ASSESSING THE EQUITY OF A GENERAL HIRING CREDIT:

A THEORETICAL APPROACH

By

Lee, Ha Kyeong

THESIS

Submitted to

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ABSTRACT

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This study aims to analyze inequity of a general hiring credit program, particularly on the consequential marginalization of the most disadvantaged workers upon its implementation. While a general hiring program is slowly gaining popularity as an efficient counter-cyclical measure in the aftermath of the Great Recession, it is likely to be inequitable, discriminating the most disadvantaged workers with visible disabilities. The depreciation arises via two channels: changes in the relative costs of hiring the hard-to-be-employed workers and the stigmatization they must bear to continue disclosing their eligibility status to a categorical hiring credit. To verify them, we take a theoretical approach via a game theory and a search-and-matching models to examine a worker's relative employability and willingness to participate in the labor market based on his degree of disability before and after the implementation of a general hiring credit program. The results suggest that the implementation of a general hiring credit program (1) induces an outflow of the better-skilled workers from participating in a categorical hiring credit programs, (2) increases the stigma the most underprivileged workers face, and (3) aggravates the latter's rent from working and an employer's costs to hire the latter. Furthermore, (4) the employer's rent reduces even faster when the outflow accelerates.

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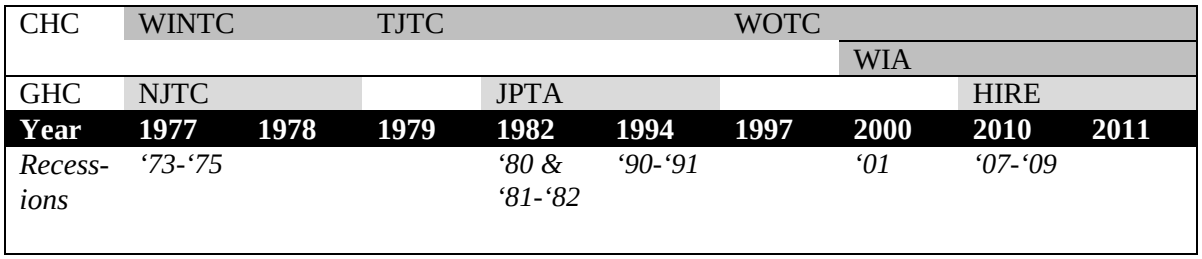
1. INTRODUCTION

The purpose of this study is to analyze inequity of a general hiring credit program, particularly on the consequential marginalization of the most disadvantaged workers upon its implementation. The depreciation arises via two channels: changes in the relative costs of hiring the hard-to-be-employed workers and the stigmatization they must bear. In this paper, through a game theory and search-and-matching models, we take a theoretical approach to examine a worker's relative employability and willingness to participate in the labor market based on his degree of disability before and after the implementation of a general hiring credit program.

1.1. Types of Hiring Credits and Their Drawbacks

A hiring credit is a monetary subsidy to a firm in exchange for a net job creation and job preservation. There are two types of hiring credits: a categorical hiring credit (CHC) program, narrowly targeting the welfare recipients or other minorities, and a general hiring credit (GHC) program, broadly targeting a bigger population such as the long-term unemployed. According to Figure 1, it is standard practice for the United States Government to implement a CHC program regularly and a GHC program intermittently as a counter-cyclical measure.

Figure 1. History of Hiring Credit Programs Enacted in the United States



Note: WINTC (Work Incentives Tax Credit), NJTC(New Job Tax Credit), TJTC(Targeted Job Tax Credit), JTPA(Job Training Partnership Act), WOTC(Work Opportunity Tax Credit), WIA(Work Incentives Act), and HIRE(Hiring Incentives to Restore Employment)

Each type of a hiring credit program has pros and cons. While a CHC program efficiently focuses on the most disadvantaged, there is a consensus that a GHC program is more effective than the first. In fact, the effectiveness of the latter is witnessed by the recent success from relaxing eligibility requirements for the WOTC, and introducing a GHC program under the HIRE Act of the 2009 American Recovery and Reinvestment Act (ARRA) after the Great Recession. These reforms induced a sharp increment in the number of newly created jobs from 692,421 in 2008 to 1,160,523 in 2011 (Scott, 2013).

In fact, the positive turnout is consistent with scholars suggesting the effectiveness of a GHC program for it overcomes an inherent problem of a hiring credit program: the stigmatization effect. A hiring credit program suffers from a low participation rate mainly due to the stigmatization effect. (Neumark and Grijalva, 2013; Neumark, 2011; Bartik, 2001; Dickery and Conlin, 2000; Katz, 1998). By policy design, a worker must uncover his welfare status to have a firm receives hiring credit benefits, unlike other employment creation policies. The disclosure inevitably imposes stigma on the worker not only from the firm's perspective but also from the worker himself, thus, making both parties less willing to participate in the program and forego improvements in their employment prospects. However, a GHC program is found to

tackle the drawback by targeting a broader population, promoting a favorable change in the composition of and eventually weakening the degree of stigmatization on the eligible personnel. Thus, the ARRA hiring credits "may have been more effective because stigma effects are likely to be severely weakened or eliminated" (Neumark and Grijalva, 2013). Therefore, having a "non-categorical subsidy would have a positive effect to stimulating employment growth" (Bartick and Bishop, 2009; Bishop, 2008).

However, we must not overlook the fact that a GHC program inevitably marginalizes the most underprivileged. Universal or broadly targeted safety net programs, by nature, are designed to promote economic recovery at the sake of the deprived. This is no different for a GHC program, which incurs the same marginalization from corresponding tempering in the relative sizes of employment costs of and labor market discrimination on the most disadvantaged.

1.2. The Relative Costs of Hiring the Disadvantaged Workers

As in the case of the post- Great Recession period, suppose a GHC program broadly aims the long-term unemployed and welfare recipients. Once a GHC program is implemented, a long-term unemployed worker will disclose his hiring credit eligibility status to improve his employment prospects as his unsuccessful employment history is apparent from his previous working records. Then, a mildly disadvantaged welfare recipient without visible disabilities may act alike for the same purpose since his potential employer (1) is likely to denounce a welfare recipient and (2) cannot tell the difference between a regular long-term unemployed and a mildly disadvantaged worker. However, a severely disadvantaged worker, who cannot fake his disability status, would remain to expose his eligibility status to a CHC program. As a result, hiring costs of a regular long-term unemployed or a mildly disadvantaged worker decrease, while

those of a severely disadvantaged worker remain the same. Then, hiring the latter over the first becomes more expensive upon the implementation of a GHC program.

1.3. The Stigmatization Effect of a CHC Program on the Disadvantaged Workers

Costs of hiring a severely disadvantaged worker increase from not only the actual wage burden but also the aggravating stigmatizing effect of a CHC program. While hiring credit benefits influence a worker's pattern of disclosing eligibility status and, thus, change a firm's relative costs of hiring the most disadvantaged workers over the low- skilled workers, the stigmatization effect influences benefit schedules of both parties. As many scholars suggest as a drawback of a hiring credit program, it inevitably provokes the stigmatization effect on the eligible.

According to the traditional studies, the stigmatization comes in four channels: structural stigma, self-stigma, public stigma and stigma by association. In detail, public stigma represents people's reaction to someone with stigmatized condition; self-stigma, the social and psychological effects of having a stigma; stigma by association, the effects from being associated with a stigmatized individual; structural stigma, "legitimation and perpetuation of a stigmatization status by society's institutions and ideological system" (Pryor and Reeder 2011).

Among the four channels, structural stigma of a welfare recipient becomes much more severe upon the implementation of a GHC program, especially making the most disadvantaged even more marginalized. Often, people show disapproval of, resent against, and, thus, impose structural stigma on a welfare recipient (BesleyT., CoateS. 1992). The structural stigma of the most disadvantaged would become even more severe as the transition of eligibility disclosure

pattern accelerates from continuous reduction in an expected average skill level of the most deprived, who remain claiming CHC benefits. As a consequence, a worker's perceived level of output would decline, making more expensive for an employer to hire him. It is, in fact, coherent with scholars claiming that narrowly targeted redistribution programs on the truly needy may exacerbate the actual level of income distribution (De Donder P. & Hindriks J., 1998; Gelbach J. & Pritchett L., 2002).

Another primary source that marginalizes the most disadvantaged is self-stigmatization. Take-up rates of low-income families in the United States to eligible means-tested government programs have been low: 40 to 70 percent for each program in 1970 (MoffittR. 1983); 84 percent in 1995 and 56 percent in 1998 for overall welfare programs (StuberJ., KronebuschK. 2004). Scholars suggest that one of the driving force of nonparticipation is "potential distaste" for the programs of the eligible (Neumark, 2011; Bartik, 2001; Dickery-Conlin and Hotz-Eakin, 2000; Katz, 1998; Moffitt R., 1983). When a GHC program is implemented, the relative degree of "distaste" of the most needy over the other welfare recipients would aggravate. As the most disadvantaged workers show noticeable disabilities, they bear the same amount of self-stigmatization before and after the implementation of a GHC program. However, those who made a transition bear less degree of stigma and become more willing to participate in a hiring credit program to enhance their competitiveness in the labor market. Thus, the relative size of self-stigma of the first over the second will inevitably grow.

1.4. Overview

In this paper, we would like to discuss the two channels we discussed via a simple game theory and a search-and-matching models. Through the first, we will prove the transition in a

worker's pattern of eligibility status disclosure upon the implementation of a GHC program, and corresponding negative changes in the relative costs of hiring the most disadvantaged over the rest. Through the second, we will prove aggravating employment prospects of the most disadvantaged workers from intensified stigmatization they face. This will be done through analyzing a worker's rent and a firm's response to each hiring credit program, based on the pattern perceived by the game theory model. We will continue with literature review in section 2, then discuss assumptions in section 3, introduce the game theory model in section 4, solve the search-and-matching model in section 5, and conclude the paper in section 6.

2. LITERATURE REIVEW

Due to difficulties in conducting empirical studies on a hiring credit program, there are only a few studies assessing its effectiveness and even less on its level of equity. One recent study on its equity is *Comparing the Effectiveness of Employment Subsidies* by Brown, Merkl and Snower (2011).

Brown, Merkel and Snower compare the levels of effectiveness and equity of a hiring credit and a wage subsidy programs through a theoretical model and a corresponding calibration. To evaluate the degree of their effectiveness, they design basic Markov model for wage determination, and account for various market failures such as insider wage bargaining, hiring and firing costs, and imperfect tax and transfer systems. Then, to assess the degree of equity, they introduce a concept of an approximate welfare efficiency(AWE). According to the AWE, a policy is approximately welfare efficient if (1) it does not aggravate earnings inequality, (2) enhances aggregate employment and welfare, and (3) is self-financing. Based on their analysis, a GHC program is more effective at unemployment reduction, welfare improvement and earning inequality reduction, and thus is more AWE than a wage subsidy program. This result, however, becomes insignificant under a CHC program. Inferring from the study, we may argue that a clear disclosure of a worker's productivity may hurt the levels of the effectiveness and the equity of a hiring credit program.

Moreover, the few studies on the equity of a hiring credit program do not examine both types of hiring credit programs simultaneously. Not only the welfare programs in general but also a hiring credit program is notorious for its low participation rates: 10 to 33 percent of participation among the eligible for CHC programs and 50 percent of participation at most for a

successful GHC program, the NJTC (Bartick, 2001; Hamersma, 2005). Therefore, the stigma imposed on a hiring credit voucher holder may be more severe than on other welfare recipients.

In *Applying for Entitlements: Employers and Targeted Job Tax Credit*, Bishop and Kang (2005) apply the Poisson representation and estimate a firm's likelihood of the TJTC participation. They use the 1982 Survey Data on Employers from National Center for Research in Vocational Education and the Gallop Organization to evaluate the impacts of fixed costs—administrative and screening costs—and variable costs—costs of identifying the eligible and the stigmatization effects—to the firm's willingness to hire a welfare recipient with a hiring credit voucher. Using a composite stigma index, they conclude that the stigmatization negatively affects a firm's attitude toward a hiring credit voucher holder, in particular among those without experiences of hiring one.

Other studies examine a single hiring credit program for each as well. Dickert Conlin and Holtz-Eakin (2000), and Bartik (2001) argue that unconvering participation eligibility would signal an employer a candidate's unsuccessful working history, leading him to regard an eligible worker less productive from their studies on the TJTC and the NJTC, respectively. Katz (1998) also supports this claim with his analysis on an experimental program in Dayton, Ohio. He finds that a worker, who does not participate in an experimental CHC program, is less successful in the search for a job.

Even though a CHC and a GHC programs are often concurrently effective as described in Figure 1, none of the relevant studies take the dynamics between the two into assessing the level of the equity of a CHC program. Therefore, we will forecast an expected change in the degree of the stigmatization on the most disadvantaged workers once a GHC program is implemented

while a CHC program is in effect. This study will make a significant contribution theorizing equity of a GHC program with reality taken into an account.

3. ASSUMPTIONS

3.1. Basic Assumptions

We consider a closed-economy model with a fixed number of low- skilled workers. We do not account for the labor force variations or hours worked by each worker. The distribution of workers' level of productivity (*y*) is exogenous. Specifically, we assume a two-point distribution based on the degree of their disability (*D*) such that most are either the regular long-term unemployed or mildly disadvantaged welfare recipients with low-skill levels, and the rest are severely disadvantaged recipients with even lower skill levels. We assume that the severely disadvantaged recipients show obvious physical and mental disabilities: $\frac{\partial y}{\partial D} < 0$. This is based on a previous study on an employer's survey, suggesting little or no difference between the regular long-term unemployed and mildly disadvantaged welfare recipients in their levels of productivity (Hamersma, 2005).

A worker is either employed or unemployed. Only an unemployed worker can search for jobs. Once employed, a worker receives a fixed wage ($\overline{w}$). This follows a conventional wage level of a low- skilled worker in the United States: one-third of all workers were low-wage workers and only 21 percent of them earned the minimum wage in 1996 (Schochet P. & Rangarajan A., 2004); one-fourth of all workers earn less than minimum wage, and even smaller if considering family size and hours worked in 2003 (Acs G. & Nichols A., 2007). While some suggest that the wage growth among the low-skilled workers is higher, the increment is still not enough to break the poverty trap as the low-wage workers suffer from short-employment spells, are likely to hold part-time jobs, are mostly involved in low-paying industries and stuck with little job mobility and small wage growth (Gladden T. & Taber C., 2009; Schochet P. &

Rangarajan A., 2004; Acs G. & Nichols A., 2007; Theodos B. & Bednarzik R., 2006; Noonan & Heflin, 2005). If unemployed, however, a worker enjoys income equivalent to utilities from nonworking activities (b) such as unemployment benefits, negative searching costs and monetary value of leisure. A worker will work only if his wage is greater than his nonworking benefits, which we call the first employment creation condition. A worker is risk-neutral and discounts his future income at a constant rate of γ. In other words, his expected present values of utility are that of income.

We assume that the firms are identical and supply an infinite number of fixed minimum-wage jobs with minimum skill requirements. A job becomes either filled or vacant at the exogenous rates of φ and δ, respectively, such that the first is negatively and the second is positively related to the degree of disability of a worker:

$$\frac{\partial \varphi}{\partial D} > 0 \; and \; \frac{\partial \delta}{\partial D} < 0$$

This is consistent with findings on a recipient's higher job turnover rate and lower job finding rate. It is due to his low skill level from part-time or inconsistent employment history, and non-work related barriers such as transportation, health and education (Burtless, 1997; Blumberg & Ong, 1998; Loeb & Corcoran, 2001). Moreover, these adversities are much worse among the severely disadvantaged workers as they are likely to suffer multiple disadvantages (Danzinger, et. al, 2002) Each position is filled only if a worker's level of productivity greater than or equal to its skill requirements. Otherwise, it stays vacant, yielding an instantaneous maintenance cost, k. A firm is also risk-neutral and discounts its future income at the same rate as a worker does.

3.2. Assumptions on Hiring Credits and Their Stigmatizing Effects.

A firm's perception on a worker's level of productivity, however, is inaccurate due to stigmatizing effects (s) of his welfare status. A recipient's welfare status negatively affects his job prospects as an employer naturally devalues a recipient's level of productivity (Bishop & Kang, 2005). In this model, if a worker is mildly disadvantaged or unemployed for a long term, the status is revealed only when a worker uncovers his hiring credit voucher eligibility to have a respective firm claim the benefits. If severely disadvantaged, however, a worker faces the same level of stigma regardless of his disclosure status due to his obvious disability status. We assume that the adverse effect of a hiring credit is proportional to its size (h), the amount that must be compensated to induce employment of a hard-to-be-employed worker: $s'(h) > 0$

In this model, there are also two types of hiring credits—the CHC and the GHC—for welfare recipients alone and all long-term unemployed workers, respectively. The CHC, exclusively targeting the recipients, is implemented at all times, while the GHC, broadly targeting the general unemployed, is became effective after a recession. Thus, a recipient can claim either the CHC or the GHC benefits while non- recipients can claim only the GHC benefits. The CHC and the GHC programs are mutually exclusive. This follows typical policy implementation patterns before and after recessions in the United States as described in Figure 1.

The size of the CHC is greater than that of the GHC, and vice-and-versa for the sizes of their stigmatizing effects. Also, a perceived worker's level of productivity is given by $y^p = y(D) - s(h)$. Then, the difference between the perceived level of productivity of a less and a

severely disadvantaged worker is likely to increase. Moreover, there also is a self-stigmatizing effect on a worker once he discloses his hiring credit eligibility: his utility of working is inversely proportional to the size of hiring credits such that his reservation wage is given by $\bar{w} - b - s$.

3.3. Frictional Labor Market Assumptions

A matching process of an unemployed worker and a vacancy does not occur simultaneously. In this model, we consider a constant-return-to-scale matching function $M(v, u)$ such that

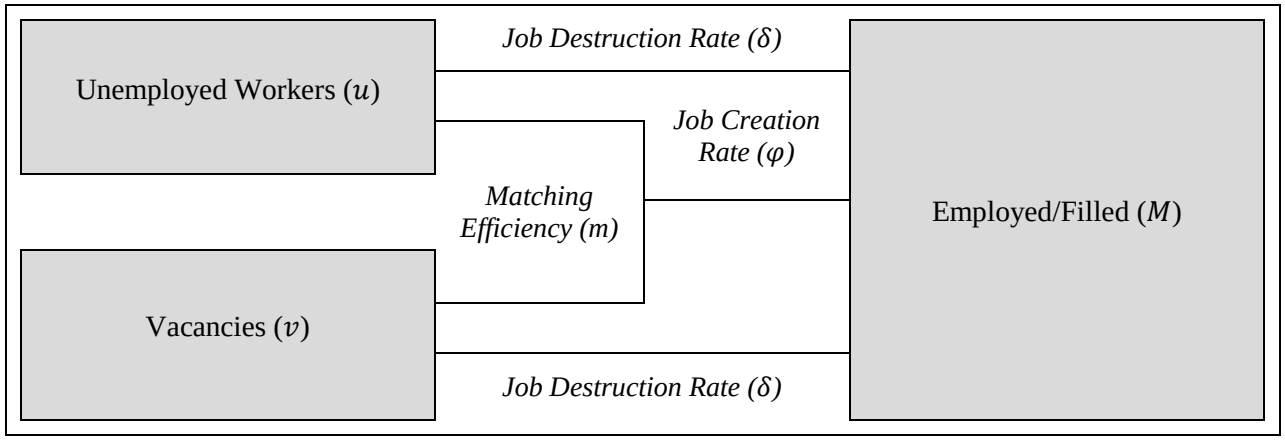
$$M(v, u) = m\left(1, \frac{v}{u}\right)u = m(\theta)u$$

where v is the number of vacancies, u is the number of unemployed workers, and θ $(= \frac{v}{u})$ is job-market tightness. Therefore, $m(\theta)$ represents the matching efficiency and job finding rate at the given job-market tightness is given by $\varphi = \theta m(\theta)$. Furthermore, in this model, we assume the matching efficiency increases as a number of vacancies increase: $m(\theta) > 0$. Although the matching efficiency may rise with the number of vacancies due to escalations in a firm's search costs, it is unlikely under a recession prevalent with job shortage (Holzer, 1999). Moreover, $\mathrm{m}'\left(\theta\right) > 0$ since search costs decreases for both actors as a number of unemployed workers decreases and/or number of vacancies increases. Also, job-market tightness is positively correlated with the size of a hiring credit as the latter decreases vacancy-creating costs: $\theta'(h) > 0$. Therefore, a job finding rate is positively correlated with the size of a hiring credit:

$$\varphi'\left(m\left(\theta(h)\right)\right) = \frac{\partial \varphi}{\partial m}\frac{\partial m}{\partial \theta}\frac{\partial \theta}{\partial h} > 0$$

We assume that a job separation rate of a worker to be consistent across different hiring credits as each hiring credit requires an employment spell proportional to its size. Figure 2 summarizes the job flow and the assumptions, discussed in this section.

Figure 2. Job Flow: Job Creation and Destruction



4. A GAME THEORY MODEL

Before we introduce the searching-and-matching model, via a series of game matrices, we will discuss patterns of a worker disclosing his hiring credit eligibility status and a firm making hires. Through this analysis, we understand how the most disadvantaged workers are discouraged from working as a relative cost of hiring the workers over other welfare recipients and regular long-term unemployed become more expensive.

A firm and two types of workers are the only actors in this model. A firm has a choice over whether to hire or not to hire a worker. Each worker (regular long-term unemployed and mildly disadvantaged welfare recipients vs. severely disadvantaged welfare recipients) determines which type of hiring credit eligibility they would like to disclose. We denote a worker's choice of exposure by the following:

- NHC: Does not reveal eligibility status
- GHC: Reveals eligibility status for a GHC program
- CHC: Reveals eligibility status for a CHC program

Since the disclosure affects sizes of a hiring credit (*h*) and the stigma (s) a worker face, we express them h_j and s_j where *j={NHC, GHC, CHC}*. Furthermore, we indicate output level of a worker y_i where i represents a skill level (low vs. lower). Lastly, note that a worker must participate in the labor market. All workers, in this game model, are actively seeking for a job, and once they reveal their eligibility status self-stigma will be in effect regardless of their employment outcomes.

Figure 3 portrays a game matrix before the implementation of a GHC program. As described in the previous section, a firm's expected net present value of hiring equals actual output minus welfare bias and net wage burden. If leaving a vacancy empty, it will bear a maintenance cost. On the other hand, if employed, a worker earns a reservation wage; if unemployed, a worker enjoys non working benefits minus the stigmatization effect. Based on a set of benefit schedules in the matrix, there is one strictly dominant strategy for each type of workers and a firm: Hire-NHC for a low skilled worker and Hire-CHC for a lower skilled worker. In other words, it is in a firm's best interest to hire at all times, a low and a lower skilled workers to conceal and report his eligibility status to a CHC program, respectively.

Figure 3. A Game Matrix: before the GHC Program Implementation

		Firm	
Regular Long-Term Unemployed & Mildly Disadvantaged Welfare Recipients (skill level = low)		Hire	Does Not Hire
	NHC	$y_{low} - \overline{w}, \overline{w} - b$	$-\mathrm{k}, \mathrm{b}$
	CHC	$y_{low} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - b - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$
Severely Disadvantaged Welfare Recipients (skill level = lower)		Hire	Does Not Hire
	NHC	$y_{lower} - s_{CHC} - \overline{w}, \overline{w} - b - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$
	CHC	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$

This optimal strategy changes after the GHC program implementation, especially during the recession. Using the same mechanism from the previous analysis, we construct another game matrix to represent a case after the GHC program implementation in Figure 4. Strictly dominant

strategies of a firm and a worker do not change. However, we must consider that the stigmatizing effect of revealing GHC eligibility status is insignificant as it is apparent from a worker's working history. Furthermore, an increasing rate of program participation of the regular long-term unemployed to a GHC program will wash out structural stigma a GHC program would impose on its voucher holder. Therefore, we assume there is no stigmatization effect from disclosing GHC eligibility status. Then, for a low-skilled worker, the optimal strategy changes from enclosing to disclosing his GHC eligibility status as described in Figure 5. Then, according to Table 1, (1) the relative costs of hiring a severely disadvantaged worker over the rest and (2) the relative benefits from working increase with increments in the value of hiring the second.

Figure 4. A Game Matrix: after the GHC Program Implementation ($s_{GHC} \neq 0$)

		Firm	
Regular Long-Term Unemployed & Mildly Disadvantaged Welfare Recipients (skill level = low)		Hire	Does Not Hire
	NHC	$y_{low} - \overline{w}, \overline{w} - b$	$-\mathrm{k}, \mathrm{b}$
	GHC	$y_{low} - s_{GHC} + h_{GHC} - \overline{w}, \overline{w} - s_{GHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{GHC}$
	CHC	$y_{low} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$
Severely Disadvantaged Welfare Recipients (skill level = lower)		Hire	Does Not Hire
	NHC	$y_{lower} - s_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$
	GHC	$y_{lower} - s_{CHC} + h_{GHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$
	CHC	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-\mathrm{k}, \mathrm{b} - s_{CHC}$

Figure 5. A Game Matrix: after the GHC Program Implementation ($s_{GHC} = 0$)

		Firm	
Regular Long-Term Unemployed & Mildly Disadvantaged Welfare Recipients (skill level = low)		Hire	Does Not Hire
	NHC	$y_{low} - \overline{w}, \overline{w} - b$	$-k, b$
	GHC	$y_{low} + h_{GHC} - \overline{w}, \overline{w} - b$	$-k, b$
	CHC	$y_{low} + h_{CHC} - \overline{w}, \overline{w} - b$	$-k, b$
Severely Disadvantaged Welfare Recipients (skill level = lower)		Hire	Does Not Hire
	NHC	$y_{lower} - s_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-k, b - s_{CHC}$
	GHC	$y_{lower} - s_{CHC} + h_{GHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-k, b - s_{CHC}$
	CHC	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-k, b - s_{CHC}$

Table 1. Net Benefits of a Worker and a Firm, Estimated from the Game Matrix

	(1) Low Skilled Workers	(2) Lower Skilled Workers	Difference:(1) – (2)
(3) Before the Implementation of a GHC program ($s_{GHC} \neq 0$)	$y_{low} - \overline{w}, \overline{w} - b$	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$y_{low} - y_{lower} + s_{CHC} - h_{CHC}, s_{CHC}$
(4) After the Implementation of a GHC program ($s_{GHC} = 0$)	$y_{low} + h_{GHC} - \overline{w}, \overline{w} - b$	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$y_{low} - y_{lower} + s_{CHC} + h_{GHC} - h_{CHC}, s_{CHC}$
Difference: (4) – (3)	$h_{GHC}, 0$	0,0	$h_{GHC}, 0$

5. A SEARCH-AND-MATCHING MODEL

In this section, through a search-and-matching model, we will evaluate net changes in the relative employability of a severely disadvantaged worker over a mildly disadvantaged or a long-term unemployed worker, and his willingness to participate in the labor market. This will give us a more accurate understanding of employment prospects of a severely disadvantaged worker by taking job flow into account. Based on the assumptions we made in section 3, we will first define net present values of a firm and a worker by their employment decisions. Then, we will compare a worker's rents before and after the implementation of a GHC program, applying the optimal strategies we identify in the game theory model. Furthermore, we continue estimating the change in a firm's employment capacity from the implementation by comparing optimal sizes of a hiring credit under the free entry condition.

5.1. Values

We denote the net present value of an employed worker, *W*, and an unemployed worker, *U*. Then, based on the assumptions and the game theory model, a worker's discounted present value (PDV) of being employed and unemployed is given by

$$(1)\ \gamma W = \bar{w} - s - \delta(W - U), \textit{ and}$$

$$(2)\ \gamma U = b - s + \varphi(W - U).$$

In other words, a worker's PDV of being employed is equal to his utilities from working after disclosing his welfare status ($w - s$) and an expected loss from job destruction ($\delta(W - U)$); a

worker's PDV of being unemployed is equal to his numerated utilities from nonworking activities (b) and an expected gain from finding a job ($-\varphi(U-W)$).

We express the net present value of a hired position, *J*, and a vacant position, *V*. Then, based on the assumptions and results of the game matrix model, a firm's PDV of filling and not filling a job is given by

$$(3)\ \gamma J = y - s + h - \bar{w} - \delta(J-V), \textit{ and}$$

$$(4)\ \gamma V = -k + \varphi(J-V).$$

This suggests that a firm's PDV of filling a vacancy is equal to the perceived level of an output of a worker ($y-s$) minus an actual wage burden given the hiring credit benefits ($\bar{w}-h$) and expected loss from job destruction ($\delta(J-V)$). Moreover, a firm's PDV of leaving vacancy open is equal to the maintenance costs ($-k$) and an expected gain from job creation ($\varphi(J-V)$).

5.2. A Worker's Optimal Strategy

Given the PDV functions, a worker has an optimal strategy to maximize his benefits when he is employed. Based on equations (1) and (2), an optimal strategy of a worker is to maximize his rent from finding a job:

$$(9)\ \mathrm{W}-\mathrm{U} = \frac{\bar{\mathrm{w}}-\mathrm{s}-\mathrm{b}}{\underbrace{\gamma+\delta+\varphi}_{>0}}$$

Note that the first employment creation must hold: $\bar{\mathrm{w}}-\mathrm{s}-\mathrm{b}>0$. A worker's reservation wage must be positive. In other words, a worker's gain must exceed numerated stigmatizing effect if

discloses his eligibility status. Furthermore, a worker's rent of disclosing his CHC eligibility status is always smaller than that of disclosing his GHC eligibility status or not participating in a hiring credit program as stima increases with the size of a hiring credit he intends to receive. In this model, similar to the game theory model, we will assume that stigma from holding a GHC voucher is insignificant. Moreover, a relative size of a rent changes between the low and lower skilled workers upon the GHC program implementation. According to Table 2, the relative value of working becomes greater for welfare recipients who switched from a CHC program to a GHC program after latter became effective. As the transition occurs more readily among mildly disadvantaged workers, the stigmatizing effect of a CHC program becomes more severe, and the relative price of holding a CHC voucher over a GHC voucher decreases at a faster rate, further marginalizing the severely disadvantaged workers with obvious disabilities.

Table 2. A Worker's Rent Before and After the GHC Program Implementation

Disclosure of Eligibility Status	(1) Before GHC Implementation	(2) After GHC Implementation	Difference: (2) – (1)
(3) NHC (skill level = low)	$\frac{\bar{w}-b}{\gamma+\delta_{low}+\varphi_{low}}$	$\frac{\bar{w}-b}{\gamma+\delta_{low}+\varphi_{low}}$	0
(4) GHC (skill level = low)	$\frac{\bar{w}-s_{CHC}-b}{\gamma+\delta_{low}+\varphi_{low}}$	$\frac{\bar{w}-s_{GHC}-b}{\gamma+\delta_{low}+\varphi_{low}}$	> 0
(5) CHC (skill level = lower)	$\frac{\bar{w}-s_{CHC}-b}{\gamma+\delta_{lower}+\varphi_{lower}}$	$\frac{\bar{w}-s_{CHC}-b}{\gamma+\delta_{lower}+\varphi_{lower}}$	0
CHC_{lower}/GHC_{low}: (5)/(4)	$\frac{\bar{w}-s_{CHC}-b}{\bar{w}-s_{CHC}-b}$	$\frac{\bar{w}-s_{CHC}-b}{\bar{w}-s_{GHC}-b}$	< 0
CHC_{lower}/NHC_{low}: (5)/(3)	$\frac{\bar{w}-s_{CHC}-b}{\bar{w}-b}$	$\frac{\bar{w}-s_{CHC}-b}{\bar{w}-b}$	0

5.3. A Firm's Optimal Strategy

5.3.1. Free Entry Condition: J=0

As for a firm, since there are an infinite number of firms posting vacancies, its entry cost should be costless: $J = 0$. Suppose $J < 0$. Then, no firm would enter. Suppose $J > 0$. Then, an infinite number of firms would enter to seek profits. Thus, the number of vacancies would converge to equilibrium at each time *t, v(t)*, where entry cost equals zero.

Plugging the condition into firm's present value equations (3) and (4), we have

$$(5)\ V = \frac{y - s + h - \bar{w}}{\gamma + \delta}, \text{and}$$

$$(6)\ V = \frac{k}{\varphi}$$

Setting right sides of equations (5) and (6) equal to each other, we see that profit flow is equal to an expected cost of finding a worker:

$$(7)\ y - s + h - \bar{w} = \frac{k}{\varphi}(\gamma + \delta)$$

Furthermore, by solving the equation (7) we have

$$(8)\ k = \frac{y - s + h - \bar{w}}{\gamma + \delta}\varphi$$

and that $y - s + h - w > 0$ is the second employment creation condition. In fact, this is obvious by intuition: perceived level of a worker's output must exceed a firm's actual wage burden to hire the worker.

Based on equations (3) and (4), an optimal strategy of a firm is to maximize its rent from filling a position:

$$(10)\ J - V = \frac{(y - s) - (\overline{w} - h) + k}{\gamma + \delta + \varphi}$$

This can be further simplified using equation (8) such that

$$(11)\ J - V = \frac{(y - s) - (\overline{w} - h)}{\gamma + \delta + \varphi} + \frac{(y - s) - (\overline{w} - h)}{(\gamma + \delta + \varphi)(\gamma + \delta)}\varphi$$

$$= \big((y - s) - (\overline{w} - h)\big)\left(\frac{1}{\gamma + \delta + \varphi} + \frac{\varphi}{(\gamma + \delta + \varphi)(\gamma + \delta)}\right)$$

$$= \big((y - s) - (\overline{w} - h)\big)\left(\frac{(\gamma + \delta) + \varphi}{(\gamma + \delta + \varphi)(\gamma + \delta)}\right) = \frac{(y - s) - (\overline{w} - h)}{\gamma + \delta}$$

5.3.2. Optimal Level of a Hiring Credit

In a traditional Nash equilibrium model, a firm and a worker bargain on the wage level to maximize their rents. In this model, we suppose wages are fixed, and a government intervenes to maximize the net benefits by changing the level of a hiring credit. The modified Lagrange maximization equation is given by

$$(12)\ \mathcal{L} = \max_{h}(W - U)^{\beta}(J - V)^{1-\beta} = \underbrace{(1 - \beta)}_{>0}\underbrace{(W - U)^{\beta}}_{>0}\underbrace{(J - V)^{-\beta}}_{>0}\frac{\partial(J - V)}{\partial h} = 0; 0 < \beta < 1$$

Assuming that the two employment creation conditions hold for both low and lower skilled workers, the following must hold true based on equation (12):

$$(13)\ \frac{\partial(J - V)}{\partial h} = 0$$

Solving the equation (13) using the firm's rent equation (10) and plugging in the zero entry condition of a firm, equation (8), we have

$$(14)\ \frac{\partial(J-V)}{\partial h} = \frac{-s'+1}{\gamma+\delta+\varphi} - \frac{(y-s)-(\overline{w}-h)+k}{(\gamma+\delta+\varphi)^2}(\delta'+\varphi')$$

$$= \frac{-s'+1}{\gamma+\delta+\varphi} - \frac{(y-s)-(\overline{w}-h)}{(\gamma+\delta+\varphi)(\gamma+\delta)}(\delta'+\varphi') = 0$$

$$(15)(y-s)-(\overline{w}-h) = \frac{1-s'}{\gamma+\delta+\varphi} \times \frac{(\gamma+\delta+\varphi)(\gamma+\delta)}{(\delta'+\varphi')} = \frac{(1-s')(\gamma+\delta)}{(\delta'+\varphi')}$$

$$(16) h = \overline{w} - (y-s) + \frac{(1-s')(\gamma+\delta)}{(\delta'+\varphi')}$$

5.3.3. The Relative Size of a Hiring Credits, Required to Induce Employment

Now, let's access how an optimal level of hiring credits, required for a firm to create employment for the two types of workers. This will give us employment prospect of each worker, especially during the recession, as a firm′s employment creation capacity is directly related to the size of a hiring credit a worker hold a voucher for. Solving the optimal level of hiring credit, we calculated from the previous section, we have

$$(17) h_j = \overline{w} - \left(y_i - s_j\right) + \frac{\left(1-s'_j\right)\left(\gamma+\delta_j\right)}{\left(\delta'_j+\varphi'_j\right)} = w - y_i + \frac{s_j\left(\delta'_j+\varphi'_j\right)+\left(1-s'_j\right)\left(\gamma+\delta_j\right)}{\left(\delta'_j+\varphi'_j\right)}$$

where *i* represents a worker's skill level (low vs. lower), and *j* denotes the type of a hiring credit a worker reveals his eligibility status for.

According to the Table 3, the relative amount of hiring credit a severely disadvantaged worker would receive over moderately disadvantaged or regular long-term unemployed workers decreases after the GHC program implementation. Thus, a firm's relative job creation capacity for a CHC holder over the rest becomes smaller. However, note that, in reality, there is no change in the size of CHC benefits. Therefore, we may conclude that there is systematic marginalization of a CHC eligible worker over the rest of working population upon the implementation of a GHC program.

Table 3. An Optimal Level of a Hiring Credit, Required to Induce an Employment

Disclosure of Eligibility Status of a Worker	(1) Before GHC Implementation	(2) After GHC Implementation	Difference: (2) – (1)
(3) NHC (skill level = low)	$\bar{w} - (y_{low}) + \frac{(1 - s'_{NHC})(\gamma + \delta_{NHC})}{(\delta'_{NHC} + \varphi'_{NHC})}$	$\bar{w} - (y_{low}) + \frac{(1 - s'_{NHC})(\gamma + \delta_{NHC})}{(\delta'_{NHC} + \varphi'_{NHC})}$	0
(4) GHC (skill level = low)	$\bar{w} - (y_{low} - s_{CHC}) + \frac{(1 - s'_{CHC})(\gamma + \delta_{CHC})}{(\delta'_{CHC} + \varphi'_{CHC})}$	$\bar{w} - (y_{low} - s_{GHC}) + \frac{(1 - s'_{GHC})(\gamma + \delta_{GHC})}{(\delta'_{GHC} + \varphi'_{GHC})}$	> 0
(5) CHC (skill level = lower)	$\bar{w} - (y_{lower} - s_{CHC}) + \frac{(1 - s'_{CHC})(\gamma + \delta_{CHC})}{(\delta'_{CHC} + \varphi'_{CHC})}$	$\bar{w} - (y_{lower} - s_{CHC}) + \frac{(1 - s'_{CHC})(\gamma + \delta_{CHC})}{(\delta'_{CHC} + \varphi'_{CHC})}$	0
$CHC_{lower} - GHC_{low}$	$y_{low} - y_{lower} > 0$	$(y_{low} - y_{lower}) - (s_{CHC} - s_{GHC})$	> 0
$CHC_{lower} - NHC_{low}$	$y_{low} - y_{lower} - s_{CHC}$	$y_{low} - y_{lower} - s_{CHC}$	0

Moreover, the marginalization may become even more severe as a CHC eligible worker is continuously discriminated by the policy design. Since a firm is less likely to hire a worker with CHC eligibility status over the one with GHC eligibility status, a growing number of welfare recipients will disclose their eligibility status to a GHC program over a CHC program. These transitions will occur only among those without noticeable disabilities. Then, the expected stigma a firm imposes on a CHC eligible worker increases (negative), further accelerating the transition. To test this scenario, we simplify a firm's rent using the optimal size of a hiring credit, and calculate its partial derivative in terms of the rate of stigmatization from holding a hiring credit voucher:

$$(18)\ J - V = \frac{(y - s) + (-\overline{w} + h)}{\gamma + \delta} = \frac{\frac{(1 - s')(\gamma + \delta)}{(\delta' + \varphi')}}{\gamma + \delta} = \frac{(1 - s')}{(\delta' + \varphi')}$$

$$(19)\ \frac{\partial(J - V)}{\partial s'} = -\frac{1}{(\delta' + \varphi')} < 0$$

Then by the given equations (18) and (19), a firm's rent from hiring a CHC eligible worker decreases as the rate of stigmatization increases. This will further marginalize a CHC eligible worker. In fact, the same would happen to a GHC eligible worker. However, the effect would be insignificant if a firm does not impose stigma on a GHC eligible worker, or smaller even if stigma is imposed since there are many more regular long-term unemployed workers to mitigate the effect.

6. DISCUSSION

6.1. Findings

We have built a game theory and a searching-and-matching models to prove the marginalization effect of a hiring credit on the most disadvantaged workers. While a general hiring credit program is effective at recovering the overall economy, it does so at the cost of the most disadvantaged. This is mainly driven by the transition of a welfare recipient in his hiring credit eligibility disclosure pattern. As less or zero stigmatizing hiring credit programs become readily available, those who do not need maximum amount of hiring credits to be hired would participate in the alternative program. While the program further increases a firm's employment creation capacity, it leaves workers who cannot make the transition behind by making them costlier to hire and imposing them greater levels of the stigmatization effects.

In fact, the marginalization would become much more severe in the presence of automatization and globalization. The United States economy has been suffering from jobless growth after the great recession: middle-wage occupation contributes 60 percent of job losses, but only 22 percent of recovery growth after the recession (NELP Analysis of Current Population Survey). Furthermore, there is a consensus that middle-wage workers are now working at low-wage occupations, pushing low-wage workers to greater poverty: "there is a new face to the poor and low wage earners: they are more educated, experienced, and employable, which only moves those without these attributes even lower" (The Vantage Point 2013). Especially, with rapid computerization, repetitive mid- wage jobs such as "bookkeeping, clerical work and manufacturing positions" are no longer necessary (Rotman, 2013). While labor demand for low- and high- wage workers remain stable, it is inevitable to have polarized workforce and thus

hollowing-out effect of the middle class. As automatization and globalization increase the number of middle wage workers competing for low wage jobs, it will decrease the stigma from disclosing GHC eligibility status and increase an expected output of those with GHC vouchers, thereby marginalizing the most disadvantaged even more.

6.2. A Policy Suggestion

Thus, we suggest the implementation of a general hiring credit program, which is not mutually exclusive to an existing categorical hiring credit program. This is to ensure progressive layering of the hiring credit policies in aggregate.

Suppose a current CHC claimant can ask for a newly implemented GHC benefits as well. As a result, a severly disadvantaged worker will reveal his GHC program eligibility status since he can improve his employment prospects without additional costs from further disclosing his status. Then, as described in Figure 7 and Table 5, a firm's benefit schedule and Nash equilibrium for each type of a worker in the game theory model change such that there is no different in the net benefits of a worker and a firm before and after the implementation of a GHC program. In other words, this will hold the relative cost of hiring the most disadvantaged workers over the rest constant. Thus, the alternative policy will prevent the transition in the hiring credit claimant pattern, the fundamental source of the inequity of a GHC program.

However, this solution may be equitable, but not efficient. Given the severely low-participation rates of hiring credit programs throughout the US history, we may advocate that channeling an excessive budget on each program to implement non- exclusive alternative hiring credit program would be equitable and legally indisputable. Yet, to support the alternative policy,

we need a further investigation on whether the fiscal efficiency of the alternative policy outweighs these benefits.

Figure 6. An Alternative Game Matrix: after the GHC Program Implementation ($s_{GHC} = 0$)

		Firm	
Regular Long-Term Unemployed & Mildly Disadvantaged Welfare Recipients (skill level = low)		Hire	Does Not Hire
	NHC	$y_{low} - \overline{w}, \overline{w} - b$	$-$k, b
	GHC	$y_{low} + h_{GHC} - \overline{w}, \overline{w} - b$	$-$k, b
	CHC	$y_{low} + h_{CHC} + \boldsymbol{h_{GHC}} - \overline{w}, \overline{w} - b$	$-$k, b
Severely Disadvantaged Welfare Recipients (skill level = lower)		Hire	Does Not Hire
	NHC	$y_{lower} - s_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-$k, b $- s_{CHC}$
	GHC	$y_{lower} - s_{CHC} + h_{GHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$-$k, b $- s_{CHC}$
	CHC	$y_{lower} - s_{CHC} + h_{CHC} + \boldsymbol{h_{GHC}} - \overline{w}, \overline{w} - s_{CHC} - b$	$-$k, b $- s_{CHC}$

Table 4. Net Benefits of a Worker and a Firm, Estimated from the Alternative Game Matrix

	(1) Low Skilled Workers	(2) Lower Skilled Workers	Difference:(1) – (2)
(3) Before the Implementation of a GHC program ($s_{GHC} \neq 0$)	$y_{low} - \overline{w}, \overline{w} - b$	$y_{lower} - s_{CHC} + h_{CHC} - \overline{w}, \overline{w} - s_{CHC} - b$	$y_{low} - y_{lower} + s_{CHC} - h_{CHC}, s_{CHC}$
(4) After the Implementation of a GHC program ($s_{GHC} = 0$)	$y_{low} + h_{GHC} - \overline{w}, \overline{w} - b$	$y_{lower} - s_{CHC} + h_{CHC} + \boldsymbol{h_{GHC}} - \overline{w}, \overline{w} - s_{CHC} - b$	$y_{low} - y_{lower} + s_{CHC} - h_{CHC}, s_{CHC}$
Difference: (4) – (3)	0, 0	0,0	**0, 0**

6.3. Limitations

There are three important limitations to this paper. The first limitation is that the paper depends on a series of assumptions. However, the assumptions are based on a number of studies, consistently asserting the same throughout different time periods. Second, it lacks empirical analysis. Individual information on hiring credit status is publically unavailable due to the privacy code in the United States. Thus, it is difficult to conduct an empirical analysis to examine if there is an actual transition in the hiring credit claimant pattern, and dynamics of the employment prospects, especially among the most disadvantaged workers. Thus, for future studies, it would be essential to have rich federal micro datasets or hold an experiment to conduct empirical analysis. Last, there must be a further analysis done to enumerate the social efficiency of implementing a GHC program. Restructuring the hiring credit benefits would be more reasonable if equity gain from the reform far exceeds additional efficiency from implementing a GHC program.

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