Hiring Policies, Worker Employability, and Labor Market Performance

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Abstract

This paper extends Shapiro and Stiglitz (1984)'s efficiency wage model to explore the relation between employers' hiring policy and worker employability. When employers determine their hiring policies, they want to know others' policies, since unemployed workers deicide whether or not to maintain their employabilities, given a representative employer's hiring policy. Such an interaction among employers is responsible for the unconditional existence of the "no-second-chance" equilibrium, in which employers choose to fill their vacancies exclusively with new entrants into the labor market, which discourages outsiders from making efforts to preserve their employability. On the other hand, the "second-chance" equilibrium, in which employers choose to fill some vacancies with them, exists only when the labor demand is sufficiently active. Unemployed workers are motivated to preserve their employabilities if and only if there is a good chance of being re-hired and making a good living again, which entails a sufficiently high demand for labor.

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1 Introduction

This paper extends Shapiro and Stiglitz (1984)'s efficiency wage model to explore the relation between employers' hiring policy and unemployed workers' employabilities. When employers determine their hiring policies, they want to know others' policies, since unemployed workers decide whether or not to maintain their employabilities, given a representative employer's hiring policy. Because of such an interaction among employers, this model exhibits potentially many equilibria, each of which is characterized by a distinct hiring policy. Among the possible equilibria, we focus on the "no-second-chance" equilibrium, in which employers choose to fill their vacancies exclusively with new entrants into the labor market, and the "second-chance" one, in which employers choose to fill some vacancies with them. It is shown that the no-second-chance equilibrium exists for any combination of parameter values, whereas the second-chance equilibrium exists only when the labor demand is sufficiently high. This is because unemployed workers are motivated to preserve their employabilities if and only if there is a good chance of being re-hired and making a good living again, which entails a sufficiently high demand for labor.

The rest of this paper is organized as follows. Section 2 presents the model. Section 3 considers the labor contract between employer and worker. Section 4 examines the "no-second-chance" equilibrium, in which unemployed workers are forced to live in poverty for the rest of lives. Section 5 examines the "second-chance" equilibrium, in which unemployed workers are given the chances of being re-hired and make a good living again. Section 6 compares two equilibria. Section 7 considers the possible transitional dynamics, or "hysterisis". Section 8 concludes this paper.

2 The Model

The analysis is based on an extended version of Shapiro and Stiglitz (1984)'s efficiency wage model. It is set in discrete time and, for simplicity, we focus on its steady states.

2.1 Workers

At the beginning of each period, a continuum of workers of measure $[\theta/(1-\theta)]N$ is born, where θ and N are constants satisfying $\theta \in (0,1)$ and $N > 0$. Unlike the counterparts of Shapiro-Stiglitz's model, those workers are "mortal". Death visits the workers living in a given period with an equal probability of θ, so that they estimate their probability of surviving into the next period at $1-\theta$. This shock is idiosyncratic, and thus population of the workers born s period before has decreased to $\theta(1-\theta)^{s-1}N$ at the beginning of the current period. In the first period of their lives, workers neither work nor consume but devote that period to job search activities. Because they do not work until in the second period of their lives, population of the "labor force" of a given period, i.e., the total number of workers who can work in that period, amounts to

$$\sum_{s=1}^{\infty} \theta(1-\theta)^{s-1}N = N. \tag{1}$$

The constant population of the labor force is attained in such a manner that, at the beginning of each period, old workers of measure θN die and exit from the labor force and, as a substitute for them, the same measure of new workers, who were born in the pervious period, enter into it.[1]

The lifetime utility of a worker born in period t is given by

$$E_t \sum_{s=1}^{\infty} \left(\frac{1-\theta}{1+r}\right)^s (\tilde{w}_{t+s} - e_{t+s}) \tag{2}$$

where E_t, r, $\tilde{w}_{t+s}$ and e_{t+s}, respectively, represent expectation evaluated at the beginning of period t, the discount rate that is positive and constant over time, the real income she earns in period $t+s$, and the effort level she chooses in that period. After entry into the labor force, a worker is either employed by an employer or unemployed in any period. She is paid wages by her employer when employed, and endowed with some fixed amount ($\overline{w}$ units) of the consumption good when unemployed.[2] Thus, $\tilde{w}_{t+s}$ can be written as

$$\tilde{w}_{t+s} = \begin{cases} w_{t+s} & \text{if employed in period } t+s \\ \overline{w} & \text{otherwise,} \end{cases} \tag{3}$$

where w_{t+s} denotes the real wage paid by her employer in period $t+s$.

The only decision the worker makes in each period is to expend either zero effort or some fixed positive level of e (>0), which affects her employer's production when employed, and her own 'employability' when unemployed. A worker can contribute to her employer's production if and only if she is employable and expending e units of work effort. Every worker is employable

[1] For any generation of workers, those of measure $[\theta^2/(1-\theta)]N$ die before entering into the labor force, by assumption.

[2] This unemployment allows such an interpretation that the worker is self-employed or in a low-paid job that is found in the secondary labor market.

when entering into the labor force, and costlessly maintains this ability during periods of employment. During periods of unemployment, in contrast, she needs to expend e units of effort in every period to maintain her employability. If she neglects this maintenance even in one period, her employability is lost and never restored.

Workers are not allowed to hop directly from one employer to another. If a worker separates from the current employer, then she must experience at least one period of unemployment before being hired by the next employer. Thus, a worker's state in a given period t can be summarized by a pair (Q_t, n_t). The first variable, Q_t, indicates her employability, taking the value of 1 if she is employable in period t, and 0, otherwise. By assumption, $Q_t = 1$ for the workers born in period $t-1$. The second variable of this pair, n_t, represents either the length of service with the current employer or duration of unemployment. Specifically, if n_t is a positive integer, this worker enters the n_tth period of service with the current employer in period t. If n_t is a negative integer, she enters the $-n_t$th period of unemployment in period t. And if $n_t = 0$, she is born in period t. Among these variables, n_t is publicly observable, whereas Q_t is usually unobservable. Nevertheless, it is publicly known that workers with $n_t = 0$ are employable in period $t+1$.

2.2 Employers

In every period, there is a continuum of employers of unit measure that produce the consumption good, exploiting their privileged access to the following technology,

$$Y = z\tilde{L}^{\alpha}, \tag{4}$$

where Y and $\tilde{L}$, respectively, denote the output of the consumption good and the number of employees who are employable and expending work efforts, while z and α are constants satisfying $z > 0$ and $\alpha \in (0,1)$. Although population of 'active' employers is time-invariant, their lineup is changing over time. At the beginning of each period, new employers of a fixed measure b $(\in (0,1))$ are born, though they start production in the next period. On the other hand, with an equal probability of b, death visits the employers who have just finished production in that period. This shock is idiosyncratic, and thus active employers of measure b stop production. These allow generation changes of active employers, without changing their total population.

The objective function of an employer born in period t is given by

$$\sum_{s=1}^{\infty} \left(\frac{1-b}{1+r}\right)^{s-1} \left(z\tilde{L}_{t+s}^{\alpha} - \mathbf{w}_{t+s} \cdot \mathbf{L}_{t+s}\right) \tag{5}$$

where $\tilde{L}_{t+s}$ and $\mathbf{w}_{t+s} \cdot \mathbf{L}_{t+s}$, respectively, denote the total number of employees who are employable and effort-expending in period $t+s$, and the wage bill in that period. The wage bill is given by an inner product of wage vector

$$\mathbf{w}_{t+s} = (w^1_{t+s}, \cdots, w^s_{t+s}) \tag{6}$$

and payroll vector

$$\mathbf{L}_{t+s} = (L^1_{t+s}, \cdots, L^s_{t+s}), \tag{7}$$

where w^i_{t+s} and L^i_{t+s}, respectively, denote the level of wage paid to the employees who complete the ith period of service in period $t+s$, and their number in that period.

The employer maximizes (5) by optimally setting a path of $\mathbf{w}_{t+s}$, $\mathbf{L}_{t+s}$, and ν_{t+s-1}. The last variable is a cut-off level for job applicants in period $t+s-1$ such that only those with $n_{t+s-1} \geq \nu_{t+s-1}$ are interviewed in that period. The reason why the employer does not directly set a path of effective labor input, i.e., $\{\tilde{L}_{t+s}\}_{s=1}^{\infty}$, is that she can observe a worker's employability and performances only imperfectly. At a job interview, the employer can detect an unemployable applicant only with a fixed probability of q $(\in (0,1))$, though she never mistakes an employable applicant for an unemployable one. Likewise, the employer can catch a shirking worker, who does not expend effort, only with the probability of q, though she never mistakes a non-shirking worker for a shirking one. Because of these imperfect observablities, $\tilde{L}_{t+s}$ can deviate from the total number of employees, $L_{t+s} \equiv \sum_{i=1}^{s} L^i_{t+s}$. To prevent such a deviation, the employer imposes the cut-off level for job applicants, thereby ensuring their employabilities, while promising her employees that she will pay them a wage significantly higher than $\overline{w}$, and that their employment continues unless they are caught shirking and unless the employer dies, thereby preventing the shirking behavior on the part of the employees.

In addition, there is a moral hazard incentive on the part of the employer, because whether or not a worker has expended effort is unobservable to the third party, and because every employer has an ability to disguise herself as another person by fabricating personal information, such as age, birth period, and past history. Thus, when the starting wage is lower than those which are supposed to be paid in and after the second period of service, the employer naturally has an incentive to save labor costs, by firing all of the current employees at the end of each period, while posing as an employer who has just entered into the economy, recruiting new workers at a low starting wage with an empty promise of future raise. Reputation cannot prevent such a deception, since it is impossible to identify the past of an employer. Given the possibility of this moral hazard, newly-recruited workers choose to expend zero effort if their current wages are lower than those they are supposed to receive in and after the next period, because they regard such an upward-sloping wage profile as an informal notice that they will be fired at the end of the current period. To clear their suspicions, and thus to elicit their work efforts, the employer need to make the starting wage no lower than those paid in and after the second period of service.[3]

2.3 Order of Events within a Period

Events within a given period t occur as follows.

After the birth of new workers and new employers, all of the employers present in that period determine, or revise, their future paths of payroll, wage, and cut-off level for job applicants, $\{(\mathbf{L}_{t+s}, \mathbf{w}_{t+s}, \nu_{t+s-1})\}_{s=1}^{\infty}$. Among these paths, those of payroll and wage are publicly observable for each employer. On the other hand, workers cannot observe each employer's path of cut-off level, but only the path of all employers' average, $\{\overline{\nu}_{t+s}\}_{s=0}^{+\infty}$. Given these observable paths, unemployed workers decide whether or not to continue maintaining their employabilities, while hired workers decide whether or not to expend work effort in the current period.

Next, the employers, except the newly born ones, start production, using their employees who were recruited in or before the previous period. After production activities are finished, wages are paid to hired workers. Then, old employers of measure b die, and their employees are fired. In addition, the employees who have been caught shirking, if exist, are also fired. On the other hand, employment of the workers who have neither experienced their employer's death nor been caught shirking are extended into the next period.

Finally, to keep their payrolls at an optimal level, the employers who are determined to survive into the next period recruit some workers to substitute

[3]The moral hazard incentive on the part of the employer is introduced to make this model immune to the criticism of Carmichael (1985) on Shapiro-Stiglitz's efficiency wage model. The point of Carmichael's criticism is that, even if employers are forced to elicit work efforts by paying efficiency wages, they can still sell their jobs, requiring newly-recruited workers to accept a low level of starting wage, or pay an entrance fee. He asserts that, contrary to the argument of Shapiro and Stiglitz, unemployment cannot be involuntary, since starting wage, or entrance fee, clears the job market in each period. In this model, however, the starting wage may fail to clear the job market when its market-clearing level is sufficiently low. Employers are reluctant to set the staring wage at such a low level, being apprehensive that this may induce newly-recruited workers to expend zero effort. To make the labor contract with them "self-enforcing", employers rather choose to set the starting wage at a sufficiently high level, which causes job rationing and involuntary unemployment in the job market. A similar and more detailed discussion of self-enforcing labor contracts is made by MacLeod and Malcomson (1989).

for those who die at the end of the current period.

3 Wage Profile and the Aggregate Demand for Labor in Steady States

Instead of fully characterizing possible equilibria of this economy, we focus on its steady states, in which wages paid to workers with $n \geq 1$ are common across employers and across periods. We begin the analysis by examining how employers determine their wages and payrolls in such a stationary environment.

Proposition 1. *Let w^n be the level of wage a worker receives in the nth period of service with an employer. Then, in a steady state, employers offer job applicants such a wage profile that*

$$w^n = \begin{cases} w^1 & \text{for} \quad n = 1 \\ w \ (\leq w^1) & \text{for} \quad \forall n \geq 2. \end{cases} \tag{8}$$

Proof. If the path of wages paid to a worker is optimally chosen, then the worker finds it optimal to expend work effort in every period, and thus, for $\forall n \geq 1$, the following relations are true:

$$\begin{aligned} V(1,n) &= w^n - e + \frac{1-\theta}{1+r} E\left[V(1,\tilde{n}) | e^n = e\right] \\ &= w^n - e + \frac{1-\theta}{1+r} \left[(1-b)V(1,n+1) + bV(1,-1)\right] \\ &\geq w^n + \frac{1-\theta}{1+r} E\left[V(1,\tilde{n}) | e^i = 0\right] \\ &= w^n + \frac{1-\theta}{1+r} \left[\begin{array}{l} (1-b)(1-q)V(1,n+1) \\ +(b+q-bq)V(1,-1) \end{array} \right] \end{aligned} \tag{9}$$

where $V(Q,n)$, $\tilde{n}$, e^n, and $E[\cdot | e^n]$, respectively, represent the lifetime utility of a worker whose current state is (Q,n), her state of employment in the next period, the level of work effort expended in the nth period of service, and conditional expectation given e^n. The second and fourth lines of (9) are, respectively, obtained from the facts that if this worker expends e units of work effort in the nth period, then in the next period, she will keep this job with probability $1-b$ and lose it with probability b, and that if she expends zero effort in the nth period, then in the next period, she will keep this job with probability $(1-b)(1-q)$ and lose it with probability $b+q-bq$. The inequality of the third line is obtained from the fact that it is optimal for this worker to expend effort in the nth period. From the third and last lines of (9), we can derive

$$\forall n \geq 1, \quad V(1,n+1) \geq V(1,-1) + \frac{1+r}{(1-\theta)(1-b)q}e, \tag{10}$$

the equality of which is valid if the employer minimizes labor costs. Using the equality of (10) to eliminate $V(1,n)$ and $V(1,n+1)$ from the first and second lines of (9), we can obtain

$$\forall n \geq 2, \quad w^n = \frac{r+\theta}{1+r}V(1,-1) + \frac{1+r-(1-\theta)(1-b)(1-q)}{(1-\theta)(1-b)q}e, \tag{11}$$

which establishes that the wages paid in and after the second period of service are equal, i.e., $w^n = w$ for $\forall n \geq 2$. For this labor contract to be self-enforcing, the starting wage, w^1, must be no lower than those paid in and after the second period of service, w. When the wage profile satisfies $w^1 \geq w$, the employer has a strong incentive to renew the contracts with a workers who has started to work in the current period, since her wage decreases from w^1 to w in the next period. When $w^1 < w$, the employer finds it profitable to fire that worker at the end of the current period, recruiting a new one at w^1. This induces the current employees to expend zero effort, which implies that there is no such self-enforcing contract that $w^1 < w$. □

In the rest of this paper, w^1 and w, respectively, denote wages paid to workers with $n = 1$ and wages paid to workers with $n \geq 2$. As shown in the proof of Proposition 1, optimally chosen values of w^1 and w satisfy

$$w^1 \geq w = \frac{r+\theta}{1+r}V(1,-1) + \frac{1+r-(1-\theta)(1-b)(1-q)}{(1-\theta)(1-b)q}e. \tag{12}$$

Whether or not w^1 is larger than w totally depends on the tightness of the job market. When the job market is tight, employers cannot hire a desired number of new workers without raising the level of w^1 to a market clearing one, which is higher than w. When the job market is loose, employers make the level of w^1 equal to w, since it is still high enough to recruit a desired number of new workers.

Corollary 1. *In steady states of this economy, all active employers have the same number of employees.*

Proof. Consider an employer born in period t. Using w^1 and w, her objective function can be written as

$$\begin{aligned} & zL_{t+1}^{\alpha} - w^1 L_{t+1} \\ & + \sum_{s=2}^{\infty} \left(\frac{1-b}{1+r} \right)^{s-1} \left\{ \begin{array}{l} zL_{t+s}^{\alpha} - w(1-\theta)L_{t+s-1} \\ -w^1[L_{t+s} - (1-\theta)L_{t+s-1}] \end{array} \right\} \end{aligned} \tag{13}$$

where $L_{t+s} \equiv \sum_{i=1}^{s} L_{t+s}^{i}$. If $\{L_{t+s}\}_{s=1}^{\infty}$ is chosen to maximize (13), then

$$\forall s \geq 1, \quad z\alpha L_{t+s}^{\alpha-1} = w^1 - \frac{(1-b)(1-\theta)(w^1-w)}{1+r}, \tag{14}$$

which implies that L_{t+s} takes a common value for any combination of t and s, and thus that, in steady states, the number of employees is common across employers and across periods. □

For analytical convenience, define $\hat{w}$ as

$$\hat{w} \equiv w^1 - \frac{(1-b)(1-\theta)(w^1-w)}{1+r}. \tag{15}$$

As is easily verified, $\hat{w}$ is a convex combination of w and w^1, and thus the sign of $\hat{w} - w$ always coincides with that of $w^1 - w$. Then we can state

Proposition 2. *Let E be a steady state level of the aggregate employment. Then, E must satisfy*

$$z\alpha E^{\alpha-1} = \hat{w}. \tag{16}$$

Proof. Because the population of active employers is equal to unity, not only the individual- but also the aggregate demand for labor is given by (14). □

4 No-Second-Chance Equilibrium

The 'no-second-chance' equilibrium (NSCE) is a steady state of this economy, in which all employers set their cut-off levels for job applicants at zero in any period, and thus $\overline{\nu}_t = 0$ for $\forall t \in (-\infty, +\infty)$. Because workers are not allowed to hop directly from one employer to another, this policy implies that employers fill their vacant positions exclusively with new entrants into the labor force, and thus that no second chance is given to unemployed workers.

In NSCE, unemployed workers stop maintaining their employabilities, and every employer finds it optimal to set her cut-off level at zero for all periods.

Proposition 3. *In NSCE, workers with $n < 0$ expend zero effort, and their lifetime utilities are determined as*

$$V(Q, n) = [(1 + r)/(r + \theta)]\overline{w}. \tag{17}$$

Proof. In NSCE, job openings are limited to newly born workers in each period, and thus the lifetime utility of a worker unemployed at the beginning of period t can be written as

$$\sum_{s=0}^{\infty} \left(\frac{1-\theta}{1+r}\right)^s (\overline{w} - e_{t+s}), \tag{18}$$

which attains its maximum, $[(1 + r)/(r + \theta)]\overline{w}$, at $e_{t+s} = 0$ for $\forall s \geq 0$. □

Corollary 2. *In NSCE, the level of w is determined as*

$$w = \overline{w} + \frac{1 + r - (1-\theta)(1-b)(1-q)}{(1-\theta)(1-b)q} e. \tag{19}$$

Proof. Substituting (17) into (12) produces the desired result. □

Proposition 4. *In NSCE, each employer finds it optimal to set her cut-off level at zero during life.*

Proof. Because each employer is an extremely small existence of measure zero, an employer's choice of cut-off level in period t has only a negligible impact on the level of $\overline{\nu}_t$. In other words, the employabilities of unemployed workers are effectively determined by other employers' choice of cut-off levels. Moreover, in NSCE, unemployed workers stop maintaining their employabilities, as shown in Proposition 3. Thus, setting ν_t at a negative level for some t means that this employer almost surely hires some umemployable workers in period $t + 1$. This is obviously unprofitable. □

For the reasons that every worker dies with probability θ, and that every job is destroyed and re-created with probability b, there are $[(\theta + b - \theta b)/(1 - \theta)]E$ of job openings in each period.[4] If employers fill their vacancies exclusively with newly born workers, then the following must hold:

$$\pi[\theta/(1-\theta)]N = [(\theta + b - \theta b)/(1-\theta)]E, \tag{20}$$

[4]Note that the total number of job openings is larger than that of vacancies that are expected to appear, $(\theta + b - \theta b)E$. This is because employers recruit extra workers, anticipating that θ fraction of their recruited workers die at the end of the current period.

where π denotes the probability for a newly born worker to find a job of the next period. Define w^* as

$$w^* \equiv \overline{w} + \frac{1 + r - (1-\theta)(1-b)(1-q)}{(1-\theta)(1-b)q} e. \tag{21}$$

When the job market is tight, i.e., $\pi = 1$, E and w^1 must satisfy

$$E = [\theta/(\theta + b - \theta b)]N, \qquad w^1 \geq w^*. \tag{22}$$

When the job market is loose, i.e., $\pi < 1$, E and w^1 must satisfy

$$E < [\theta/(\theta + b - \theta b)]N, \qquad w^1 = w^*. \tag{23}$$

Conditions (22) and (23) can be merged as

$$\begin{aligned} \{[\theta/(\theta + b - \theta b)]N - E\}(w^1 - w^*) = 0; \\ [\theta/(\theta + b - \theta b)]N - E \geq 0; \\ w^1 - w^* \geq 0, \end{aligned} \tag{24}$$

which summarize possible combinations of the aggregate employment and the level of starting wages the employers offer to newly born workers. Using $\hat{w}$, which is defined by (15), condition (24) can be rewritten as

$$\begin{aligned} \{[\theta/(\theta + b - \theta b)]N - E\}(\hat{w} - w^*) = 0; \\ [\theta/(\theta + b - \theta b)]N - E \geq 0; \\ \hat{w} - w^* \geq 0, \end{aligned} \tag{25}$$

which constitute the "wage-setting rule" for NSCE.[5]

NSCE is a pair $(E, \hat{w})$ satisfying (16) and (25). Its unconditional existence and uniqueness is obvious from the facts that the locus of (16), which we call the aggregate labor demand, is downward-sloping with $w \to +\infty$ as $E \to 0$ and with $w \to 0$ as $E \to +\infty$, and that the locus of (25), which we call the wage setting rule for NSCE, is inverted L-shaped, as depicted in Figure 1. The next proposition states this result more formally.

Proposition 5. *Let w^* be as defined by (21). When parameters satisfy $z\alpha[\theta N/(\theta + b - \theta b)]^{\alpha-1} \leq w^*$, NSCE is uniquely determined as*

$$E = (z\alpha/w^*)^{1/(1-\alpha)}, \qquad \hat{w} = w^*. \tag{26}$$

In other cases, NSCE is uniquely determined as

$$E = [\theta/(\theta + b - \theta b)]N, \qquad \hat{w} = z\alpha[\theta N/(\theta + b - \theta b)]^{\alpha-1}. \tag{27}$$

Proof. By solving (16) and (25) with respect to E and $\hat{w}$, we can obtain the desired results. □

[5]This rule is roughly equivalent to what is called "no-shirking condition" or "surrogate labor supply curve" in the literature of efficiency wages.

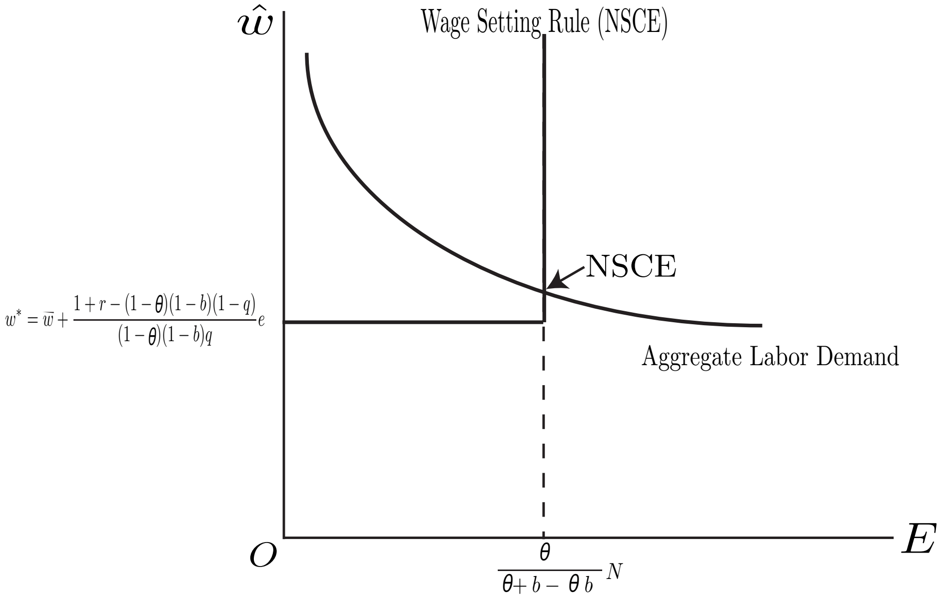

Figure 1: NSCE

5 Second-Chance Equilibrium

The 'second-chance' equilibrium (SCE) is a steady state of this economy, in which all employers set their cut-off levels at a negative infinity in any period, and thus $\overline{\nu}_t = -\infty$ for $\forall t \in (-\infty, +\infty)$. In that equilibrium, employers do not care about applicants' record of unemployment, since unemployed workers almost surely retain their employabilities. Nevertheless, we need to examine lifetime utilities unemployable workers would enjoy in that equilibrium, which is necessary in deriving the conditions under which unemployed workers preserve their employabilities.

In SCE, lifetime utilities of unemployable workers are determined in such a manner that

$$\begin{aligned} V(0,1) &= V_{DE}^1 \\ V(0,n) &= V_{DE} \qquad \text{for } \forall n \geq 2 \\ V(0,n) &= V_{DU} \qquad \text{for } \forall n \leq -1, \end{aligned}$$

where V_{DE}^1, V_{DE}, and V_{DU} solve the following simultaneous equations,

$$\begin{aligned} V_{DE}^1 &= w^1 + \frac{1-\theta}{1+r}[(1-b)(1-q)V_{DE} + (b+q-bq)V_{DU}], && (28) \\ V_{DE} &= w + \frac{1-\theta}{1+r}[(1-b)(1-q)V_{DE} + (b+q-bq)V_{DU}], && (29) \\ V_{DU} &= \overline{w} + \frac{1-\theta}{1+r}[a(1-q)V_{DE}^1 + (1-a+aq)V_{DU}]. && (30) \end{aligned}$$

Notation a denotes the probability for those who are currently unemployed to be interviewed by an employer at the end of that period. Although both employers and workers take the value of a as given, it is endogenously determined in equilibrium.

From (28)-(30), we can obtain

$$\begin{aligned} V_{DU} &= \frac{1+r}{(r+\theta)[1+r-(1-\theta)(1-q)(1-a-b)]} \\ &\times \left\{ \begin{array}{l} [1+r-(1-\theta)(1-q)(1-b)]\overline{w} \\ \\ +\dfrac{(1-\theta)(1-q)a[1+r-(1-\theta)(1-q)(1-b)]}{1+r-(1-\theta)(1-b)}\hat{w} \\ \\ -\dfrac{(1-\theta)^2(1-q)qa(1-b)}{1+r-(1-\theta)(1-b)}w \end{array} \right\}, \end{aligned} \quad (31)$$

where $\hat{w}$ is as defined by (15). The value of V_{DU} serves as a reference point for unemployed workers who are still employable and thus must decide whether or not they will preserve their employabilities. To see this, consider a worker with $Q = 1$ and $n \leq -1$. This worker chooses to preserve her employability if and only if the following is true:

$$\begin{aligned} V(1,n) &= \overline{w} - e + \frac{1-\theta}{1+r}[aV(1,1) + (1-a)V(1,n-1)] \\ &\geq \overline{w} + \frac{1-\theta}{1+r}[a(1-q)V(0,1) + (1-a+aq)V(0,n-1)] \\ &= V_{DU}, \end{aligned} \quad (32)$$

the last equality of which is obtained from (30). We call (32) "employability preserving condition (EPC)".

In SCE, condition (32) holds for $\forall n \leq -1$, and thus lifetime utilities of employable workers are determined in such a manner that

$$\begin{aligned} V(1,1) &= V_E^1 \\ V(1,n) &= V_E \qquad \text{for } \forall n \geq 2 \\ V(1,n) &= V_U \qquad \text{for } \forall n \leq -1, \end{aligned}$$

where V_E^1, V_E, and V_U solve the following simultaneous equations,

$$V_E^1 = w^1 - e + \frac{1-\theta}{1+r}[(1-b)V_E + bV_U], \tag{33}$$

$$V_E = w - e + \frac{1-\theta}{1+r}[(1-b)V_E + bV_U], \tag{34}$$

$$V_U = \overline{w} - e + \frac{1-\theta}{1+r}[aV_E^1 + (1-a)V_U]. \tag{35}$$

From (33)-(35), we can obtain

$$\begin{aligned} V_U &= \frac{(1+r)[1+r-(1-\theta)(1-b)]}{(r+\theta)[1+r-(1-\theta)(1-a-b)]}(\overline{w}-e) \\ &+ \frac{(1+r)(1-\theta)a}{(r+\theta)[1+r-(1-\theta)(1-a-b)]}(\hat{w}-e), \end{aligned} \tag{36}$$

which enables us to derive some important conditions.

First, by substituting (36) into (12), we can derive the wage setting rule for an individual employer. Specifically, each employer sets the level of w as

$$w = \frac{[1+r-(1-\theta)(1-b)]\overline{w} + (1-\theta)a\hat{w}}{1+r-(1-\theta)(1-a-b)} + \frac{1+r-(1-\theta)(1-b)}{(1-\theta)(1-b)q}e. \tag{37}$$

This rule implies that, in setting the level of w, each employer considers other employers' wages, $\hat{w}$, and the tightness of the job market, a, as well as the endowments during unemployment periods, $\overline{w}$. These influence an employer's wage setting through the lifetime utilities of unemployed workers. In SCE, unemployed workers have a chance of being re-hired, and thus their lifetime utilities depend on its probability and wages paid by future employers. These utilities, in turn, affect the effort expenditure decision of hired workers, and hence their employers' wage setting.

Second, by substituting (31) and (36) into (32), we can rewrite the employability preserving condition as

$$\begin{aligned}
&\frac{[1+r-(1-\theta)(1-b)]\overline{w}+(1-\theta)a\hat{w}}{1+r-(1-\theta)(1-a-b)}-e \\
&\geq [1+r-(1-\theta)(1-q)(1-a-b)]^{-1} \\
&\times \left\{ \begin{array}{l} [1+r-(1-\theta)(1-q)(1-b)]\overline{w} \\ \\ +\dfrac{(1-\theta)(1-q)a[1+r-(1-\theta)(1-q)(1-b)]}{1+r-(1-\theta)(1-b)}\hat{w} \\ \\ -\dfrac{(1-\theta)^2(1-q)qa(1-b)}{1+r-(1-\theta)(1-b)}w \end{array} \right\}.
\end{aligned} \tag{38}$$

Unemployed workers preserve their employabilities if and only if $\hat{w}$, w and a satisfy (38). This, in turn, implies that, only when this condition is satisfied, employers find it optimal to adopt such a non-discriminatory hiring policy that they treat unemployed workers the same as newly born ones. When condition (38) is not satisfied, it is no longer profitable to recruit unemployed workers, since they have already stopped preserving employabilities.

Because job applicants in each period is the sum of newly born workers and currently unemployed ones, i.e., $[\theta/(1-\theta)]N+N-E$, and because job openings in each period equal $[(\theta+b-\theta b)/(1-\theta)]E$, the hiring probability a must satisfy

$$a\{[\theta/(1-\theta)]N+N-E\}=[(\theta+b-\theta b)/(1-\theta)]E$$

or equivalently

$$a=\frac{(\theta+b-\theta b)E}{N-(1-\theta)E}, \tag{39}$$

which yields the following implications. If the job market is tight, i.e., $a=1$, then $\hat{w}$, w and E must satisfy

$$E=[1/(1+b-\theta b)]N \qquad \hat{w}\geq w, \tag{40}$$

since the tight market can make starting wage higher than those paid in and after the second period of service, i.e., $w^1 \geq w$. If the job market is loose, i.e., $a<1$, then $\hat{w}$, w and E must satisfy

$$E<[1/(1+b-\theta b)]N \qquad \hat{w}=w, \tag{41}$$

since the loose market make starting wage equal to those paid in and after the second period of service, i.e., $w^1 = w$. Conditions (37)(40) and (41) jointly imply that

$$\hat{w} - \overline{w} \geq \frac{1 + r - (1-\theta)(1-a-b)}{(1-\theta)(1-b)q} e, \tag{42}$$

the inequality of which can be true only when $a = 1$. Conditions (37) and (42) provide possible combinations of $\hat{w}$, w and a in SCE.

Proposition 6. *Let $(\hat{w}, w, a)$ be a triplet satisfying (37) and (42). Then, this triplet satisfies the employability preserving condition (38) if and only if*

$$a \geq 1 - b. \tag{43}$$

Proof. When $a = 1$, conditions (37) and (42) are, respectively, reduced to

$$w = \frac{[1 + r - (1-\theta)(1-b)]\overline{w} + (1-\theta)\hat{w}}{1 + r + (1-\theta)b} + \frac{1 + r - (1-\theta)(1-b)}{(1-\theta)(1-b)q} e. \tag{44}$$

and

$$\hat{w} - \overline{w} \geq \frac{1 + r + (1-\theta)b}{(1-\theta)(1-b)q} e. \tag{45}$$

On the other hand, EPC, i.e., (38), is reduced to

$$\begin{aligned} &\frac{[1 + r - (1-\theta)(1-b)]\overline{w} + (1-\theta)\hat{w}}{1 + r + (1-\theta)b} - e \\ &\geq [1 + r + (1-\theta)(1-q)b]^{-1} \\ &\times \left\{ \begin{array}{l} [1 + r - (1-\theta)(1-q)(1-b)]\overline{w} \\ + \dfrac{(1-\theta)(1-q)[1 + r - (1-\theta)(1-q)(1-b)]}{1 + r - (1-\theta)(1-b)} \hat{w} \\ - \dfrac{(1-\theta)^2(1-q)q(1-b)}{1 + r - (1-\theta)(1-b)} w \end{array} \right\}. \end{aligned} \tag{46}$$

Using (44) to eliminate w from (46) and rearranging it, we can obtain a simplified version of EPC, i.e.,

$$\hat{w} - \overline{w} \geq \frac{1 + r + (1-\theta)b}{(1-\theta)q} e. \tag{47}$$

Because $\hat{w}$ satisfies (45), it also satisfies (47), which establishes that, when $a = 1$, $\hat{w}$ and w satisfy EPC. When $a < 1$, conditions (37) and (42) are equivalent to

$$\hat{w} - \overline{w} = \frac{1 + r - (1-\theta)(1-a-b)}{(1-\theta)(1-b)q} e. \tag{48}$$

On the other hand, EPC is reduced to

$$\hat{w} - \overline{w} \geq \frac{[1 + r - (1-\theta)(1-a-b)][1 + r - (1-q)(1-\theta)(1-a-b)]}{(1+r)(1-\theta)aq} e. \tag{49}$$

Using (48) to eliminate $\hat{w} - \overline{w}$ from (49) and rearranging it, we can obtain a simplified version of EPC, i.e., (43). □

Conditions (39)(42) and (43) produce the "wage setting rule" for SCE, i.e.,

$$\begin{aligned}
&\left\{\hat{w} - \overline{w} - \left[\frac{r + \theta + (1-\theta)b}{(1-\theta)(1-b)q} + \frac{\theta + b - \theta b}{(1-b)q} \cdot \frac{E}{N - (1-\theta)E}\right] e\right\} \\
&\qquad \times \left(\frac{1}{1 + b - \theta b} N - E\right) = 0; \\
&\hat{w} - \overline{w} - \left[\frac{r + \theta + (1-\theta)b}{(1-\theta)(1-b)q} + \frac{\theta + b - \theta b}{(1-b)q} \cdot \frac{E}{N - (1-\theta)E}\right] e \geq 0; \\
&\frac{1}{1 + b - \theta b} N - E \geq 0; \\
&E - (1-b)N \geq 0.
\end{aligned} \tag{50}$$

SCE is a pair $(E, \hat{w})$ satisfying (16) and (50).

Proposition 7. *SCE is uniquely determined if parameters satisfy*

$$z\alpha[(1-b)N]^{\alpha-1} \geq \overline{w} + \frac{1 + r}{(1-\theta)(1-b)q} e. \tag{51}$$

In other cases, no SCE exists in this economy.

Proof. Figure 2 depicts the loci of (16) and (50), which we call the aggregate labor demand and the wage setting rule for SCE, respectively. As shown in that figure, these loci have a single intersection point if and only if the locus of the aggregate labor demand is not located below that of the wage setting rule at $E = (1-b)N$. □

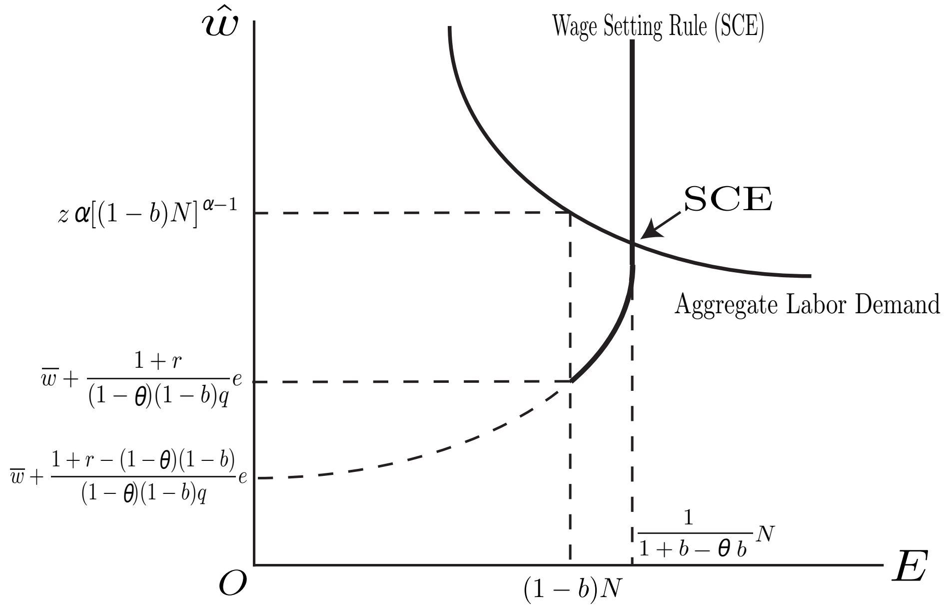

Figure 2: SCE

It must be emphasized that SCE exists only when the aggregate demand for labor is sufficiently large. If this condition is not met, unemployed workers will stop preserving their employabilities, either because of a low probability of being re-hired, or because of low wages that will be received after being re-hired.

6 Comparing SCE with NSCE

The striking difference between SCE and NSCE is that SCE provides unemployed workers with "second chances", i.e., chances of being re-hired and making a good living again, whereas NSCE provides no such chances, merely forcing them to receive $\overline{w}$ of endowments for the rest of their lives. Although the presence of second chances renders the lifetime utilities of unemployed workers in SCE higher than those of their counterparts at NSCE, it is still unclear whether or not SCE outperforms NSCE in resource allocation.

In fact, the presence of second chances has two conflicting effects on the aggregate employment. On the one hand, it induces unemployed workers to preserve their employabilities, increasing total population of employable workers, thereby facilitating a higher level of the aggregate employment. On the other hand, it raises the value of default option for the currently

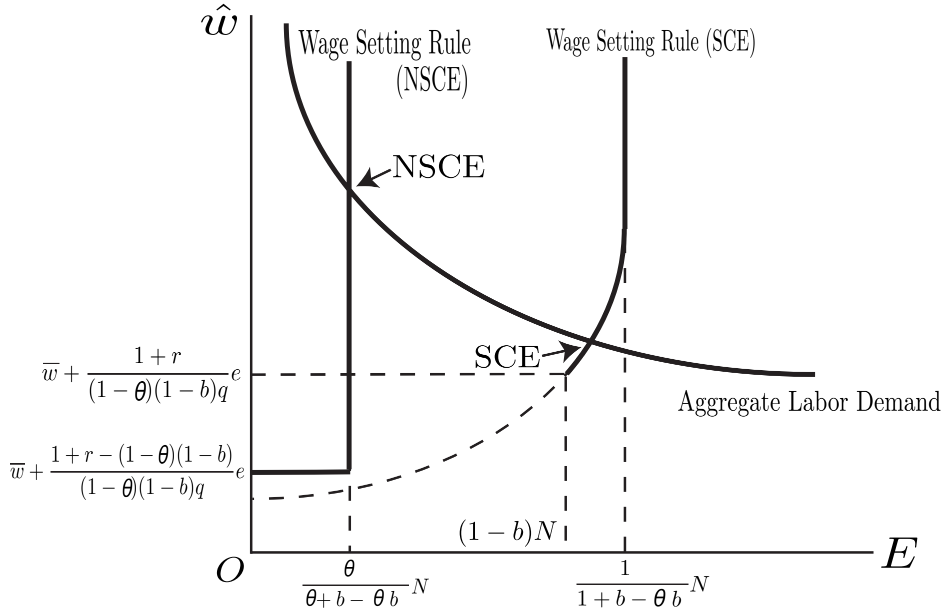

Figure 3: NSCE and SCE for $\theta < (1-\theta)(1-b)$

employed workers, thereby requiring their employers to pay higher wages to motivate them. This wage hike may induce unemployed workers to preserve their employabilities, even when their re-hiring probaility is not so high. Of course, this effect facilitates a lower level of the aggregate employment. When the former effect dominates the latter, the employment of SCE is larger than that of NSCE. When the latter effect dominates the former, the employment of SCE is smaller than that of NSCE. Figures 3 and 4 tell us that both cases are possible.

Figure 3 depicts SCE and NSCE for a case in which θ and b satisfy

$$\theta < (1-\theta)(1-b), \tag{52}$$

In this case, the continuation probability of employment, which is given by $(1-\theta)(1-b)$, is so high that employers need not pay high wages to elicit work efforts from their employees. This, in turn, reduces the incentive of unemployed workers to preserve their employabilities. They stop preserving their employabilities, unless their re-hiring probability is sufficiently high. As a result, the realized employment levels of SCE and NSCE are quite close to their maximum employment ones.

Figure 4 depicts SCE and NSCE for a case in which θ and b satisfy

$$\theta \geq (1-\theta)(1-b). \tag{53}$$

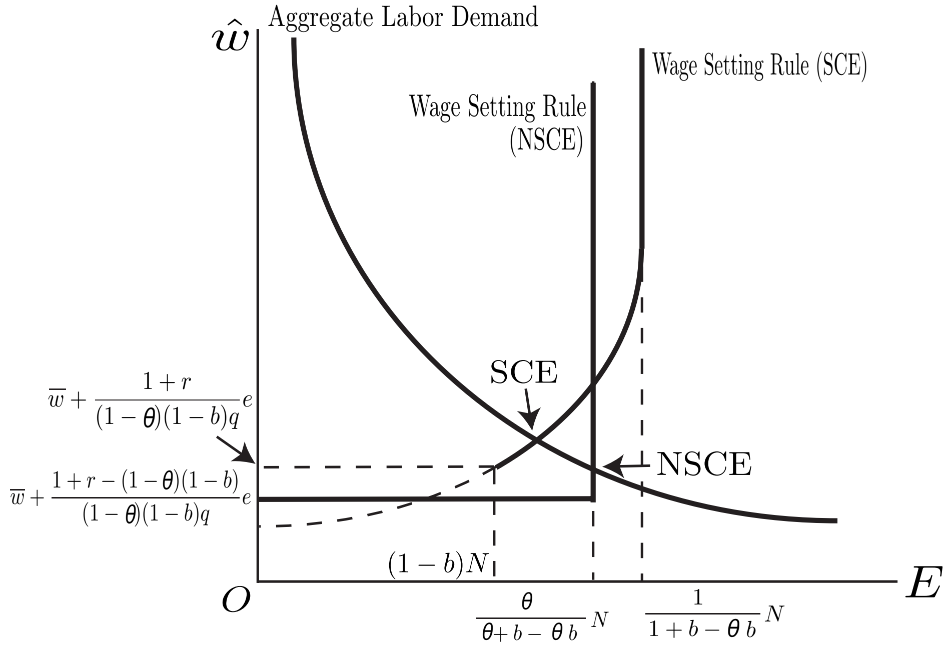

Figure 4: NSCE and SCE for $\theta \geq (1-\theta)(1-b)$

In this case, the continuation probability of employment is so low that employers need to pay sufficently high wages to elicit work efforts from their employees. This, in turn, increases the incentive of unemployed workers to preserve their employabilities. They choose to preserve their employabilities, even when their re-hiring probability is not so high. As a result, the realized employment levels of SCE can be far below its maximum and even lower than that of NSCE.

These diagrammatical expositions, however, do not answer the question of which equilibrium attains the better allocation. To answer this question, assume that, in every period, all of the profits earned by employers are equally distributed to the workers in the labor force. define the measure of economic welfare as

$$EM \equiv LU + \frac{1-\theta}{r+\theta} \cdot \frac{zE^{\alpha} - [w^1 - (1-\theta)(1-b)(w^1 - w)]E}{N}, \tag{54}$$

where LU is the lifetime utility of a worker, which is evaluated at her birth period, i.e.,

$$LU = \begin{cases} \dfrac{1-\theta}{1+r}[\pi V(1,1) + (1-\pi)V(1,-1)] & \text{for NSCE} \\ \\ \dfrac{1-\theta}{1+r}[aV_E^1 + (1-a)V_U] & \text{for SCE} \end{cases} \tag{55}$$

and the second term of (54) represents the expected receit of profit of that worker. Parameter values are configured as

$$r = 0.01, \quad \alpha = 0.7, \quad \theta = 0.8, \quad \overline{w} = 1, \quad q = 0.9, \quad N = 1, \quad z = 1.$$

Then the values of E, $\hat{w}$, w^1, w, $V(Q,n)$, LU, EM are computed for varaious values of b. Results are reported in Table 1-4. They indicate a tendency that the equilibrium attaining the higher level of employment also attains the higher value of EM.

7 Hiring Policy and Hysterisis

Due to difference in dominant hiring policy, SCE and NSCE may respond differently to an increased demand for labor. To see this, consider such increases in the aggregate demand for labor as depicted in Figures 5 and 6. In both cases, total employment of employers is finally increased, but the transition to those new states varies between SCE and NSCE. Specifically, the transition of SCE is prompt, whereas that of NSCE is slow and time-consuming. When employers adopt the nondiscriminatory hiring policy, the increased demand for labor are promptly met by hiring unemployed workers, which enables SCE to jump into the new state. When employers adopt the discriminatory hiring policy, in contrast, the increased demand for labor are only met by new entrants, since employers view unemployed workers unemployable. As a result, NSCE makes such a transition that, initially, the wages of currently hired workers is overshootingly increased, and then the aggregate employment is gradually increased to its new level.

A substantial change in the labor demand may lead to a change in employers' hiring policy. For example, when the labor demand is so reduced that SCE can no longer exist, employers that have hitherto believed in the employability of unemployed workers will choose to switch their hiring policy from nondiscriminatory to discriminatory one, which discourages those workers from preserving their skill. Likewise, when the labor demand is so increased that SCE can exist again, employers that have hitherto believed in the unemployability of currently unemployed workers may start thinking

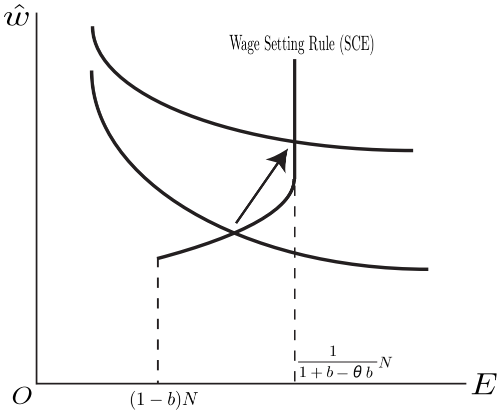

Figure 5: Response of SCE

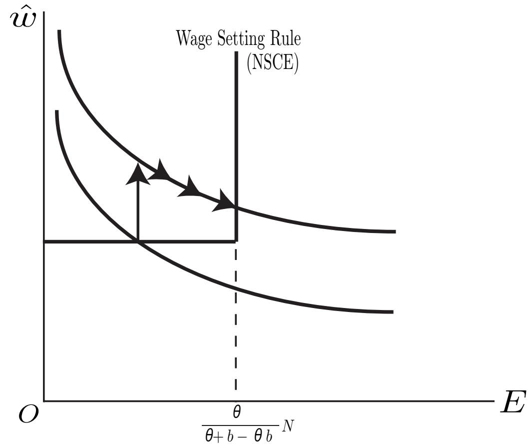

Figure 6: Response of NSCE

that the workers who have just quitted from an employer are still employable, and filling some vacancies with such workers. This change motivates those workers to maintain their skill, and the total supply of employable workers is gradually increased over time. In the long run, the hiring policy adopted by employers has become effectively the nondiscriminatory one, since all of the workers existing in the labor market are employable.

These arguments imply that experience of long stagnation lets employers cling to the discriminatory hiring policy even after the labor demand is restored, since such experience convinces employers of the unemployability of such workers. Even if employers reverse their views of the employability of those workers after the recovery, the process of restoring SCE is slow and time-consuming, since the supply of employable workers increases only gradually, as argued above. In this manner, the aggregate employment exhibits a "hysterisis".

8 Conclusion

There are two essential conditions for realization of the second-chance society. One is stable labor demand, and the other is a system guaranteeing the employability of those who are working in the informal sector. The economic welfare of the poorest people in the society depends highly on the extent to which these conditions are met.

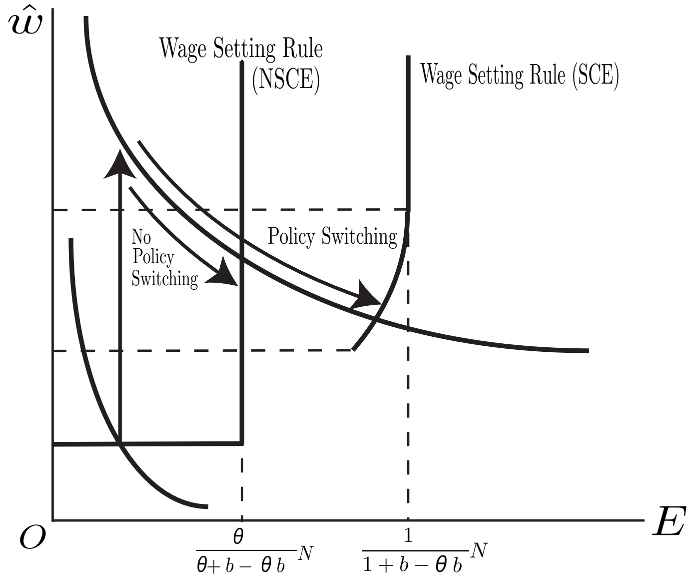

Figure 7: Transitions with or without Policy Switching

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Table 1: NSCE & SCE: $0.1 \leq b \leq 0.9$

	NSCE							SCE						
b	E	π	$\hat{w}$	w^1	w	LU	EM	E	a	$\hat{w}$	w^1	w	LU	EM
0.1	0.98	1.00	7.05	7.70	4.06	1.58	2.31	0.98	1.00	7.04	7.54	4.73	1.59	2.32
0.2	0.95	1.00	7.10	7.60	4.45	1.57	2.28	0.96	1.00	7.08	7.45	5.11	1.57	2.29
0.3	0.93	1.00	7.15	7.51	4.95	1.55	2.25	0.94	1.00	7.12	7.37	5.60	1.55	2.26
0.4	0.91	1.00	7.20	7.42	5.62	1.53	2.22	0.93	1.00	7.16	7.29	6.25	1.53	2.24
0.5	0.89	1.00	7.25	7.33	6.56	1.51	2.19	0.91	1.00	7.20	7.21	7.17	1.52	2.21
0.6	0.65	0.75	7.96	7.96	7.96	1.29	1.84	0.57	0.59	8.28	8.28	8.28	1.15	1.65
0.7	0.28	0.32	10.30	10.30	10.30	0.85	1.15	NA	NA	NA	NA	NA	NA	NA
0.8	0.08	0.10	14.97	14.97	14.97	0.51	0.64	NA	NA	NA	NA	NA	NA	NA
0.9	0.01	0.01	29.00	29.00	29.00	0.31	0.33	NA	NA	NA	NA	NA	NA	NA

Table 2: NSCE & SCE: $0.1 \leq b \leq 0.9$

	NSCE							SCE						
b	E	π	$V(1,1)$	$V(1,2)$	$V(1,-1)$	LU	EM	E	a	V_E^1	V_E	V_U	LU	EM
0.1	0.98	1.00	8.00	4.36	1.25	1.58	2.31	0.98	1.00	8.01	5.20	2.09	1.59	2.32
0.2	0.95	1.00	7.90	4.75	1.25	1.57	2.28	0.96	1.00	7.92	5.58	2.07	1.57	2.29
0.3	0.93	1.00	7.81	5.25	1.25	1.55	2.25	0.94	1.00	7.83	6.06	2.05	1.55	2.26
0.4	0.91	1.00	7.72	5.92	1.25	1.53	2.22	0.93	1.00	7.74	6.71	2.03	1.53	2.24
0.5	0.89	1.00	7.63	6.86	1.25	1.51	2.19	0.91	1.00	7.66	7.63	2.02	1.52	2.21
0.6	0.65	0.75	8.26	8.26	1.25	1.29	1.84	0.57	0.59	8.66	8.66	1.65	1.15	1.65
0.7	0.28	0.32	10.60	10.60	1.25	0.85	1.15	NA	NA	NA	NA	NA	NA	NA
0.8	0.08	0.10	15.27	15.27	1.25	0.51	0.64	NA	NA	NA	NA	NA	NA	NA
0.9	0.01	0.01	29.30	29.30	1.25	0.31	0.33	NA	NA	NA	NA	NA	NA	NA

Table 3: NSCE & SCE: $0.49 \leq b \leq 0.7$

	NSCE							SCE						
b	E	π	$\hat{w}$	w^1	w	LU	EM	E	a	$\hat{w}$	w^1	w	LU	EM
0.49	0.89	1.00	7.25	7.34	6.45	1.51	2.20	0.91	1.00	7.20	7.21	7.06	1.52	2.21
0.5	0.89	1.00	7.25	7.33	6.56	1.51	2.19	0.91	1.00	7.20	7.21	7.17	1.52	2.21
0.51	0.89	1.00	7.26	7.32	6.67	1.51	2.19	0.88	0.97	7.27	7.27	7.27	1.49	2.17
0.52	0.88	1.00	7.26	7.31	6.79	1.51	2.19	0.85	0.92	7.36	7.36	7.36	1.45	2.11
0.53	0.88	1.00	7.27	7.30	6.91	1.51	2.18	0.81	0.88	7.45	7.45	7.45	1.42	2.06
0.54	0.88	1.00	7.27	7.29	7.04	1.50	2.18	0.78	0.83	7.55	7.55	7.55	1.38	2.00
0.55	0.88	1.00	7.28	7.29	7.18	1.50	2.18	0.74	0.79	7.66	7.66	7.66	1.34	1.94
0.56	0.86	0.98	7.32	7.32	7.32	1.49	2.15	0.71	0.75	7.77	7.77	7.77	1.31	1.89
0.57	0.81	0.92	7.47	7.47	7.47	1.44	2.07	0.67	0.71	7.89	7.89	7.89	1.27	1.83
0.58	0.75	0.86	7.62	7.62	7.62	1.39	1.99	0.64	0.67	8.01	8.01	8.01	1.23	1.77
0.59	0.70	0.80	7.79	7.79	7.79	1.34	1.91	0.60	0.63	8.14	8.14	8.14	1.19	1.71
0.6	0.65	0.75	7.96	7.96	7.96	1.29	1.84	0.57	0.59	8.28	8.28	8.28	1.15	1.65
0.61	0.61	0.70	8.14	8.14	8.14	1.24	1.76	0.54	0.56	8.43	8.43	8.43	1.11	1.59
0.62	0.56	0.65	8.33	8.33	8.33	1.19	1.69	0.51	0.52	8.59	8.59	8.59	1.07	1.53
0.63	0.52	0.60	8.53	8.53	8.53	1.15	1.61	0.47	0.49	8.76	8.76	8.76	1.03	1.47
0.64	0.48	0.55	8.74	8.74	8.74	1.10	1.54	0.44	0.45	8.93	8.93	8.93	0.99	1.41
0.65	0.44	0.51	8.96	8.96	8.96	1.06	1.47	0.41	0.42	9.13	9.13	9.13	0.95	1.35
0.66	0.40	0.47	9.20	9.20	9.20	1.01	1.41	0.38	0.39	9.33	9.33	9.33	0.91	1.29
0.67	0.37	0.43	9.45	9.45	9.45	0.97	1.34	0.36	0.36	9.55	9.55	9.55	0.87	1.23
0.68	0.34	0.39	9.71	9.71	9.71	0.93	1.27	0.33	0.33	9.78	9.78	9.78	0.83	1.17
0.69	0.31	0.36	9.99	9.99	9.99	0.89	1.21	NA	NA	NA	NA	NA	NA	NA
0.7	0.28	0.32	10.30	10.30	10.30	0.85	1.15	NA	NA	NA	NA	NA	NA	NA

Table 4: NSCE & SCE: $0.49 \leq b \leq 0.7$

	NSCE							SCE						
b	E	π	$V(1,1)$	$V(1,2)$	$V(1,-1)$	LU	EM	E	a	V_E^1	V_E	V_U	LU	EM
0.49	0.89	1.00	7.64	6.75	1.25	1.51	2.20	0.91	1.00	7.67	7.52	2.02	1.52	2.21
0.5	0.89	1.00	7.63	6.86	1.25	1.51	2.19	0.91	1.00	7.66	7.63	2.02	1.52	2.21
0.51	0.89	1.00	7.62	6.97	1.25	1.51	2.19	0.88	0.97	7.72	7.72	1.99	1.49	2.17
0.52	0.88	1.00	7.61	7.09	1.25	1.51	2.19	0.85	0.92	7.80	7.80	1.95	1.45	2.11
0.53	0.88	1.00	7.60	7.22	1.25	1.51	2.18	0.81	0.88	7.89	7.89	1.92	1.42	2.06
0.54	0.88	1.00	7.60	7.35	1.25	1.50	2.18	0.78	0.83	7.98	7.98	1.88	1.38	2.00
0.55	0.88	1.00	7.59	7.48	1.25	1.50	2.18	0.74	0.79	8.08	8.08	1.84	1.34	1.94
0.56	0.86	0.98	7.62	7.62	1.25	1.49	2.15	0.71	0.75	8.18	8.18	1.81	1.31	1.89
0.57	0.81	0.92	7.77	7.77	1.25	1.44	2.07	0.67	0.71	8.29	8.29	1.77	1.27	1.83
0.58	0.75	0.86	7.93	7.93	1.25	1.39	1.99	0.64	0.67	8.41	8.41	1.73	1.23	1.77
0.59	0.70	0.80	8.09	8.09	1.25	1.34	1.91	0.60	0.63	8.53	8.53	1.69	1.19	1.71
0.6	0.65	0.75	8.26	8.26	1.25	1.29	1.84	0.57	0.59	8.66	8.66	1.65	1.15	1.65
0.61	0.61	0.70	8.44	8.44	1.25	1.24	1.76	0.54	0.56	8.80	8.80	1.61	1.11	1.59
0.62	0.56	0.65	8.63	8.63	1.25	1.19	1.69	0.51	0.52	8.95	8.95	1.57	1.07	1.53
0.63	0.52	0.60	8.83	8.83	1.25	1.15	1.61	0.47	0.49	9.11	9.11	1.53	1.03	1.47
0.64	0.48	0.55	9.04	9.04	1.25	1.10	1.54	0.44	0.45	9.29	9.29	1.49	0.99	1.41
0.65	0.44	0.51	9.26	9.26	1.25	1.06	1.47	0.41	0.42	9.47	9.47	1.45	0.95	1.35
0.66	0.40	0.47	9.50	9.50	1.25	1.01	1.41	0.38	0.39	9.66	9.66	1.41	0.91	1.29
0.67	0.37	0.43	9.75	9.75	1.25	0.97	1.34	0.36	0.36	9.88	9.88	1.37	0.87	1.23
0.68	0.34	0.39	10.01	10.01	1.25	0.93	1.27	0.33	0.33	10.10	10.10	1.33	0.83	1.17
0.69	0.31	0.36	10.30	10.30	1.25	0.89	1.21	NA	NA	NA	NA	NA	NA	NA
0.7	0.28	0.32	10.60	10.60	1.25	0.85	1.15	NA	NA	NA	NA	NA	NA	NA