Labor Market Segmentation with Rationed Entry: Theory and Mechanisms

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A different class of labor markets

Some Labor Markets Do Not Clear Through Wages

- **Benchmark.** Standard labor markets clear through wage adjustment; price moves until supply meets demand.
- **A different class.** Entry is rationed by fixed quotas and competitive selection, not by price.
- **Largest, cleanest example, China's civil service:** 1.5M applicants for ~20,000 seats (2021).

Same features elsewhere: East-Asian civil service, PhD admissions, academic hiring, quota-based recruitment.

Labor theory is built for wage-clearing markets; **we study markets where equilibrium is set by rationing.**

Research Question: How should equilibrium be modeled when admission, not wages, is the adjustment variable?

Traditional labor markets
(price adjustment)

Higher labor demand

Higher **wages**

Market clears

adjustment variable: **wages**

Rationed labor markets
(probability adjustment)

More applicants

Competition intensifies

Admission prob. falls

Market clears *by rationing*

adjustment variable: **admission probability**

Both markets reach equilibrium; what differs is the **adjustment variable**. Standard wage-clearing models identify the wrong one.

Three defining features: fixed positions; administered wages; selection.

Our Key Insight: Who Applies Is Endogenous

- Individuals differ in **comparative advantage** across occupations.
- This drives **who chooses to enter** the rationed market.
- Each application decision depends on **whom else you expect to apply**.
- So the **applicant pool is endogenous**, and admission probabilities emerge from it, not assumed exogenous.

Optimal application decisions are mutually dependent.

Model: an endogenous admission mechanism

Model Environment and Timeline

- A **continuum** of heterogeneous workers
- Multiple **wage-clearing** sectors
- One **rationed** sector
- An **outside option**

Everything is standard, except how admission is determined.

Heterogeneity and a Scalar Ability Index

Workers differ in comparative advantage across occupations.

Ability from endowments, education, and a mismatch term, reduced to one number:

$$\mathbf{a}_i \;=\; \Theta\,\mathbf{E}_i + \Phi\,\mathbf{B}_i + \boldsymbol{\varepsilon}_i \qquad \longmapsto \qquad A_O(\mathbf{a}_i) \in \mathbb{R}$$

$\mathbf{E}$: endowments; $\mathbf{B}$: education; $\boldsymbol{\varepsilon}$: mismatch. Scalar index A_O via an O-ring aggregator (Kremer 1993).

The scalar ability index determines each worker's position in the applicant pool.

Each worker chooses probabilistically among the outside option, wage-clearing sectors, and the rationed sector.

$$V_{ij} = \begin{cases} b - c_0 & \textit{outside option} \\ \max\{\beta_j f(A_O, a_{ij}) + \eta_j - c_{ij},\ b - c_0\} & \textit{wage-clearing sector} \\ \max\{\, p_i(w^{\text{high}} - c_{ik}) + (1 - p_i)(b - c_0),\ b - c_0\} & \textit{rationed sector} \end{cases}$$

$$P_{ij} = \frac{\exp(sV_{ij})}{\exp(sV_{i0}) + \sum_{\ell \in J} \exp(sV_{i\ell})}.$$

The rationed sector is different: its payoff depends on admission probability.

Participation:

$$I_{ij} = \mathbf{1}\{V_{ij} > b - c_0\}, \qquad L_j^s = \int P_{ij} I_{ij}\, di.$$

Admission: Competition in an Endogenous Pool

Intuition: applicants compete against *each other*, not against a fixed probability. Admission probability rises with each worker's rank in the applicant pool.

Admission is a smooth top-θ cutoff:

$$p_i \;=\; \sigma\big(\lambda\,[\,F(A_O(\mathbf{a}_i)) - (1-\theta)\,]\big)$$

λ: screening precision θ: admission quota F: rank in the pool

The rank F is computed **among applicants**, not the population:

$$F(a) \;=\; \frac{\int \omega_i\,\mathbf{1}\{A_O(\mathbf{a}_i) \le a\}\,di}{\int \omega_i\,di} \qquad (\omega_i:\ \text{weight that } i \text{ applies})$$

So the applicant pool is endogenous: policies reshape the pool, and the pool reshapes admission probabilities.

General Equilibrium Conditions

A general equilibrium consists of wages, choices, applicant pools, admission probabilities, and employment outcomes satisfying four conditions.

1. **Common sectors clear through wages.**

$$\int P_{ij} I_{ij}\, di = L_j^d(\eta_j), \qquad j \in J_1.$$

2. **The rationed sector is allocated through admission.**

$$L_k^{\text{actual}} = \int P_{ik} p_i I_{ik}\, di.$$

3. **Workers choose optimally under logit choice.**

$$P_{ij} = \frac{\exp(sV_{ij})}{\exp(sV_{i0}) + \sum_{\ell \in J} \exp(sV_{i\ell})}, \qquad I_{ij} = \mathbf{1}\{V_{ij} > b - c_0\}.$$

4. **Admission probabilities are consistent with the applicant pool.**

$$p_i = \sigma(\lambda\left[F(A_O(\mathbf{a}_i)) - (1-\theta)\right]), \qquad F(a) = \frac{\int \omega_i \mathbf{1}\{A_O(\mathbf{a}_i) \leq a\}\, di}{\int \omega_i\, di}.$$

Under standard regularity conditions, this equilibrium is well-defined: common-sector base wages exist and are unique (proved in Theorem 1 & 2).

The fixed point is: choices form the applicant pool, and the applicant pool determines admission probabilities.

Results and implications

Object. Queue unemployment is the rejected part of the applicant queue:

$$U_{\text{invol}}(b) = \int P_{ik}(b)(1 - p_i) I_{ik}\, di.$$

Per-agent mechanism. For worker i, define

$$g_i(b) = P_{ik}(b)(1 - p_i).$$

Then the sign of the derivative is governed by

$$\operatorname{sign} g_i'(b) = \operatorname{sign}\left[(1 - p_i)e^{s\mathcal{A}_i} - p_i e^{s(b - c_0)}\right].$$

Since the second term is strictly increasing in b, each $g_i(b)$ rises and then falls. The turning point is

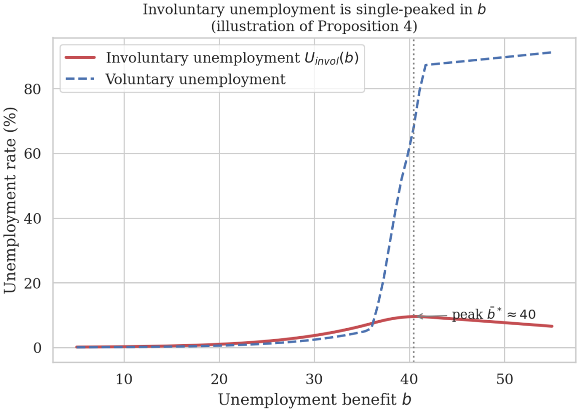
$$b_i^* = c_0 + \mathcal{A}_i - \frac{1}{s} \log \frac{p_i}{1 - p_i}.$$

$$\frac{\partial b_i^*}{\partial \mathcal{A}_i} = 1, \qquad \frac{\partial b_i^*}{\partial p_i} < 0.$$

$\mathcal{A}_i = \frac{1}{s} \log \sum_{j \in J_1} e^{sV_{ij}}$: common-market inclusive value.

Intuition: low b cushions the payoff from a rejected application, so more workers gamble on the queue (rejection-cushion effect); high b makes the outside option dominate (outside-option effect).

Baseline Simulation: The Queue-Unemployment Hump



What the figure shows

Low b: the benefit cushions rejection, so the applicant queue expands.

High b: the outside option becomes attractive, so workers leave the queue.

Turning point shifts with

$$\frac{\partial b_i^*}{\partial \mathcal{A}_i} = 1, \qquad \frac{\partial b_i^*}{\partial p_i} < 0.$$

Peak $\bar{b}^* \approx 40$. The applicant pool is fully endogenous; the single peak survives the feedback.

Analytical Result 2: Screening Quality Has an Interior Optimum

Object. Screening quality is the average ability of admitted workers relative to the population:

$$Q(w^{\text{high}}) = \frac{\int_{\mathbf{I}} A_O(\mathbf{a}_i) m_i(w^{\text{high}})\, di}{\int_{\mathbf{I}} m_i(w^{\text{high}})\, di} - \bar{A}, \qquad m_i(w^{\text{high}}) = P_{ik} p_i I_{ik}.$$

Proposition. Screening quality has a two-sided ceiling:

$$Q(w^{\text{high}}) \leq Q_\infty \quad \text{as } w^{\text{high}} \downarrow w_{\min} \text{ and as } w^{\text{high}} \to \infty.$$

If the interior applicant pool FOSD-dominates the population at some $\tilde{w}$, then

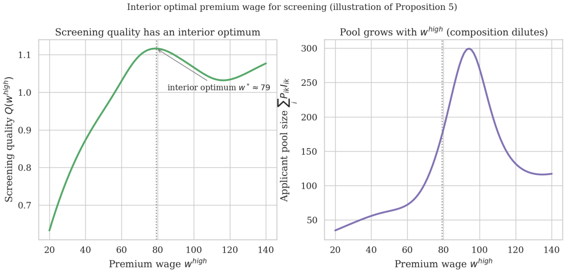
$$Q(\tilde{w}) > Q_\infty, \qquad \Rightarrow \qquad \exists\, w^* \in (w_{\min}, \infty).$$

At the optimum:

$$\int_{\mathbf{I}} \left(A_O(\mathbf{a}_i) - \bar{A}_{\text{adm}}\right) \frac{\partial m_i}{\partial w^{\text{high}}}\, di = 0.$$

Intuition: a larger prize first improves selection, but eventually makes the applicant pool look like the population again.

Why the Screening Hump Appears



Left panel. Screening quality $Q(w^{\text{high}})$ rises first and reaches an interior optimum around $w^* \approx 79$.

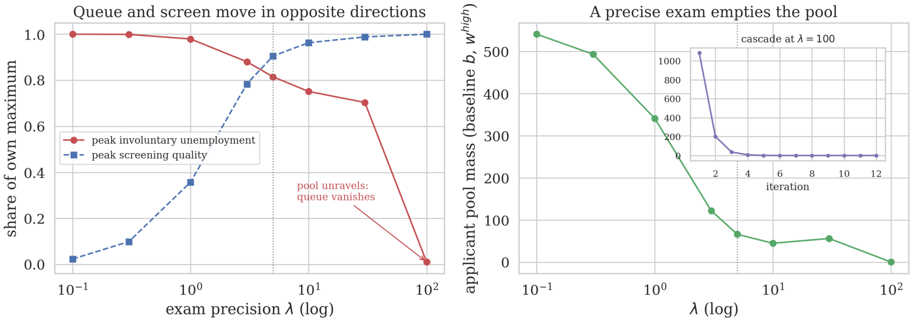
Right panel. The effective applicant-pool intensity $\sum_i P_{ik} I_{ik}$ also responds non-monotonically to w^{high}.

Mechanism. A higher prize first attracts more positively selected applicants. Past the peak, marginal applicants are less selected and admission probabilities adjust through the endogenous pool.

The rising branch is consistent with Dal Bó et al. (2013); Morgan–Sisak–Várdy (2018) provides the closest theoretical antecedent.

Precision Kills the Queue, Not the Screen

A third lever: screening precision λ, i.e. exam design (stages, interview weight, grading noise).



Noise feeds the queue; precision builds the screen. A perfect exam **unravels** the pool ($1083 \to 202 \to 38 \to 7 \to 2 \to 0.6$); nobody queues.

Takeaways

- Higher benefits need not increase **involuntary unemployment**.
- Rationed labor markets clear through **endogenous admission** rather than wage adjustment.
- Higher rewards need not improve **equilibrium screening quality**.
- Policy instruments interact through the **endogenous applicant pool** and should therefore be designed jointly.

Thank you.