\theta})$, but from the increase in output price that is needed to make novice-hiring feasible. This price increase causes some of potential consumer surplus to be transferred into rents for the workers in the industry, especially to the most talented. Furthermore, since output is produced less efficiently, more workers are needed to satisfy any

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[9]While risk neutral workers are indifferent between any gambles of the same expected value, it is reasonable to use the solution that is the unique limit of vanishingly small risk aversion. Note that there are no match-specific rents and therefore no scope for bargaining.

given level of demand. In an industry with sufficiently inelastic demand, the hiring of medi-ocrities is associated with too many people working in the industry.[10] In addition to this transfer there is of course the deadweight loss from the higher price, whose severity also depends on the elasticity of demand.

Above the comparison of an efficient and an inefficient market was made between markets where novices can and cannot pay for jobs. Efficiency could also be achieved by eliminating the other imperfection, the inability to commit to long-term wage contracts. In that case novices would commit to lifelong contracts at the outside wage and the talent rents $w\left(\theta\right) - w_0$ would accrue to firms. The rent that was part of a veteran's wages before would now be the rental cost of talent. Talent at and below the efficient threshold level A^* would be available at zero rental cost, so the initial payment $P^*(A^* - \bar{\theta})$ would be the opportunity cost borne by a novice-hiring firm (free entry would still guarantee that firms make zero profits in expectation). While the model itself does not require any turnover between firms, it is consistent with firms renting workers at the equilibrium rental cost or trading them at the present value of future rents.

In reality, changes to imperfections are unlikely to be of the all-or-nothing type, but the direction of the effect of more limited changes should be clear. (A few such potential episodes are discussed in Section 5.) Any payments by novices would displace the worst of the mediocrities, thus increasing the exit threshold and reducing the talent rents of all veterans. Similarly, even a limited commitment time would give firms some incentives to hire novices instead of the lowest types of mediocrities. They could count on keeping any talent rents generated during the commitment (when the wage is at w_0), after which the rents accrue to the released veterans or "free agents." Firms would then choose a hiring policy that maximizes the average talent of committed workers. The longer the duration of commitment, the closer the solution is to full efficiency and the lower the wages of free agents of any given talent.

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[10]This effect is not a case of excess talent rents attracting too many hopefuls to the industry, as in the story of Frank & Cook (1995), but rather a distortion from an inefficient production method which benefits the owners of a factor of which too much is used.

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Monopsony. One implication of inefficient hiring is that a monopoly could serve the consumers better than a competitive industry if demand is sufficiently elastic. Suppose that the industry could merge into one firm that would be a monopsonist on the talent market. It would then have the incentives to enforce the socially optimal exit threshold. By being able to maximize the average level of talent in the industry, a monopolist would therefore also minimize the average cost of production. With sufficiently elastic demand this would be enough for the monopoly price to be below the competitive price. For example, with constant elasticity of demand η, we know that a profit-maximizing monopoly marks up its price by a factor of $\eta/(\eta - 1)$. Since the competitive output price is $(w_0 + c)/\bar{\theta}$, and monopolists' average cost is $(w_0 + c)/A^*$, it follows that the output price would be lower under a monopolist if $\eta > A^*/(A^* - \bar{\theta})$.

The Role of Production Costs. Consider two otherwise identical talent markets with different production costs. Higher cost means higher output price, meaning higher dollar value for any given difference in talent. In the case of unconstrained novices, higher expected rents are offset by an increase in the required novice payment, and the costs have no effect on the hiring threshold. In the constrained case all mediocrities are rehired regardless of the production cost. However, in the intermediate case, where novices have some ability to pay, the distribution of talent in the industry does indeed depend of the cost of production. Any payment by novices displaces the worst of the mediocrities, namely those whose output advantage over the population mean is worth less than the novice payment. With a higher output price the same amount of payment by novices displaces a narrower range of mediocrities, so hiring gets lets efficient. In an industry with a low cost of production the novice payment required for full efficiency is relatively low, so the assumed credit constraint is also less plausible.

The Role of the Speed of Revelation. The parameter T can be interpreted as the ratio of veteran time to novice time, with the latter normalized at one. A higher number of "veteran periods" therefore corresponds to quicker revelation of talent. For any given exit threshold, quicker revelation means that the average level of talent is higher for the

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mechanical reason that below-threshold talents spend less time in the industry. In the constrained case this is the only benefit: the exit threshold is always $\bar{\theta}$; with higher T the average talent in the industry gets closer to $\mathrm{E}[\theta|\theta > \bar{\theta}]$ as the below-average types get filtered out faster. The speed of revelation has no effect on the output price as it is fixed by the need of novice-hiring firms to break even. However, the social return to the investment of hiring a novice is increasing in the speed of revelation, and so is the efficient threshold. To see this, totally differentiate the equilibrium condition (6) with respect to ψ and T, and use the envelope theorem; this yields

$$(12) \qquad \frac{\partial A^*(T)}{\partial T} = \frac{1 - F(A^*)}{1 + T\left(1 - F(A^*)\right)} \left\{ \mathrm{E}[\theta|\theta > A^*] - A^* \right\} > 0.$$

For ever faster revelation the efficient threshold and the resulting average talent get closer to the maximum of the talent distribution. With price equal to average cost this higher productivity goes entirely to the benefit of the consumers.

The main effect of quicker revelation is to increase the social value of experimentation with new talent. On the other hand, for quicker revelation the required novice payment (for normalized lifetime length) to achieve efficiency may also get smaller (in the limit, where the revelation time goes to zero, it must also go to zero), thus making the assumption of a binding credit constraint less plausible.

4   Gradual Learning and The Phenomenon of Has-beens

This section extends the model by allowing information about talent to be revealed over time. While the optimal solution is analogous to that of the basic model, the case of credit constrained individuals is altered by the opportunity to save. I will show that, instead of mitigating the inefficiency caused by a credit constraint, saving will actually make things worse. It lowers exit rates even further below optimal because some veterans of below-average talent will stay in the industry.

In the basic model, individuals have essentially two-period careers, with the relative length of the second "veteran" period described by T. All uncertainty about an individual's talent is resolved at a single point in time, so the only variable of choice is the exit threshold

at that point. When new information about talent arrives at several points in time, then the decision to continue must take into account the option of exiting at a later time. Without further constraints, this would be a standard optimal stopping problem, introduced into the theory of labor markets by Jovanovic (1979). In this section I explore the general implications of a similar problem, but when job slots are scarce, learning is public and industry-specific, and individuals have finite careers and cannot commit to long-term contracts.

Assumptions

1. Each firm employs one worker per period whose output is $y_t = \theta + \varepsilon_t$, where θ is the worker's talent and ε_t an i.i.d. error term.

2. There is an unlimited supply of individuals willing to work at outside wage w_0.

3. Individual careers last up to $1 + T$ periods.

4. The cumulative distribution functions of θ and ε are strictly increasing, continuous, and yield finite moments.

5. $\{\hat{\theta}_t, t\}$ is a sufficient statistic for $\hat{\theta}_{t+1}$, where $\hat{\theta}_t \equiv E[\theta | y_1, \ldots, y_t]$ is the expected level of talent at tenure t (i.e. after t periods of work).

The expectation $\hat{\theta}_t$ is taken with respect to the known distributions f_θ and f_ε. For the novices, no output has yet been observed, so $\hat{\theta}_0 = \bar{\theta}$ for all of them. Since predictions are unbiased by definition, $E[\hat{\theta}_{t+s} | \hat{\theta}_t] = \hat{\theta}_t$ for any $s = 1, \ldots, T - t$. Period t perceived talent $\hat{\theta}_t$ will often be simply referred to as talent. A crucial implication of the assumptions is that the distribution of prediction errors does not become degenerate in finite time: there is always some chance that the individual is better than he is expected to be.

Going forward in time, the estimate of any particular worker's talent becomes more precise; it gets closer to the true value in expectation and moves about less. However, a worker's talent never becomes known for sure. In terms of a whole cohort, the distribution $f_{\hat{\theta}_t}$ starts as a degenerate distribution at $\bar{\theta}$, and then becomes more spread out. Without filtering, it would become more like the true distribution f_θ; with filtering, more of the lower types, as well as some unlucky higher types, get discarded as time goes by.

Other assumptions

6. Firms are infinitely lived and maximize average expected per-period profits. There is no discounting.

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7. There is a unit measure of firms.

8. Price of output is normalized to one.

These assumptions are made in order to simplify the notation. Extending the analysis to allow for free entry and an endogenous output price is straightforward in light of section 3.

Social Planner's Problem

The variable of choice is a stopping (exit) policy $\boldsymbol{\psi} = \{\psi_1, \ldots, \psi_T\}$, which consists of T separate exit thresholds. Analogously to the single exit threshold of the basic model, this policy states that an individual with talent $\hat{\theta}_t < \psi_t$ will exit the industry. Since everyone looks identical at $t = 0$, there is no meaningful choice for ψ_0 (besides $\bar{\theta}$). On the other hand, after $T + 1$ periods, the individual will retire anyway, and the updating of $\hat{\theta}$ based on y_{T+1} is useless. Hence there are in total T points in time where a decision to continue or stop has to be made. A decision to exit is final, because after the exit no new information will ever arrive that could change the decision.

The average level of talent in the industry depends on the whole stopping policy. In line with earlier notation, denote the maximal solution by $A^* \equiv \max_{\boldsymbol{\psi}} A(\boldsymbol{\psi})$. This would be the object of a surplus-maximizing social planner, as well as of a firm who could keep individuals at a fixed wage. The optimal solution must adhere to the following variant of the fixed point result in Proposition 1.

Proposition 6 *In the optimal solution, $\psi_T = A^*$.*

The proof is omitted as it is basically the same as in the basic model. Intuitively, given an individual with just one period left, the optimal decision of whether to retain him or not depends solely on his expected talent for his final period; there is no value for any further information about him. Thus he should be retained if and only if he contributes positively to the average talent in the industry.[11] At the social optimum, this means that he should be retained if and only if $\hat{\theta}_T \geq A^*$.

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[11] Again, with a positive discount rate the optimal exit threshold would be below the optimal average, which in turn is decreasing in the discount rate (since hiring novices is an investment). Discount factors would complicate the notation without affecting the comparison between different cases.

Market Equilibrium

As in the basic model, equilibrium wages are determined on the spot market, taking into account that individuals on their last period before retirement have a trivial exit decision—for them it's all about the current wage.

Proposition 7 *Wages are $w(\hat{\theta}) = \hat{\theta} - \psi_T + w_0$.*

The proof is a combination of two observations. First, for individuals at tenure T, the value of continuing in the industry is simply $w(\hat{\theta}) - w_0$. With a continuum of types, the lowest type to stay is one who gets exactly the outside wage w_0 by doing so, hence $w(\psi_T) = w_0$ regardless of the value of ψ_T. Second, firms must be indifferent between hiring a type ψ_T and any worker in the industry. The difference in current period wage between any two workers must therefore be equal to the difference in their expected talent.$\square$

In Jovanovic (1979, p. 976), workers have infinite lives, and this "*assumption justifies the exclusion of age as an explicit argument from the wage function.*" Here that exclusion follows from the existence of a spot market for talent, and from the fact that the market price of talent must be constant in steady state.

Proposition 8 *Given any $\psi_T \geq \bar{\theta}$, the optimal exit policy for risk-neutral individuals is strictly increasing in tenure: $\psi_t < \psi_{t+1}$.*

Proof by backwards induction. First, consider an individual of type $\hat{\theta}_T = \hat{\theta}$ at tenure T. His payoff or "value function" is

$$(13) \qquad\qquad V_T(\hat{\theta}) = \max\{0, \hat{\theta} - \psi_T\}.$$

The value function gives the excess expected utility from continuing as opposed to exiting, and zero if that difference is negative.

Next consider an individual of type $\hat{\theta}_{T-1} = \hat{\theta}$ at tenure $T - 1$. If he decides to continue, he gets lifetime expected utility

$$(14) \qquad\qquad \tilde{V}_{T-1}(\hat{\theta}) = \hat{\theta} - \psi_T + \mathrm{E}[V_T(a)|\{\hat{\theta}, T - 1\}].$$

The expected utility is taken with respect to $f_{\hat{\theta}_T|\hat{\theta}_{T-1}}(a|\hat{\theta})$. Since the expectation is increasing in the prior, also (14) is strictly increasing in $\hat{\theta}$. Since the distribution functions were assumed to be continuous, this is also continuous in $\hat{\theta}$. The optimal exit threshold ψ_{T-1} is defined by $\tilde{V}_{T-1}(\psi_{T-1}) = 0$.

To see that $\psi_{T-1} < \psi_T$, notice that $\tilde{V}_{T-1}(\psi_T) > 0$, because the expectation is strictly positive at $\hat{\theta} = \psi_T$ (recall that the distribution of prediction errors does not become degenerate in finite time). Denote by V (without tilde) the value function that incorporates the current period optimal exit policy:

$$(15) \qquad V_{T-1}(\hat{\theta}) = \max\{0, \hat{\theta} - \psi_T + \mathrm{E}[V_T(a)|\{\hat{\theta}, T-1\}]\}.$$

This is zero for $\hat{\theta} \leq \psi_{T-1}$, and strictly increasing for $\hat{\theta} > \psi_{T-1}$.

Completing the induction backwards in time is straightforward. The value function V_t is always zero below ψ_t, where there is a kink, and then has positive slope above. Hence $\tilde{V}_{t-1}(\psi_t) > 0$ and $\psi_{t-1} < \psi_t$.□

Intuitively, of two workers of the same expected ability, the younger one has always more upside potential because the prediction about his talent is less precise. The standards for hiring should therefore be tougher for older workers. In terms of the market equilibrium, the willingness to pay for a job slot is higher for a younger individual: paying for continuation today includes the option to continue tomorrow, and other things equal, an option on an asset with higher variance is more valuable.

Unconstrained Individuals

If individuals are risk neutral and not credit constrained, then market equilibrium must be efficient so that $\psi_T = A^*$. Again, the inability to commit to long-term contracts is inconsequential when individuals can pay their first employer for the expected value of future rents which are made possible by that initial job opportunity. Competition from novices forces incumbent workers to follow the socially optimal exit policy. This policy is illustrated in Figure 1 as the smoothly increasing graph from $\{0, \bar{\theta}\}$ to $\{T, A^*\}$.[12] All possible individual paths for $\hat{\theta}$ must start at $\bar{\theta}$; an individual stays in the industry until retirement if and only

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[12]The figures are drawn for a large number of periods T so that time looks continuous.

if the path stays above the optimal exit policy throughout. At each point in time, wages are described by the vertical difference with the horizontal line at A^*, on which they are equal to the outside wage.

[Figure 1: Efficient Benchmark.]

With many potential points in career for exiting, the breakdown of the workforce by tenure can no longer be captured by the fraction of novices. As in the basic model, more novices are hired in the efficient case, but the exit rates (hazard rates of exit) are in general difficult to solve.

Constrained Individuals

Proposition 9 *If individuals are credit constrained, then $\psi_T = \bar{\theta}$, and no one will exit while $\hat{\theta}_t > \bar{\theta}$.*

Proof. Novices are not scarce, so they cannot get more than the outside wage w_0. By assumption of being constrained, they cannot get less either. Therefore $w(\bar{\theta}) = w_0$. But then anyone with expected talent above the population mean is making rents and does not exit. Also, by Proposition 7, w_0 must be the wage of last period's threshold type $\hat{\theta}_T = \psi_T$. Therefore $\psi_T = \bar{\theta}$.□

In contrast to the basic model, here the definition of mediocrity is age-dependent. A mediocre individual is above the population mean, but below the optimal exit threshold for his tenure. As in the basic model, there is too little exit when individuals are credit-constrained. Mediocre individuals take up job slots that would be in better use with novices. The mediocrities are illustrated by the light shaded region in Figure 2. The wage is now equal to w_0 at the horizontal line, and the rents at any point in time are described by the vertical distance from it.

If constrained individuals require at least the outside wage w_0 regardless of past earnings, then the actual exit policy is $\psi_t = \bar{\theta}$ at all t. This behavior would only arise if there were no saving at all, e.g. if individuals were infinitely risk averse or impatient.

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The Phenomenon of Has-beens It seems reasonable to assume that individuals could save at least some of their rents. In this case the actual exit decision becomes path-dependent. Novices still cannot pay for jobs because they have had no opportunity to accumulate savings; this pins down wages and the tenure-T exit threshold. However, now some below-mean individuals have enough savings to be able to buy a job and continue in the industry. Whether they want to depends on how far below the mean they are and how much savings they have accumulated.

Proposition 10 *If individuals are credit constrained, risk neutral, and it is possible to save, then some veterans of tenure $t = 2, \ldots, T - 1$ will not exit even if $\hat{\theta}_t < \bar{\theta}$.*

Proof. We know that $w(\bar{\theta}) = w_0$ and $\psi_T = \bar{\theta}$ by Propositions 7 and 9. Consider an individual with $\hat{\theta}_{T-1} = \bar{\theta} - \epsilon$ and savings of at least ϵ, for some $\epsilon > 0$. The value of continuing is, using the proof of Proposition 8, $V_{T-1}(\bar{\theta} - \epsilon)$. This is strictly positive for small enough ϵ since, by Proposition 7, $\psi_{T-1} < \psi_T$. And since $V_t(\bar{\theta} - \epsilon) > V_{t+1}(\bar{\theta} - \epsilon)$ for any $\epsilon > 0$, then any individual with $\hat{\theta}_t = \bar{\theta} - \epsilon$, with $t < T - 1$, and with savings of at least ϵ will also not exit.□

The exit policy that is induced by $w(\bar{\theta}) = w_0$ is only *privately* optimal. Anyone with sufficiently large savings will follow the privately optimal exit policy. From now on, denote this privately optimal exit policy of the credit constrained case by $\boldsymbol{\psi}^* \equiv \{\psi_1^*, \ldots, \psi_T^*\}$, where we know that $\psi_1^* < \cdots < \psi_T^* = \bar{\theta}$. However, some individuals—including anyone whose estimated talent is below the population mean after first period of work—are not able to do so because of lack of savings.

I assume that even risk neutral individuals need to consume at least w_0 every period, but that they don't mind saving all of the excess until retirement. Savings are useful by making it possible to follow the individually optimal exit policy in the future, should the individual's talent dip below the population mean but not so much as to go below ψ_t^*. These previously successful veterans, or "has-beens," are able to compete against novices for scarce job slots, who would pay more for the job if only they had the money. However, just having enough funds to pay for the next period's job is, in general, not enough for continuation to be worthwhile. This is because the expected benefits of continuation come in part from

possible future paths where the individual gets positive rents only several periods from now.

Denote the savings of an individual with a history $\hat{\boldsymbol{\theta}}_{t-1} \equiv \{\hat{\theta}_1, \ldots, \hat{\theta}_{t-1}\}$ by $S_t(\hat{\boldsymbol{\theta}}_{t-1})$. Since individuals save all of the rents we have $S_t(\hat{\boldsymbol{\theta}}_{t-1}) = \sum_{s=1}^{t-1} \left(\hat{\theta}_t - \bar{\theta}\right)$. Denote the necessary and sufficient amount of savings for an individual with $\hat{\theta}_t$ to choose to continue by $W_t\left(\hat{\theta}_t\right)$. This is only defined for $\hat{\theta}_t \geq \psi_t^*$, because, below the threshold, the individual will want to exit regardless of savings.

Proposition 11 *The minimum wealth requirement W_t for an individual with expected talent $\hat{\theta}_t \geq \psi_t^*$ to choose to continue at time t satisfies the following properties.*

$$(i) \qquad W_t\left(\psi_t^*\right) = \sum_{s=t}^{T} \left(\bar{\theta} - \psi_s^*\right) \equiv W_t^*$$

$$(ii) \qquad \frac{\partial}{\partial \hat{\theta}} W_t\left(\hat{\theta}\right) < 0 \quad for \ \hat{\theta} \in (\psi_t^*, \bar{\theta})$$

$$(iii) \qquad W_t\left(\hat{\theta}\right) = 0 \quad for \ \hat{\theta} \geq \bar{\theta}$$

For proof of sufficiency of part (i), observe that W_t^* is the amount of spending under the worst case scenario, where expected talent evolves along the stopping policy. Thus an individual with savings W_t^* can never again be bound by the credit constraint—he will exit before retirement if and only if his talent falls below the stopping policy. For a proof of necessity, recall that an (unconstrained) individual of threshold talent gets zero expected rents by the definition of the exit threshold. Having savings that are less than W_t^* means that some of the possible future paths that are chosen by the unconstrained individual are not available; because these paths must have contributed positively to the expected rents, their removal will pull the expectation below zero. Part (ii) follows already from the fact that the current period payment for continuation is lower for a higher talent, and future prospects are at least as good. Part (iii) is trivial, since above-mean types don't need to pay for jobs.

Definition 2. Has-beens. *Individuals with $\hat{\theta}_t \in [\psi_t^*, \bar{\theta})$ and $S_t(\hat{\boldsymbol{\theta}}_{t-1}) \geq W_t(\hat{\theta}_t)$.*

A has-been is currently below the population mean but above the privately optimal exit policy. He must have once been successful enough to have sufficient funds to continue. In Figure 2, the potential has-beens are in the area between the horizontal line and the privately optimal stopping policy ψ^*. The solid line shows a career path for a has-been that decides

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to continue at tenure t, and two possible continuations after that (one leading to early exit and the other to resurrection). The dashed line shows a career path for someone who is more talented (by expectation) at tenure t but nevertheless exits. He has all the same and even better chances at resurrection in principle, but his lower savings mean that he would have a higher risk of running out of funds before resurrection.[13]

[Figure 2: Mediocrities and Has-beens]

The dependence of the exit decision on previous success and wealth implies a rather peculiar correlation of features in the workforce. Among those below the population mean by talent, there is a negative correlation between talent and wealth. This results from selection by wealth: it takes deeper pockets, and so more past success, to be able to continue for a lower level of below-mean talent. This selection can also be expressed in terms of the time profile of individual output history. Consider two individuals with the same expected talent $\hat{\theta}_t$ and same cumulative output $\sum_{s=1}^{t-1} y_s$, but with one having been an early success and the other a late bloomer. The one with better recent performance is the one with less wealth and is thus more prone to exit at a given $\hat{\theta}_t$. The reason is that good luck early on has a higher impact on lifetime wealth, first because the posterior reacts more to a single observation early on when there are fewer observations (so the variance of the prior is higher), and second because any performance will affect the wages of all subsequent periods (i.e. early luck gets counted into the wage more times over the career).

The presence of any has-beens in the workforce means that the efficiency loss in terms of average talent in the industry is greater than if saving was not possible. Just like mediocrities, has-beens reduce total output in the long run (by having less upside potential than novices), but unlike mediocrities they also reduce it in the near term (by being worse than novices by expectation).

Where could we observe "has-beens" in the sense defined here?[14] In the movie industry, a has-been could be an actor who used to be a star and made large talent rents, but has

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[13]The dotted area is W_t^*, the future spending under the worst-case scenario for a threshold type has-been at time-t.

[14]In MacDonald and Weisbach (2001), the term "has-beens" is used for individuals with outdated vintage human capital.

flopped more recently. He then uses savings from earlier rents to participate in the financing of a movie, which makes negative profits in expectation, but in return offers him a role and a chance at a resurrection. For him this gamble has a positive expected value, because a successful comeback would generate more talent rents in the future.

Interpretation as One-Sided Long-Term Contracts Suppose firms commit to a lifetime wage-policy, including a severance payment policy, even though individuals cannot commit to contracts that require them to make payments to the firm at any time in the future (e.g., no quitting penalty). Now the accumulated wealth S_t would be analogous to money "in escrow" at the firm, which must always be nonnegative. In the simplest contract individuals would get w_0 until they exit, upon which the firm pays out S_t. Some separations result from insufficient funds in escrow, but even those typically involve severance payments by the firm. When the escrow is full (i.e., $S_t \geq W_t^*$) exit is voluntary: the worker quits to stop the bleeding of the escrow because he has fallen below the privately optimal exit policy ψ_t^*.

More interestingly, the contract could also include wages above w_0 before separation or retirement. For sufficiently good histories, the escrow balance can reach a point where no amount of bad news in the future could ever cause the individual to be fired due to insufficient funds. In terms of the spot contract world, the credit constraint can no longer become binding because $S_t \geq W_t^*$, even though the privately optimal exit policy can still become binding after sufficiently bad performance. This allows the firm to start unloading the account with payments above w_0, up to the point where the remaining balance is W_t^*.

The result that a worker's escrow can reach a firing-proof level W_t^* is reminiscent of the "tenure standard" of Harris and Weiss (1984), but this is a different phenomenon. In their paper, for a sufficiently good history of performance, the expected marginal product of a worker reaches a level at which the firm knows it can never again fall below the outside wage. A crucial assumption there is that output consists of successes that arrive as a Poisson process and that failures are not possible; the impact of the worst possible news is therefore bounded below.

Firms' ability to commit to long-term contracts does not improve efficiency here, it merely

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allows a different interpretation of the equilibrium. In a setup with credit-constrained individuals and unobservable effort, an escrow can serve the useful purpose of (imperfectly) mimicking an up-front performance bond, as proposed by Akerlof and Katz (1989). Also, if individuals were both credit-constrained and risk averse, then one-sided long-term contracts would allow firms to provide insurance, as in Harris and Holmström (1982). The difference here is that wage insurance against type realizations below ψ_T is provided by the outside wage (turning out to be a bad actor does not diminish one's prospects as a dishwasher). Note that there is no scope for wage insurance in the basic model, because workers do not face downside risk: novices know that they will make at least their current wage in the future, and veterans know that their type (and wages) will stay constant until retirement.

5   Applications

The prototypical and most high-profile talent markets are found in the entertainment industry. There job performance is almost entirely publicly observable and success of young talents hard to predict. Neither formal education nor on-the-job training seem to play a large role in explaining wage differences in these industries. The chance to reveal one's talent in a real job is precious, as is suggested by the queuing for positions. Auditions seem to have limited usefulness beyond working as a cut-off that reduces the number of candidates for any entry-level position; huge uncertainty over talent remains among many viable candidates. There simply is no good substitute for observing the success of actual end-products. Based on a quip by screen writer William Goldman, Richard Caves (2000) has dubbed this uncertainty the "nobody knows" property, as the first on a list of distinctive and pervasive characteristics of the entertainment industry. It could be said that, in the entertainment trades, finding out about someone's talent is largely about finding out the tastes of the public, but this distinction is not operational for analytical purposes.

For a talent market to be analyzable with this model, it should exhibit certain broad features. There should be relatively high exit rates early on (this is true without long-term commitment, although more so with it). The level of talent should be imprecisely known at the entry level, and then become known relatively quickly once in the industry. This would

appear as a quick increase in within-cohort income dispersion among the "survivors" in the industry (under long-term contracting, only among free agents). Observed performance in one firm should be a good predictor of performance at other firms, i.e. match-specificity should not be too important. If these conditions hold, and if firms are not compensated for the lifetime value of the talent they discover, then this would suggest the potential for inefficiencies and excess talent rents described in the model.

There are many models to describe markets for talent that are consistent with stylized facts about entertainment industry, such as high and skewed income distribution. Just observing a talent market under one set of institutions does not allow one to show the existence, not to mention estimate the magnitude, of any inefficiencies. Besides comparing models by the plausibility of their assumptions, it would of course be desirable to try to identify and quantify "the curse of mediocrity" proposed in this paper. This would require an exogenous change in one of the imperfections behind the inefficiency—a natural experiment. The ideal experiment would be a surprise legal change from full individual commitment ability to none or vice versa. Such a change would also allow the quantification of the economic value of commitment ability, and its impact on within-profession income inequality. While a careful empirical analysis of such natural experiments would require further elaboration, the model presented here can be used to shed light on stylized facts and to suggest potential empirical applications.[15]

Motion Pictures The motion picture industry in Hollywood operated under the so-called studio system from 1920s to late 1940s. In this system, artists and other inputs were assembled together within a studio under long-term relationships. As a part of the system, entering actors made exclusive seven-year contracts with movie studios.[16] This kept their compensation at moderate levels until the initial seven years came to an end, even if they became big stars meanwhile. This allowed studios to capture much of any increase

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[15]A careful empirical analysis would require a dynamic model that takes into account how a market adjusts from one steady state to another (which can in principle take a lifetime), and how it reacts to demand shocks. This depends on features that are irrelevant for the analysis of the steady state, such as whether previously exited individuals can return to the industry.

[16]The seven-year limitation on personal service contracts dates back to 1890s.

in an artists' worth during the contract. The studios could rent the artist to other studios on "loan-outs" (for which they charged a premium), and the artist had no right to refuse roles. The contracts did *not* provide insurance. Even though wages were specified for the whole contract period (typically including moderate increases), the studios had the right to terminate the contract every six or twelve months.

A successful lawsuit by actress Olivia de Havilland, resolved in 1945, made a crucial part of these long-term contracts unenforceable. She had been hired by Warner Bros. in 1935, having been an unknown protagonist in a college theater play. She quickly proved very popular with both audiences and critics and won her first Oscar nomination four years into the contract, which she then attempted to renegotiate. She refused roles offered by Warner Bros., and as a result did not work for six months. At the end of the contract Warner Bros. claimed that the skipped six months should be added to the contractual obligation, since the original contract required her to actually work for seven years.[17] Warner Bros. lost, and the "De Havilland decision" made long-term contracts less useful, as it gave more renegotiating power to artists who turn out to be big stars.

At the same time, the studio system came under fire from the Justice Department, which filed an anti-trust lawsuit against Paramount Pictures in 1938. The suit accused the eight major studios, which among them produced 95% of movies, of monopolizing the motion picture industry by restraining trade and fixing prices. The main thrust of the suit was aimed at the vertical integration of movie theaters and studios. The Supreme Court decision in 1948 forced the studios to divest from movie theaters, which is commonly thought to have ended the studio system. Whatever the reason, the system of long-term contracting ended in the 1940s. After the change, movies have been produced as one-time affairs, where an entrepreneur-producer assembles a line of talents and other inputs for one movie only.[18]

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[17]Sources: Screen Actors Guild History Page, *www.sag.org*, and Capellon & McCann trial lawyers, *www.cappellomccann.com.*

[18]It has also been suggested that the system unraveled because of 90% personal income tax rates during World War II. This caused individuals to set up their own production companies to shift taxable income toward dividends (also complicating any empirical analysis), which were taxed at 60%. See Stanley (1978), Chapter 3. Presumably too frequent dealing with the same studio would have exposed the tax dodge. However, the return of lower tax rates did not bring back the studio system.

According to the model, the end of long-term contracting should have led to insufficient exit of mediocre entertainers, showing up as substitution from unexperienced actors to experienced (but relatively less paid) actors, to higher and more uneven incomes for veteran actors, and to lower total revenue. The wages of star actors on their initial contract during the studio system can be expected to be lower for obvious reasons. More interestingly, the contractual situation of free agents (those past the initial seven years) under the studio system is comparable to actors with the same amount of experience under spot contracting. During the studio system, there should have been a higher supply of talent due to better use of movie roles in discovering talent, moderating also the wages of star free agents. After the change, the share of less experienced actors should have gone down, but the special nature of the product makes predictions about the age structure less clear-cut; actors of different ages are not always substitutable, as the actor's age must be matched with that of the character in the script. Yet, to the degree that it is feasible, the end of the studio system should have led to actors being older than their roles.

Unfortunately, the wage data for actors is lacking. According to Caves (2000, p. 389), *"no systematic data have been assembled on whether the studios' disintegration brought more rents into the stars' hands, but casual evidence suggests that it did."* There is more concrete evidence of a post-war decline in revenue and output at movie studios. The number of movies made was down 48% from the 1940 level in 1956, while revenues declined by 19%; however, this fact is difficult to interpret without quantifying the impact of the advent of television in the 1950s.[19] Interestingly though, in terms of quality, the era from the 1920s to the 1940s is often referred to as the golden age of Hollywood movies. For example, according to film director Peter Bogdanovich *"It was a whole system that found actors who were unusual, not necessarily versatile in the way we think of versatile actors today, but actors who had a personality, who had a certain quality ... there was a whole system to that, and it was extraordinary and produced the greatest array of star actors in the history of the world."*[20]

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[19] Average costs (available for two studios) roughly doubled at the same time, but I have not found data on the share of wage costs. The figures are from Conant (1960), Chapter 5.

[20] MacNeil/Lehrer NewsHour, PBS, July 3, 1997.

Record Deals   Exclusive record deals, by which musicians agree to make a certain number of albums for the same record company, are a form of long-term commitment similar to what used to be possible in the motion picture industry. This arrangement is possible in the record industry, because record deals are exempt from the seven year limitation on the length of personal service contracts. Challenges similar to the De Havilland case were forestalled by the California legislature in 1987, when it was decreed that record companies retain rights to the agreed number of albums by an artist, even if seven years has passed since the signing of contract.[21]

The music industry is very competitive at the entry level, where upstart bands and artists are free agents, but agree to exclusive contracts in exchange of production, distribution, and promotion by the record company. The production cost alone for a typical record is from $100,000 up,[22] but the biggest cost may be the opportunity cost of promoting one band rather than another. The scarcity of attention of programming directors for radio stations and people looking for new music for record shops means that a record simply by its mere existence has little chance of becoming known. Forecasts of which artist will become a big seller are notoriously uncertain. About 80-90% of records by new artists end up making a loss—this must be compensated by the small number of very profitable hits. For the record companies, the most profitable hits are those by artists still on their initial low-paying contracts.

However, the efficacy of the system is constantly threatened by attempts to renege or renegotiate by those who turn out to be big stars and end up getting paid much less than their current "market price" (high-profile cases include Prince and George Michael). The quality of the product is obviously not contractible, and artists can fulfill contractual requirements (or try to force a renegotiation) with a substandard product, though at a reputational cost to themselves. Furthermore, there is currently a lobbying battle in the Congress involving RIAA (Recording Industry Association of America) and AFTRA (American Federation of Television and Radio Artists) about the continued application of the seven-album amendment. Were the current system of record deals to break down, the proportion of new artists

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[21]This amendment is Subsection B of California Labor Code Section 2855.

[22]Vogel (2001).

and new releases can be expected to be reduced, while the proportion of new artists whose record earns profits and who go on making a second record should go up. This reduced proportion of "failed artists" would probably be regarded by many as a sign of a more judicious choice of artists by the record companies, but according to the model proposed here it would actually be an indication of reduced experimentation and lower efficiency.

Professional Team Sports Professional team sports in North America have very unusual labor markets, mainly because the firms are organized into leagues that are close to natural monopsonies. The leagues have devised rules that restrict firms from competing for each others' employees. In particular, potential novice players ("rookies") are each assigned to a single firm, which then has the sole right to negotiate with that particular player (the allocation of these monopsony rights is known as the "draft"). Under the "reserve clause" system, players cannot leave for other firms at will, but employers can always sell the player's contract to another firm. This system was upheld by a U.S. Supreme Court ruling, Flood v. Kuhn (1972), against a challenge by baseball player Curt Flood who had been traded against his will.

Players have responded to owners' monopsony power by unionization, leading to occasional strikes.[23] Baseball players achieved some concessions through collective bargaining in 1975, after which players reaching six years of league experience became eligible for free agency, where all teams are free to bid for their services. This change seems to have been anticipated, and 1975 was more like a culmination of gradual unraveling than a sudden shift. The change is only applicable to a minority of players however, since slightly more than half of careers do not last long enough for a player to get a contract as a free agent.

The exit (hazard) rates of major league baseball players indicate that a major shift took place in the 1950s. In the first half of the century, more than half (52.8%) of players exited after no more than three seasons, and over two thirds (68.2%) by the end of their sixth year.[24] From 1960 to 1990 these rates were down to 33% and 50.1% respectively, without a significant break at 1975. For rookies the exit rate was 35.7% before 1950, and 17.2%

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[23]The first collective bargaining agreement is from 1968; there have been five strikes and three lockouts in major league baseball since then.

[24]Based on data from Sean Lahman's website "The Baseball Archive," *www.baseball1.com.*

after 1960. Meanwhile the average age of new players has stayed at 24 years, while the number of teams and players has been growing. Further investigation would be necessary to establish the cause of the shift in exit rates, but based on the model in this paper, increasing (re)negotiation power of players is a prime candidate.

The accuracy of information about novice talent in professional sports remains an open question under the reserve clause. The draft makes it nearly impossible to evaluate the economic value of expected talent differences between novice players.[25] If prior information is very inaccurate, then the draft should not make much difference to wages.[26] On the other hand, if the rookies also differ from each other substantially by the expected value of their talent, then the reserve clause is both rent extraction (the draft) and remedy to the curse of mediocrity (enforced long-term commitment) bundled in one. However, instead of being just a transfer of rents from owners to players as claimed by most pundits and some economists, an implication of the model is that complete free agency could be expected to cause a welfare loss. It would lead to lower exit rates for young players, lower average quality of players and lower total revenue. In total, players gain less than the owners and the consumers lose.

A similar but potentially much stronger natural experiment may be about to start in Europe, where the system of transfer fees in professional soccer is under scrutiny by EU labor regulators. There young players start as free agents but have the right to commit to binding long-term contracts, the length of which can be negotiated.[27] Casual evidence suggests that entry level information about talent is very inaccurate compared to what is known 4-5 years later. If transferable contracts become unenforceable, then players can be expected to gain more than will be the loss to owners and consumers; at the same time, the age distribution of players should move upwards.[28]

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[25]Occasional barter between teams, where draft numbers are traded for free agents, could allow some inference.

[26]According to Rottenberg (1956), "the process by which players are brought to the major leagues can be likened to that by which paying oil wells are brought in or patentable inventions discovered."

[27]In some European countries the contract length became freely negotiable only after the 1995 "Bosman decision," until which a player's old team could require a transfer fee from the new team even at the end of the contract.

[28]In Terviö (2003), the institution of transfer fees in professional sports is analyzed as a solution to the mediocrity problem in the presence of a job assignment problem.

Entrepreneurship It may be useful to think of the market where entrepreneurs and venture capitalists meet as a talent market. This market would exhibit the curse of mediocrity if two conditions are met. First, the success of a new firm should depend on the talent of its founding entrepreneur, of which relatively little is known until after his first project is financed. Second, entrepreneurs should be able to go on to found new companies later in their career, and the profits of these new firms cannot be claimed by the financiers of previous firms. In this case, much of the expected value of financing a start-up by a novice entrepreneur is not contractible, because it will accrue to the entrepreneur through profits of future projects. As a result, the investment decisions of venture capitalists do not take into account the value of information produced about the abilities of the entrepreneur, only the expected profits from the current project. There is too little investment into projects of inexperienced entrepreneurs, while too many mediocre entrepreneurs go on to found more companies. The mediocrities' new companies are profitable by expectation, but they are not as profitable as is the expected lifetime profitability of novice entrepreneurs' projects, taking into account that unsuccessful entrepreneurs will be filtered out of the market. Known entrepreneurial talent is artificially scarce, leading to excessive incomes for incumbent entrepreneurs. Under these circumstances, we could also expect to see has-been entrepreneurs using their own wealth from previous start-ups to try to bounce back into talent rents.

6 Conclusion

This paper has presented a model of a labor market where individual talent can only be learned publicly and on the job. The talent is general to a whole competitive industry that faces a joint production problem of output and information about individual productivity. The focus has been on the effect of standard labor market imperfections (credit-constrained individuals and their inability to commit to long-term wage contracts), which cause firms to ignore the upside potential of workers and base their hiring decisions on expected talent alone. As a result, firms hire "mediocrities;" that is, individuals who are above the population mean but not talented enough to justify them taking up scarce jobs that could be used to experiment with new talent. Besides implying lower talent levels, this problem is also

associated with artificially high rents to talent. Insufficient turnover is associated with higher wages because revealed talent is scarcer than it need be, and because a higher price of output (and so a higher value for talent) is required for novice-hiring firms to break even in equilibrium.

One might expect saving by workers to alleviate the inefficiencies that stem from a credit constraint, but here saving actually makes matters worse. Saving allows some incumbent workers, who are even worse than novices, in expectation, to linger in the industry. When talent is learned over time, even workers with expected talent below the population mean retain some upside potential and can be willing to pay for the chance of resurrection and more talent rents in the future. "Has-been" individuals, those who were successful early in their career, can use saved rents to pay for jobs and thus end up displacing novices, thereby reducing the average talent in the industry even further.

The model presents a rather bleak picture of talent markets, which is disturbing since most labor markets are markets for ex-ante unobservable talent to some extent. Markets for lawyers, advertising copywriters, and college professors are among potential cases not explored in this paper. If the differences in talent that are only discovered on the job are indeed the main source of talent rents, then much of observed superstar incomes could be, instead of a rent to truly scarce factors, a symptom of potentially large inefficiencies resulting from limitations to contracting. Whether a labor market exhibits the inefficiency and excess rents described in this paper, and whether these are economically significant, is of course an empirical question. One empirical strategy would be to consider an exogenous change to one of the imperfections behind the inefficiency, but such changes are rare. This paper suggested some potential natural experiments from the entertainment industry for detecting and quantifying these problems, but actual empirical analysis has been left for future work.

Economists have long understood the economic value of allowing individuals to commit to long-term contracts and do not tend to take at face value the complaints by those who find it in their interest to renege. It is well understood that commitment makes it possible for firms to finance on-the-job training by allowing the firm to recoup the training cost while keeping the worker at less than his improved post-training market wage. Commitment also allows employers to offer insurance to credit-constrained individuals, and this insurance

requires that those who turn out to do surprisingly well don't get paid their full market wage. The argument in favor of long-term commitment presented in this paper is more subtle in that it involves no spending by the firm that would show up in its accounts. The cost of experimentation is a pure opportunity cost here, it arises when a firm hires a novice over a mediocrity who would be more talented by expectation. No doubt, it would be even more difficult to convince courts or politicians about this argument than about the more traditional benefits of long-term contracts. Nevertheless, the issue is potentially far-reaching: the extent of personal service contract enforcement can have huge implications not only for economic efficiency but also for the income distribution.

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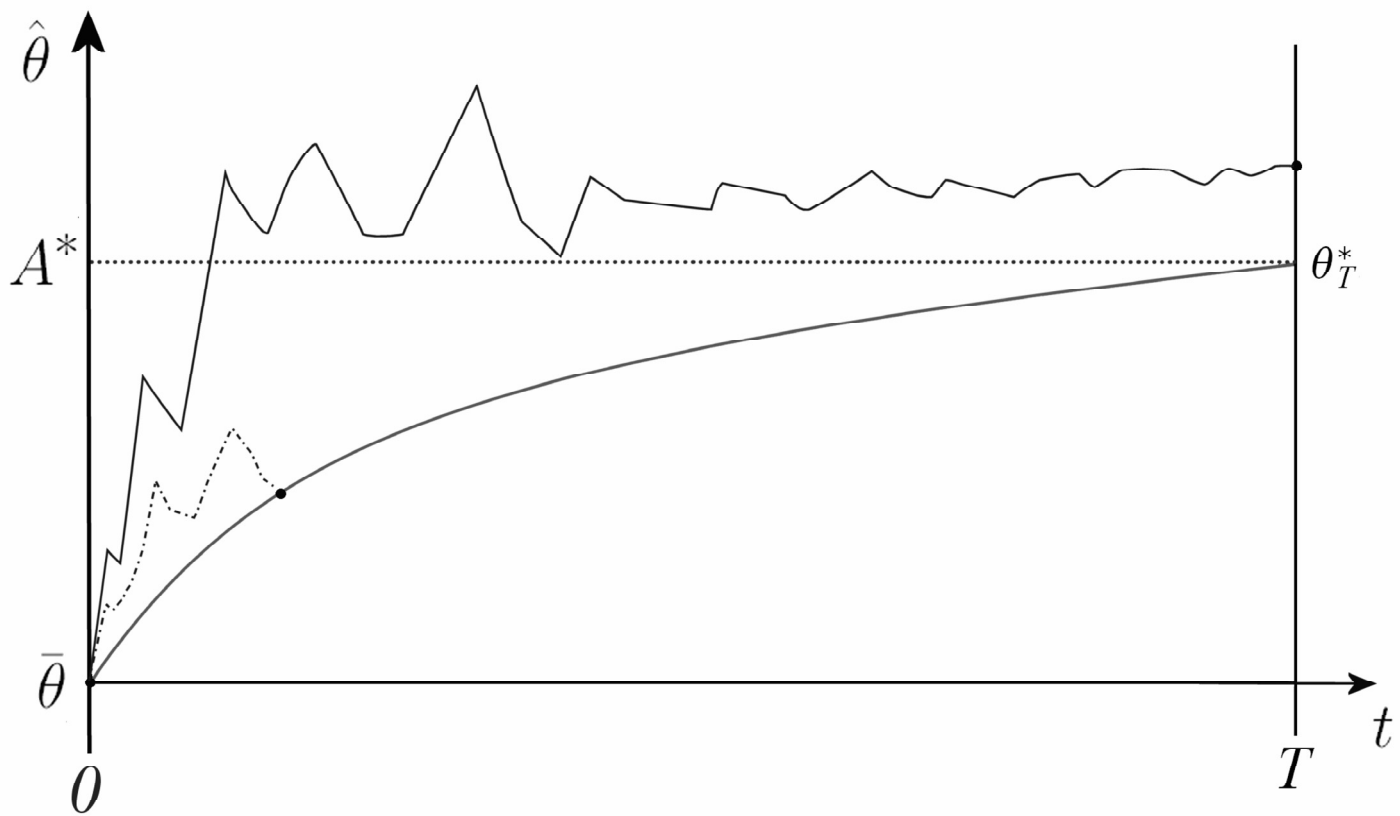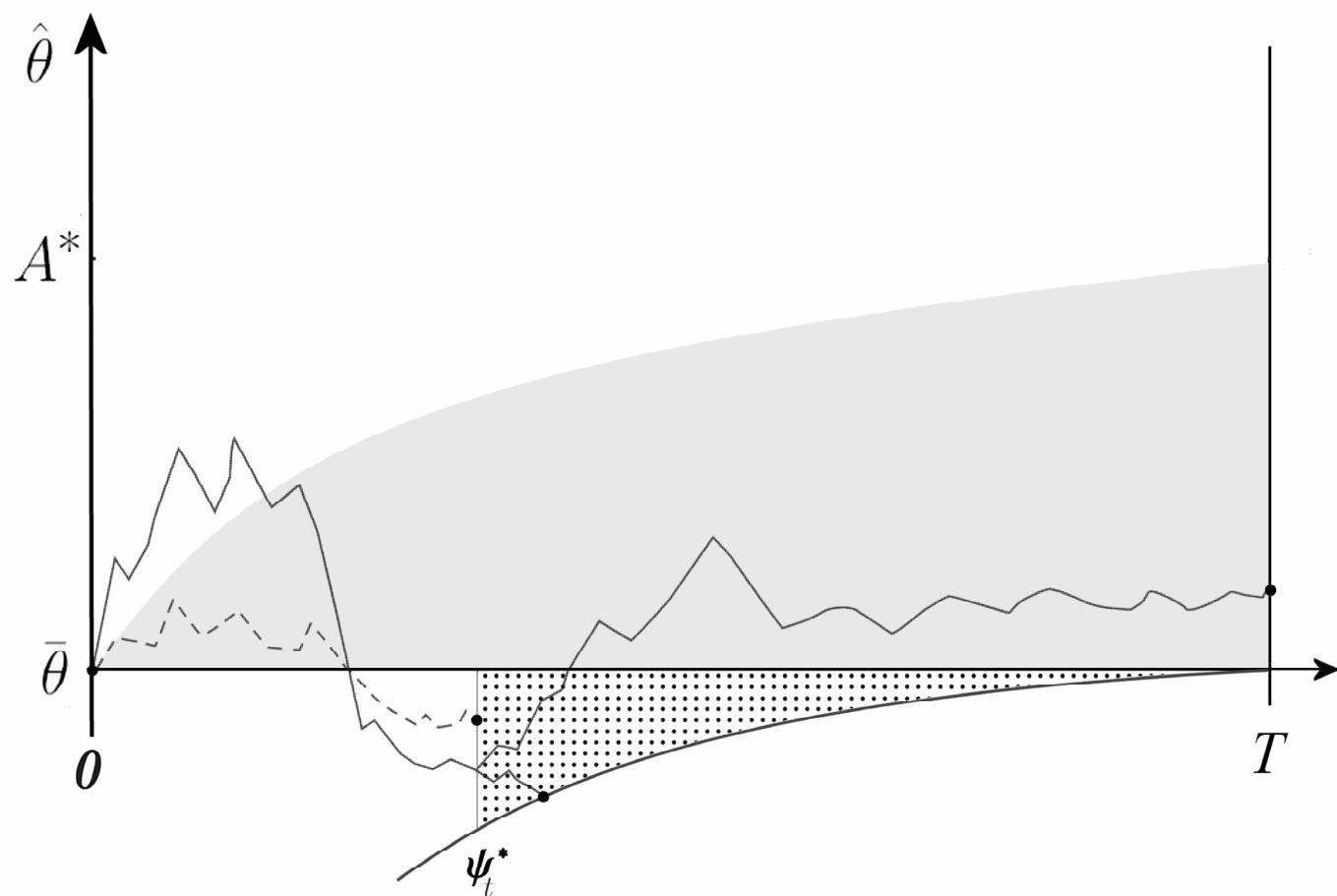— (1990), "Up-or-Out Contracts: A Signaling Perspective." *Journal of Labor Economics*, 8, pp. 230–250.

Figure 1. *Efficient Benchmark.*

Figure 2. *Mediocrities and Has-beens.*