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Who is Hurt by Discrimination?

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Who is hurt by discrimination ?

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Abstract

The effects of discrimination of immigrants on the labour market are studied within a search and wage-bargaining setting including a risk of losing skills during the experience of unemployment. The negative effects of discrimination in the form of higher unemployment and lower wages spread to all workers, immigrants and natives, in all sectors of the economy. The effect is stronger for immigrants, but natives also suffer. An increase in the share of immigrants in the economy exacerbates the problem of discrimination.

1 Introduction

Labour market discrimination is a situation where individuals who are equally productive are treated unequally. Specifically, they may receive lower wages or face lower demands for their services at a given wage in a way that is related to an observable characteristic, such as race or ethnicity.

In 2003, 90% of the respondents to the "Integrationsbarometer" (Swedish Integration Barometer), a survey carried out by Integrationsverket (The Swedish

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Integration Board), thought that immigrants are discriminated against in Sweden. Furthermore, 9% of the respondents declared that they had witnessed ethnic discrimination at their own workplace. Field experiments provide further evidence of the existence of discrimination. Carlsson and Rooth (2006) performed a field experiment in May 2005 to February 2006 that showed every fourth Swedish employer to discriminate against men with Arabic sounding names in the hiring process. Similar field experiments find evidence of discrimination in the selection of job interviews in Australia (Riach and Rich (1991)) and the US (Bertrand and Mullainathan (2003)).

The present paper takes as a starting point that workers may end up in occupations below their qualifications due to discrimination. The problem of discrimination becomes more severe if workers are subject to the risk of losing skills during a spell of unemployment. If a worker's attachment to the labour market becomes fragile due to discrimination, her skills potentially deteriorate and the worker ends up searching for less qualified jobs. Hence, discrimination may not only result in natives and immigrants getting different pay for the same work, but also in natives and immigrants with similar skill levels ending up in different occupations, if in any occupation at all. This issue has previously been ignored in the theoretical literature.

Our purpose in this paper is to theoretically study the effects of discrimination of immigrants on labour market performance for both natives and immigrants, given that all workers are subject to the risk of losing skills during a period of unemployment.[1]

We formulate a model of Becker-style taste discrimination within a search and wage-bargaining setting. In this model, even an employer who does not dislike immigrants himself may think that it is against his interests to employ immigrants if he expects that co-workers and clients will disapprove of them. Not all firms discriminate against immigrants, however. For simplicity, we assume that neither job searchers nor firms opening a vacancy know whether

[1] See Larsen (2001) for a related set-up which does not distinguish between immigrants and natives, however.

discrimination will take place before they enter a given match. Formally, we assume that each firm has many interviewers, some of which dislike immigrants, but the firm cannot observe if a particular interviewer has such discriminating tastes. A discriminating interviewer does not offer a job to an immigrant. Discrimination therefore implies that immigrants face a lower probability of getting a job.

An alternative way of modelling discrimination is to assume that immigrants are discriminated against when they separate from a job instead of upon entry. An immigrant worker would then be fired, or forced to resign, due to discrimination with a probability that is higher than that for a native worker. This alternative set-up would fit better with the assumption that neither job searchers nor employers can observe whether discrimination will take place in a particular firm. However, we believe that discrimination upon entry is more common in the labour market. Moreover, the two modelling strategies yield qualitatively similar results.

For simplicity, we assume that all workers enter the labour market as skilled workers. Unemployed workers face the risk of losing their skills. If this happens, they can only search for jobs in the low productivity sector. Low productivity workers may regain their skills by accumulating work experience or training when unemployed.

The model delivers the following results. Discrimination directly reduces an immigrant worker's transition probability out of unemployment and thereby deteriorates her wage-bargaining position. Therefore, discrimination implies that wages received by immigrants are lower than wages received by natives, even when they face a non-discriminating employer. A lower hiring probability also implies that immigrants suffer from higher unemployment rates, despite receiving lower wages. By being unemployed more often, immigrants are subject to a higher risk of skill loss and the economy ends up with a higher proportion of immigrants than natives in low productivity jobs. One further important result of the model is that not only immigrants are affected by discrimination, so are the native workers in the economy. We perform comparative statics analyses

where we consider the effect on wages and unemployment for all workers of an increase in the level of discrimination and the share of immigrants in the economy.

Finally, we endogenize training which allows us to examine how discrimination affects the relative skill levels of natives and immigrants.

Related Research

Empirical evidence supports the idea that employment below the individual's qualifications and loss of skills are important issues to consider. Arai et al (2000) compare the percentage of immigrants in different occupations with the percentage of immigrants in the labour force in Sweden. Immigrants are overrepresented in only three occupations out of 29, all of which require no education or training.[2] The authors estimate the likelihood of getting a qualified job, controlling for the years since immigration and the level of education. Immigrants born in the other Nordic countries or in Western Europe have a 25% lower probability of getting a qualified job than natives. The probability of getting a qualified job is 50% lower for immigrants born in Latin America and 70% lower for those born in East Europe, Asia or Africa, than for natives. Reitz (2001) shows that the under-utilization of immigrant skills is significant in Canada. In an empirical study for Denmark, Nielsen et al (2004) show that a large fraction of the wage gap between immigrants and natives would disappear if only immigrants could find employment and thus accumulate work experience.

Most existing theoretical models studying discrimination in the labour market emphasize either of two broad types of discrimination. The first is prejudice, which Gary Becker formalizes as a "taste" of at least some members of the majority group for not interacting with members of the minority group. The

[2] Immigrants are overrepresented in handicraft (such as baker, butcher, tailor), service work that requires no vocational education / training (such as salesman, cleaner, newspaper distributor) and other work that requires no vocational education / training (such as unskilled labour in building and construction and other factory work). The underrepresentation in all other occupations is stronger for immigrants from Africa, Asia or Latin-America than for those born in Europe.

second is statistical discrimination by employers in the presence of imperfect information about the skills or behaviour of members of the minority group.

Simple models of taste-based discrimination often predict the elimination of discrimination through competition or segregation. Borjas and Bronars (1989) and subsequent papers merge ideas from search models of the labour market with Becker-style models of taste discrimination and obtain a number of important results. Rosén (1997), Flabbi (2004) and our own model belong to this group. The difference between our model and the models of Rosén, Flabbi and Borjas is that in a thorough analysis of unemployment, we incorporate the risk that workers potentially lose skills**.**

The paper is organized as follows. The model is set up in section 2. Section 3 incorporates the comparative statics. In section 4 we show the effect of relaxing simplifying assumptions and endogenizing the training decision when unemployed. Section 5 concludes.

2 The model

We develop a model with two types of agents, workers and firms. Both workers and firms are risk-neutral and infinitely-lived and have a common discount rate. Workers may either be employed or unemployed. To hire new workers, firms must create a vacancy at a cost k. Free entry drives the discounted profits from creating a vacancy to zero.

The economy is divided into two different sectors, called h and l. Firms in sector h require skilled workers with high productivity, while firms in sector l employ low productivity workers. The skills of workers are observable, implying that low productivity workers never get a job offer in sector h.

The economy is populated by native and immigrant workers and the labour force is normalized to one. The proportion of native workers, n, is exogenously given.

To acknowledge that not all firms discriminate against immigrants, we consider the following set-up:

- All firms in a sector have interviewers that meet job seekers, a proportion d_s of which dislikes immigrants ($s = h, l$).
- When a discriminating interviewer meets a skilled immigrant, she does not get a job offer.
- Firms cannot observe whether their own interviewers discriminate against immigrants or not. Neither job searchers nor the firm opening a vacancy know whether discrimination will take place before the match.
- Firms and workers only know that, with a given probability d_s $(s = h, l,)$, an immigrant worker will not get a job, and a vacancy will not be filled due to discrimination.

For simplicity, we assume that all workers enter the labour market as skilled workers. A more realistic set-up where we assume that a proportion of workers are low skilled to start with does not substantially modify the results. When unemployed, skilled workers lose their skills with probability λ. Workers who have lost their skills are only able to search for jobs in the low productivity sector. Workers may regain skills in two different ways: i) they can train while unemployed and become skilled unemployed, which happens at the rate γ and ii) they can get a low productivity job and regain their skills at rate a. For simplicity, γ and a are assumed to be exogenous and identical for natives and immigrants. The alternative where workers decide whether they want to make an effort to train and once more become skilled is considered as an extension below.

2.1 Matching

Unemployed workers search for jobs in sector h or l, depending on their productivity level. The matching function for sector s is assumed to have the functional form $(v_s)^{\alpha} (u_s)^{1-\alpha}$, where v_s is the sectoral vacancy rate and u_s is the unemployment rate in sector $s = h, l$ and $0 < \alpha < 1$.

A native worker with productivity s gets a job offer at rate f_s^N. The transition rate into employment for a native worker with productivity s is given by $f_s^N = f(\theta_s) = \theta_s^\alpha$, $s = h, l$, where $\theta_s = v_s/u_s$ captures sectorial labour market tightness. An immigrant faces a discriminating interviewer with probability d_s, so the transition rate into employment for an immigrant worker of productivity s is reduced relative to the transition rate of natives to $f_s^I = f(\theta_s)(1 - d_s) = \theta_s^\alpha (1 - d_s)$, $s = h, l$. The rate at which vacant jobs become filled is $q_s = q(1/\theta_s) = \theta_s^{\alpha-1}$, $s = h, l$.

2.2 Workers and firms

The arbitrage equation facing unemployed workers in sector h is given by

$$\rho U_h^J = f_h^J \left(W_h^J - U_h^J\right) + \lambda \left(U_l^J - U_h^J\right), \qquad J = N, I. \tag{1}$$

The present discounted value (PDV) of being an unemployed skilled worker of origin $j = N, I$ (natives or immigrants) is given by the likelihood that the worker changes state. With probability f_h^J, she gets a job in the high productivity sector and receives the value W_h^J and with probability λ she loses skills and becomes a low skilled unemployed with value U_l^J.

$$\rho U_l^J = f_l^J \left(W_l^J - U_l^J\right) + \gamma \left(U_h^J - U_l^J\right), \qquad J = N, I. \tag{2}$$

Low skilled unemployed workers get a job in the low productivity sector with probability f_l^J and regain skills by training while unemployed at the rate γ. The value of γ is assumed to be exogenous but will be endogenized in an extension.

The present discounted utility for a skilled employed worker of origin J satisfies

$$\rho W_h^J = w_h^J + \sigma \left(U_h^J - W_h^J\right), \tag{3}$$

where w_{jh} is the wage received by skilled workers of origin J and σ is the rate of job separation, assumed to be the same for all workers. Similarly

$$\rho W_l^J = w_l^J + \sigma \left(a U_h^J + (1 - a) U_l^J - W_l^J\right). \tag{4}$$

We assume that workers separated from their jobs regain their skills and join the pool of skilled unemployed at rate a, while they join the pool of low skilled unemployed at a rate $(1-a)$.

The present discounted value of a new vacancy in sector s is

$$\rho V_s = q_s\left(\phi_s\left(X_s^N - V_s\right) + (1-\phi_s)(1-d_s)\left(X_s^I - V_s\right)\right) - k, \quad s = h, l. \quad (5)$$

q_s is the likelihood that a firm matches with any worker, ϕ_s is the proportion of natives among the unemployed workers of productivity s and k is the cost of opening a vacancy. With probability $q_s\phi_{s,}$ the vacancy can be filled by a native and provide a value X_s^N to the firm, while the probability of filling it with an immigrant is $q_s(1-\phi_s)(1-d_s)$, creating the value X_s^I.

Interviewers always hire the native worker with whom they are matched, but if they are discriminating, they do not hire an immigrant. As a consequence, there is an instantaneous probability $q_s(1-\phi_s)d_s$ that the vacancy is not filled. Firms would prefer to avoid discriminating interviewers in this setting, but they cannot since this characteristic is not observable.

The PDV of a job occupied by a worker of origin J, X_s^J satisfies

$$\rho X_s^J = y_s - w_s^J + \sigma\left(V_s - X_s^J\right), \qquad s = h, l \text{ and } J = N, I. \quad (6)$$

Productivities y_h and y_l and the exogenous separation rate σ are assumed to be the same for natives and immigrants. Free entry drives the value of vacancies to zero in both sectors. Using equations (5) and (6) and setting $V_s = 0$, we obtain two equations to determine labour market tightness, $\theta_s \quad s = h, l$.

$$g_h = k\frac{1}{q_h}(\rho+\sigma) - \phi_h\left[y_h - w_h^N\right] - (1-\phi_h)(1-d_h)\left[y_h - w_h^I\right] = 0, \quad (7)$$

$$g_l = k\frac{1}{q_l}(\rho+\sigma) - \phi_l\left[y_l - w_l^N\right] - (1-\phi_l)(1-d_l)\left[y_l - w_l^I\right] = 0. \quad (8)$$

The matching function relates the rates at which vacant jobs become filled to labour market tightness. Note that, for given wages, a firm's outside option deteriorates when there are many unemployed immigrants in the unemployment pool, that is when ϕ_s is small. In the next subsection, we derive equilibrium

wages which depend on labour market tightness through the transition rates into employment.

2.3 Wages

Wages are determined by Nash Bargaining with bargaining power equal to one half, so they are set to equalize the parties' outside options,

$$W_s^J - U_s^J = X_s^J.$$

For skilled workers, this equalization implies a wage

$$w_h^J = \frac{1}{2}\left(y_h + \rho U_h^J\right), \qquad J = N, I, \tag{9}$$

while, for low skilled workers, the equilibrium wage is

$$w_l^J = \frac{1}{2}\left(y_l + \rho U_l^J - \sigma a\left(U_h^J - U_l^J\right)\right). \qquad J = N, I. \tag{10}$$

The wage of a low skilled worker decreases with σa, the rate at which an employed worker separates from the present match having regained skills. The possibility of regaining skills makes employment more attractive, so the worker is willing to accept a lower wage in the bargaining process.

Substituting equation (2) into the wages of low skilled workers, we obtain

$$w_l^J = \frac{1}{2}\left[y_l + f_l^J\left(W_l^J - U_l^J\right) + \gamma\left(U_h^J - U_l^J\right) - \sigma a\left(U_h^J - U_l^J\right)\right].$$

For simplicity, we assume that $\gamma = \sigma a$, that is, the rate at which a low skilled worker moves to the pool of skilled unemployed by training during unemployment equals the rate at which she enters that pool after separating from a job where she regained skills. This assumption implies that the last two terms in w_l^J cancel and the wages of low skilled workers become independent of the transition rate of skilled workers. The model becomes recursive and can be solved analytically.

Inserting the PDV from equation (1)-(4) in equations (9) and (10) and solv-

ing the two equations, we obtain:

$$w_l^J = \frac{\rho+\sigma+f_l^J}{2(\rho+\sigma)+f_l^J} y_l \qquad J=N,I, \tag{11}$$

$$w_h^J = \frac{\left[(\rho+\sigma)(\rho+\lambda+\gamma)+(\rho+\gamma)f_h^J\right] y_h + \lambda f_l^J \frac{\rho+s}{2(\rho+s)+f_l^J} y_l}{2(\rho+\sigma)(\rho+\lambda+\gamma)+(\rho+\gamma)f_h^J} \tag{12}$$

where $f_s^N = f_s$ and $f_s^I = f_s(1-d_s)$, $s=h,l$ and $J=N,I$.

Proposition 1 *Native workers receive higher wages than immigrants whatever their sector, $w_s^N > w_s^I$, $s=h,l$ as $f_s^N > f_s^I$. Moreover, skilled workers, whatever their origin, receive higher wages than low skilled workers, $w_h^J > w_l^J$, $J=N,I$ if $f_h > f_l$.*

Wages are increasing in the transition rates out of unemployment. Due to discrimination, skilled natives have a higher transition rate than skilled immigrants. This gives them a better bargaining position after a match, so they receive higher wages. Skilled workers receive higher wages than low skilled workers, due to their higher productivity.

Equations (11) and (12), together with equations (7) and (8), determine labour market tightness for the two sectors, $\theta_h = v_h/u_h$ and $\theta_l = v_l/u_l$.

A sufficient condition for the labour market tightness facing skilled workers to be higher than that facing low skilled workers, $\theta_h > \theta_l$ is that there is more discrimination in the low productivity sector, $d_h \leq d_l$, when the match efficiency $\alpha = \frac{1}{2}$. This implies that it is easier for a skilled worker than for a low skilled worker to find a job, $f_h > f_l$, irrespective of country of origin. This is only a sufficient condition and we can easily obtain $f_h > f_l$ even if discrimination is higher in the high productivity sector, as long as the productivity difference is sufficiently large.

2.4 Unemployment

Steady state employment and unemployment for skilled and low skilled workers are derived by considering the flows into and out of employment and the fact that $e_l^N + e_h^N + v_h^N + v_l^N = n$ and $e_l^I + e_h^I + v_h^I + v_l^I = 1-n$, where $e_s^J\left(v_s^J\right)$

denotes employment (unemployment). We obtain the following unemployment rates for immigrants and natives:

$$u_s^N = \frac{\upsilon_s^N}{e_s^N + \upsilon_s^N} = \frac{\sigma}{\sigma + f_s}, s = h, l \tag{13}$$

$$u_s^I = \frac{\upsilon_s^I}{e_s^I + \upsilon_s^I} = \frac{\sigma}{\sigma + f_s\left(1 - d_s\right)}, s = h, l. \tag{14}$$

Proposition 2 *Immigrants face higher unemployment than natives in both sectors. That is, the unemployment rates faced by immigrants relative to those of natives for both high and low skilled workers, u_h^I/u_h^N and u_l^I/u_l^N are higher than one. The rate of unemployment facing skilled workers is lower than that experienced by low skilled workers as long as $f_h > f_l$.*

Both skilled and low skilled immigrants face an additional negative impact through discrimination, which increases the unemployment of immigrants relative to the unemployment of natives. This is easily seen using equations (13)-(14).

The proportion of native workers among unemployed high and low productivity workers is given by

$$\phi_h = \frac{1}{1 + \frac{(1-n)}{n}\kappa}, \quad \phi_l = \frac{1}{1 + \frac{(1-n)}{n}\frac{(\sigma+f_l)}{(\sigma+f_l(1-d_l))}\kappa},$$

where we assume that $\gamma = \sigma a$ and define $\kappa = \frac{\lambda+a(f_h+\sigma)}{\lambda+a(f_h(1-d_h)+\sigma)} > 1$. The additional negative impact of discrimination on low skilled immigrant workers results in relatively more natives among the skilled unemployed, $\phi_h > \phi_l$.

We now consider some partial impacts on the proportion of natives among the unemployed. When more immigrants are searching for jobs, a lower n, this directly reduces the share of native unemployed workers. If discrimination increases, a higher d_s, there will be relatively more immigrants among the unemployed workers. When labour market tightness increases, workers' transition rates increase, in particular reducing unemployment for natives since their transition rate is higher.

The unemployment facing high productivity workers is

$$v_h = v_h^N + v_h^I = \frac{n\sigma a}{\lambda + (\sigma + f_h)\, a} + \frac{(1-n)\,\sigma a}{\lambda + (\sigma + f_h\,(1-d_h))\, a}$$

and the unemployment facing low productivity workers is

$$v_l = \frac{\lambda n\sigma}{(\sigma + f_l)\,(\lambda + (\sigma + f_h)\, a)} + \frac{\lambda\,(1-n)\,\sigma}{(\sigma + f_l\,(1-d_l))\,(\lambda + (\sigma + f_h\,(1-d_h))\, a)}.$$

The unemployment rate facing natives and immigrants is

$$u^J = \frac{u_h^J + u_l^J}{u_h^J + u_l^J + e_h^J + e_l^J} = \frac{\sigma\left(a\left(\sigma + f_l^J\right) + \lambda\right)}{\left(a\left(\sigma + f_h^J\right) + \lambda\right)\left(\sigma + f_l^J\right)}, \qquad J = N, I. \tag{15}$$

Discrimination reduces the transition rates for immigrants with respect to natives, $f_s^I < f_s^N$, so that the unemployment rate facing immigrants is higher than the one facing natives.

2.5 Skills

For simplicity, we have assumed that all workers enter the labour market as skilled workers. The difference in unemployment rates derived in the previous subsection has consequences for the distribution of skills in the steady state.

Proposition 3 *Due to discrimination, the proportion of low skilled immigrants is higher than the proportion of low skilled natives in the economy.*

Proof. The proportion of high productivity workers among immigrants and natives is

$$\begin{aligned} \frac{v_h^I + e_h^I}{1-n} &= \frac{a\,(\sigma + f_h\,(1-d_h))}{(\lambda + a\,(f_h\,(1-d_h) + \sigma))}, \\ \frac{v_h^N + e_h^N}{n} &= \frac{a\,(\sigma + f_h)}{(\lambda + a\,(f_h + \sigma))}. \end{aligned}$$

We observe that

$$\frac{v_h^I + e_h^I}{1-n} < \frac{v_h^N + e_h^N}{n}, \quad \frac{v_l^I + e_l^I}{1-n} > \frac{v_l^N + e_l^N}{n}.$$

■

In our model where natives and immigrants enter the economy with the same distribution of skills, immigrants become less skilled just because some

interviewers refuse to offer them a job**.** Note that this result is independent of whether we have discrimination of low skilled workers, due to the fact that the rate of regaining skills during the spell of unemployment is equal to the rate of regaining skills during the spell of employment. On the other hand, if there is no discrimination of high skilled workers, the proportion of natives and immigrants among both high and low skilled workers is identical.

Next, we consider comparative statistics of an increase in the level of discrimination and an increase in the share of immigrants in an economy where some interviewers discriminate immigrants.

3 Comparative Statics

We consider two shocks to labour market conditions: an increase in the level of discrimination and an increase in the share of immigrants. When there is a change in the labour market conditions, this affects the bargaining position of a worker in the match. If her position is strengthened, because of a better outside option, then she will be able to negotiate a higher wage. This is the direct effect of the change. But there is a further indirect effect. Firms become discouraged by the fact that at least some workers require higher wages to accept the job and thus, they offer less vacancies. This reduces labour market tightness and thus, the probability of any worker in that sector (independently of the origin) becoming employed. Therefore, the indirect effect affects both natives and immigrants in the sector.

In each of the following subsections, we need to identify how the comparative statics affect the position of the different workers to assess the direct and indirect effect on wages and unemployment rates.

3.1 Effects of higher discrimination

In this section, we perform comparative statics regarding the impact of an increase in the share of discriminating interviewers on the rates of unemployment,

the distribution of unemployment, wages and the distribution of wages. The proofs easily follow from differentiation of the appropriate expression(s) stated in sections 2.3 and 2.4.

It is easier to understand the intuition behind the results if we concentrate on discrimination in a single sector at a time. First, we consider the case when discrimination only appears in the high productivity sector. Then, we describe the effect of an increase in the level of discrimination when it exists only in the low productivity sector. Finally, we describe the effect of having discrimination in the whole economy. Empirical evidence is not conclusive with respect to which sector is most affected by discrimination, but most theoretical papers assume that the problem is more acute for skilled immigrants.[3]

3.1.1 Discrimination of skilled workers

If discrimination is only present in the high productivity sector, it has no effect on the transition rates in the low productivity sector and the wage received by low skilled natives equals that of low skilled immigrants, due to the simplifying assumption ($\gamma = \sigma a$) that makes the model recursive. Furthermore, the proportion of natives among the unemployed is the same for skilled and non skilled workers, that is, $\phi_h = \phi_l$, as low skilled immigrants are only indirectly affected by discrimination in sector h.

When only skilled immigrants are discriminated, the sufficient condition that $d_h \leq d_l$ to ensure that $f_h > f_l$ no longer holds. If productivity differences are not sufficiently large, $f_h (1 - d_h) < f_l$ is a possibility. In this case, it would be optimal for high skilled workers to search for low skilled jobs. In order to rule out this possibility, we therefore assume that productivity differences are sufficiently large so that $f_h (1 - d_h) > f_l$ holds.

Proposition 4 *All wages in the high productivity sector decrease whenever the*

[3] In a companion paper, Waisman and Larsen (2007), we show that well educated immigrants suffer more than less educated immigrants in Swedish municipalities where the attitudes against them are more negative. We interpret this result as evidence that discrimination has a larger effect on skilled workers.

discrimination of skilled workers, d_h, increases. The wages of low skilled workers are not affected. The relative wage of skilled immigrants vs. skilled natives, w_h^I/w_h^N, decreases.

As d_h increases, the wages of skilled immigrants are directly reduced by the deterioration in the bargaining position caused by higher discrimination and indirectly by the lower transition rate faced by all skilled workers. The wages of skilled natives are only affected by the lower transition rates, so the relative wages of immigrants in the high productivity sector are reduced.

Due to the simplifying assumption that makes the model recursive, discrimination in the high productivity sector has no impact on the labour market tightness faced by low skilled workers, which implies that their wages are not affected.

Proposition 5 *The unemployment of all skilled workers goes up when the discrimination of skilled workers, d_h, increases. Skilled immigrants are more affected than skilled natives. Unemployment of low skilled workers is not affected by d_h.*

The direct effect of higher discrimination is that more skilled immigrants become unemployed and risk losing their skills, which would imply that they join the pool of low skilled unemployed. This direct effect affects immigrants only, thereby increasing their relative unemployment rate among skilled workers, $\left(u_h^I/u_h^N\right)$.

The indirect effect is a reduction in the transition rates into employment for all skilled workers when less vacancies are opened. At the same time, discrimination conducted by some interviewers generates a reduction in wages which provides a positive externality on firms with non discriminating interviewers. The first impact dominates and the total impact on labour market tightness is negative. Due to discrimination, natives are over-represented among skilled workers and more affected by this negative indirect effect.

The impact on skilled natives' unemployment is smaller than the total impact

on skilled immigrants' unemployment if

$$\frac{\lambda+\gamma}{\lambda+af_h+\gamma}\left(\frac{d_h}{f_h}\right)\frac{df_h}{dd_h}+1>0.$$

If this is the case, $\left(u_h^I/u_h^N\right)$ increases when d_h rises. The relative unemployment rate of low skilled vs. high skilled workers decreases for both immigrants $\left(u_l^I/u_h^I\right)$ and natives $\left(u_l^N/u_h^N\right)$.

3.1.2 Discrimination of low skilled workers

Wages are affected in the following way:

Proposition 6 *All wages go down whenever the discrimination of low skilled workers, d_l, increases. The relative wages of immigrant vs. native low skilled workers, w_l^I/w_l^N, decrease with discrimination.*

Low skilled immigrants suffer from both the direct and the indirect effect of discrimination. Low skilled natives only suffer from the indirect effect; hence their wages decrease less than those of low skilled immigrants. More discrimination in the low productivity sector reduces vacancy supply and thus, the outside option even for low skilled natives and skilled workers, since they are subject to the risk of losing skills. Skilled workers' bargaining position is then damaged and all skilled workers accept lower wages. The wage reduction increases their transition rate which, in turn, has a positive effect on wages, but this effect is smaller than the wage reduction. The total impact on wages is then negative for all skilled workers.

The impact on relative wages of immigrants vs. native skilled workers, w_h^I/w_h^N, is ambiguous as there are several diverging effects. As d_l increases, there is a direct negative impact on relative wages. In addition, there is an increase in the transition rate of high productivity sector workers, which tends to decrease relative wages. Finally, the reduction in the transition rate of low productivity workers has an ambiguous impact on relative wages as immigrants' wages already being lower dampens the impact.

Proposition 7 *When discrimination of low skilled workers, d_l, increases, unemployment of skilled workers falls and unemployment of low skilled workers increases. The relative unemployment of immigrant vs. native low skilled workers increases when d_l becomes higher.*

The direct effect of higher discrimination in the low productivity sector is that more low skilled immigrants cannot get a job. But all low skilled workers face higher unemployment, due to the indirect effect that reduces the transition rates in this sector. This indirect effect hits immigrants more strongly as they are over-represented in the low productivity sector. The relative unemployment of low skilled workers, $\left(u_l^I/u_l^N\right)$, increases with d_l as a result of both the direct and the indirect effect.

When the value of being a low skilled worker decreases, all skilled workers accept a lower wage in order to avoid losing skills during the experience of unemployment. The lower wage makes skilled workers more attractive for firms and therefore, more vacancies are opened in the high productivity sector. Hence, in this case, the existence of discrimination in the low productivity sector provides a positive externality on the high productivity sector by weakening the skilled workers' outside option. This raises the labour market tightness in the high productivity sector and therefore, reduces the unemployment of skilled workers. Hence, the discrimination of low skilled immigrants improves the employment perspectives of all skilled workers.

The relative unemployment of immigrants $\left(u_l^I/u_h^I\right)$ and natives $\left(u_l^N/u_h^N\right)$ increases as u_l^J increases and u_h^J falls for $J = N, I$.

3.1.3 Discrimination in both sectors

When discrimination prevails in both sectors, we can no longer obtain analytical results and instead turn to numerical solutions. The following parameter values are used (annual values) in the solutions: the discount rate is set to $\rho = 0.08$; the separation rate is set to $\sigma = 0.10$ (see Millard and Mortensen 1997); the match efficiency is assumed to be $\alpha = 0.5$ (Pissarides 1995); y_l is normalized to one;

y_h is set equal to 1.3 to obtain a relatively large difference between productivity levels in the two sectors. Hiring costs are assumed to be $k = 0.6$ (60% of an annual low skilled wage). These costs are set in relation to the productivity of high skilled workers in order to generate reasonable unemployment rates. The fraction of natives was around $n = 0.9$ in Sweden in 2005 (www.scb.se). The rest of the parameters are set to approximately match unemployment in Sweden in 2005, $u = 0.073$ (www.oecd.org), the fact that the unemployment of natives was 59% of the unemployment of immigrants (Integrationsverket[4]) and that the fraction of long-term unemployed (more than 12 months of unemployment) was 19% (www.scb.se and www.oecd.org). In our model, the long-term unemployed correspond to the workers that have lost their skills. We assume $\lambda = 0.25$ and $\gamma = 0.08$, which implies that $a = \gamma/\sigma = 0.8$. We assume in the benchmark that one fourth of the interviewers discriminates against immigrants in both sectors[5]. Table 1 shows the wages and unemployment rates of all workers in the economy as well as the share of skilled natives and immigrants.

We can start by comparing our benchmark with an economy where immigrants are not discriminated at all. Discrimination reduces all wages, increases the rates of unemployment faced by all workers and reduces the share of skilled natives and immigrants. But the negative effect is much stronger for immigrants than for natives. In our numerical exercise, immigrants' wages are reduced by 3%, while natives' wages are reduced by less than 0.1%. The rates of unemployment faced by immigrants increase by more than 30%, while those faced by natives increase by less than 1%. The share of skilled natives decreases by almost 5% compared to less than 0.1% for natives. In this numerical analysis, natives are only marginally affected by discrimination.

The share of low skilled workers obtained in the exercise is close to the share of long-term unemployed workers in Sweden, that is, those workers who are most likely to have lost their skills. Our numerical exercise shows that, due to

[4] http://ivpxweb.digitalinformation.se/Database/
/Integrationsverket/Arbetslivet/Arbetslöshet/Arbetslöshet.asp

[5] Consistent with the results by Carlsson and Rooth (2006).

discrimination, immigrants end up being less skilled than natives even if they entered the economy being as productive. The share of skilled workers would be smaller had we not, for simplicity, assumed that all workers enter the economy being skilled. Furthermore, the difference in the skill composition of natives and immigrants would be larger if we had assumed that immigrants enter the economy with low skills to a higher extent.

In the rest of this subsection, the benchmark with $d_h = d_l = 0.25$ constitutes the basis from which we will study the effect of increasing the level of discrimination in one sector at a time.

Doubling the share of interviewers that discriminate in the high productivity sector reduces the wages of skilled immigrants by 4% and increases the unemployment rate they face from 6.63% to 9.77%. The unemployment rate faced by skilled natives increases slightly from 5.05% to 5.14%. The reduction in skilled natives' wages and the increase in the unemployment rate faced by all low skilled workers are very small (they all change by less than 1%). The share of skilled immigrants falls by almost 9%, while the share of skilled natives decreases by only 0.3%.

The same increase in the level of discrimination in the low productivity sector mainly affects low skilled immigrants, whose wages decrease by 5.3% while the unemployment rate they face increases from 8.6% to 12.53%. The unemployment rate faced by low skilled natives increases from 6.59% to 6.69%. All other wages and unemployment rates change by 1% at most. There is a slight increase in the share of skilled workers, both natives and immigrants.

The simulations basically confirm the results derived in the previous subsections. In general, the effect of an increase in the level of discrimination on wages has a smaller order of magnitude than the effect on unemployment rates.

When we allow for different levels of discrimination in the two sectors, we find the following additional results that are worth noting:

- When discrimination is higher in the low productivity sector, the relative wages of immigrants vs. natives are higher for skilled workers and vice

versa, that is, $\left(w_h^I/w_h^N\right) \gtrless \left(w_l^I/w_l^N\right)$ when $d_h \lesseqgtr d_l$.

- When discrimination is higher in the high productivity sector, the relative unemployment of immigrants vs. natives is larger for skilled workers than for low skilled workers and vice versa, that is, $\left(u_h^I/u_h^N\right) \gtrless \left(u_l^I/u_l^N\right)$ when $d_l \lesseqgtr d_h$.

- When discrimination is higher in the high productivity sector, the relative unemployment of low skilled vs. skilled natives is higher than that of low skilled vs. skilled immigrants and vice versa, that is, $\left(u_l^N/u_h^N\right) \gtrless \left(u_l^I/u_h^I\right)$ when $d_l \lesseqgtr d_h$.

3.2 Effects of higher share of immigrants

In this subsection, we perform comparative statistics on an increase in the proportion of immigrants in the population, while the total work force is still normalized to one. If there is discrimination in one sector, then an increase in the share of immigrants searching for a job in that sector makes vacancies less attractive, as the probability of their being filled is now smaller. We will describe the effect of an increase in the share of immigrants on wages and unemployment rates. The results are easily derived by differentiation.

3.2.1 Discrimination of skilled immigrants

Proposition 8 *When the share of immigrants rises in an economy where only skilled immigrants are discriminated, then the wages received by all skilled workers decrease. The impact on relative skilled wages across population groups is ambiguous. Wages received by low skilled workers remain unchanged.*

When there are more immigrants in the work force, the likelihood of a high productivity firm with a discriminating interviewer matching with one of them is higher, which makes vacancies less attractive. The bargaining position of all workers in the sector is weakened, so they accept lower wages. The reduction in wages itself increases the transition rates for skilled workers which, in turn, leads

to a smaller reduction in wages. The impact on the relative wages of immigrant vs. natives skilled workers $\left(w_h^I/w_h^N\right)$ is ambiguous. When there is an increase in the transition rates of high productivity sector workers, this tends to decrease the wages of immigrants relative to natives. However, this impact is modified due to the immigrants' transition rate already being the lower.

Due to the simplifying assumption on the rates at which workers regain skills, discrimination in the high productivity sector has no impact on the labour market tightness faced by low skilled workers. This implies that their wages are not affected.

Proposition 9 *When the share of immigrants increases in an economy where only skilled immigrants are discriminated against, the unemployment rate of all skilled workers increases. The unemployment rate of skilled natives increases relatively more than that of skilled immigrants. The unemployment of low skilled workers remains unchanged.*

When vacancies become less attractive, more skilled immigrants end up being unemployed. Note that the impact is purely a result of discrimination, which reduces the rate at which an open vacancy is filled and thereby reduces the equilibrium number of vacancies supplied in the economy. The prevalent discrimination means that skilled natives are working to a higher extent, so that they are more affected by the reduction in the transition rates in the high productivity sector. As a consequence, the relative unemployment rate of immigrant vs. native skilled workers $\left(u_h^I/u_h^N\right)$ decreases. The relative unemployment of low skilled vs. skilled workers $\left(u_l^J/u_h^J\right)$ decreases for both natives and immigrants, because u_l^J is constant and u_h^J increases for $J = N, I$.

3.2.2 Discrimination of low skilled workers

Proposition 10 *In an economy where low skilled immigrants are discriminated against, a higher proportion of immigrants, a higher* $(1-n)$*, reduces the wages received by all low skilled workers. The impact on skilled workers' wages and relative wages is ambiguous.*

An increase in the share of immigrants makes opening a vacancy in the low productivity market less attractive. The fall in the transition rate of low skilled workers when less vacancies are opened deteriorates their bargaining position, causing them to accept lower wages. Even skilled workers are induced to accept lower wages to avoid unemployment and the risk of losing skills, but the lower wages themselves lead to an increase in the transaction rate that once more raises wages. The total effect on skilled workers' wages is ambiguous.

As natives are employed to a higher extent, they are more affected by the reduction in wages. But the fact that immigrants' wages were already lower dampens the impact. The effects on relative wages for immigrant vs. native skilled workers $\left(w_h^I/w_h^N\right)$ and low skilled workers $\left(w_l^I/w_l^N\right)$ are ambiguous.

Proposition 11 *When the share of immigrants,* $(1-n)$*, increases in an economy where only low skilled immigrants are discriminated against, the unemployment rates of all low skilled workers increase, while the unemployment rates of all skilled workers fall. The unemployment of low skilled natives increases more than the unemployment of low skilled immigrants. The relative unemployment of skilled workers is kept unchanged.*

Fewer vacancies reduce the transition rate of all low skilled workers and increase their unemployment. As low skilled natives are employed to a higher extent, they suffer a higher increase in unemployment, whereby the relative unemployment rate for immigrant vs. native low skill workers $\left(u_l^I/u_l^N\right)$ decreases.

The fall in the transition rate of low skilled workers even deteriorates the wage-bargaining position of skilled workers. Skilled workers accept lower wages to avoid unemployment and the potential loss of skills. As there is no discrimination in the high productivity sector, all workers in this sector are equally affected by the indirect effect, so that the relative unemployment for immigrant vs. native skilled workers $\left(u_h^I/u_h^N\right)$ remains unchanged.

3.2.3 Discrimination in both sectors

The comparative analysis when discrimination is present in both sectors in only possible in a numerical exercise. We start from the same benchmark defined in subsection 3.1.3 and analyse two different increases in the share of immigrants in the economy: i) we double the share of immigrants and ii) we increase this share by the same amount of percentage points as we increased the level of discrimination. These two exercises allow us to compare the effect on wages, unemployment rates and skills of an increase in the share of immigrants with the effect of an increase in the level of discrimination.

A doubling of the share of immigrants in the economy decreases the wages of all agents by 0.1% at most and increases the unemployment rates they face by 0.6% at most. If the share of immigrants in the economy increases from 10% to 35%, the wages of all agents still increase by 0.1% at most while the unemployment rates increase by 1.2% at most. In both exercises, there is a slight decrease in the share of skilled workers (natives and immigrants).

Our numerical example shows that the effect of an increase in the share of immigrants has a much smaller order of magnitude than the effect of an increase in discrimination.

4 Extensions

4.1 Comparative analysis with $\gamma \neq \sigma a$

In the main body of the paper, we have assumed that $\gamma = \sigma a$ as a devise for making the model recursive. When we relax this assumption, wages in the low productivity sector depend on the difference in the value of being a high skilled vs. a low skilled unemployed, according to the following equation:

$$w_l^J = \frac{1}{2}\left[y_l + f_l^J\left(W_l^J - U_l^J\right) + (\gamma - \sigma a)\left(U_h^J - U_l^J\right)\right]. \tag{16}$$

Let us compare this with the case where $\gamma = \sigma a$. When $\gamma > \sigma a$, the low skilled worker's outside option improves, as the probability of regaining skills

is higher while unemployed. This tends to increase the wages of low skilled workers. When $\gamma < \sigma a$, the opposite holds: low skilled workers are more eager to get a job as training opportunities are now relatively higher while employed.

The new equilibrium wages and shares of natives among the unemployed in both sectors in the economy are presented in Appendix 1. The unemployment rates are defined by the same functions as before; they are only affected through the changes in the transition rates.

We now examine the impact on wages and unemployment of increasing the probability of regaining skills in a numerical exercise where parameters have the same values as in subsection 3.1.3. In Figures 1 and 2, we observe that both wages and unemployment rates increase when the probability of regaining skills when unemployed, γ, increases for a given σa. An increase in the probability of regaining skills while unemployed raises the low skilled worker's outside option and increases the wages of low skilled workers. It also improves the outside option of skilled workers since, if they happen to lose their skills, they will more easily regain them and, furthermore, they face higher wages when unskilled. A better outside option means that skilled workers also get better wages. Fewer vacancies are therefore created in both sectors.

The effect of an increase in γ is stronger for low skilled workers, as they are more directly affected. The stronger negative impact on labour market tightness and on the transition rate of low skilled workers implies that they face a stronger increase in unemployment. Hence, a larger increase in the rate at which low skilled workers regain skills induces a negative impact on workers due to the increase in unemployment and a positive impact on workers due to the increase in wages.

However, simulations show that relaxing this simplifying assumption entails a small change in the effect on wages and unemployment rates of an increase in discrimination or the share of immigrants. The main difference is that discrimination in the high productivity sector now also affects low skilled workers' wages. When $\gamma > \sigma a$, the wages received by low skilled immigrants fall, while w_l^I was unaffected by d_h when $\gamma = \sigma a$. The reduction in wages received by

skilled workers causes an increase in labour market tightness in the low productivity sector, which reduces low skilled workers' unemployment. When $\gamma < \sigma a$, the wages of low skilled immigrants instead increase by d_h. This is the case since low skilled workers are more eager to get a job when $\gamma < \sigma a$ because they more frequently regain skills while employed than when unemployed. Therefore, when discrimination of high skilled workers increases, their outside option deteriorates and they become relatively less eager to get a job which corresponds to an improvement in their bargaining position. The wage induces a negative impact on vacancy supply in the low productivity sector, whereby labour market tightness falls. However, the effect on unemployment is very small in our numerical example.

4.2 Endogenous training

In the previous subsection, we showed the effect on wages and unemployment of an increase in the exogenous rate at which skills are regained by an unemployed low skilled worker. This rate was assumed to be identical for natives and immigrants. Now, we will ask two different questions. To which extent would low skilled unemployed individuals choose to train and regain skills if they could do it at a cost? How is this decision affected by discrimination?

We assume that low skilled unemployed individuals face different costs of training every period. This cost is assumed to be measured in terms of effort. The exact amount of effort needed by a worker to retrain in a particular period depends on the location and time where this training is provided, whether she is healthy or sick, etc. These factors vary over time, so the worker does not know in advance how costly it would be for her to train. Each worker only knows the distribution of these costs in the population, which is assumed to be the same for natives and immigrants. This distribution determines the percentage of natives and immigrants choosing to train, which is equal to the probability that each worker will regain her skills. Once the choice to train becomes endogenous, immigrants will face different probabilities of regaining skills than natives

because discrimination alters the value of skills.

In every period where they happen to be low skilled unemployed, natives and immigrants compare the value of skills with the cost of regaining skills they face in that particular period and decide whether to train or not. Notice that a worker who chose to train because he had a low cost of training in one period may instead have a very high cost next time he happens to become unemployed. The costs a worker gets over time are completely independent of each other. This is equivalent to assuming that the low skilled unemployed draw costs from a lottery in each period.

Let the distribution of the cost of training $c_{i,}$ be uniformly distributed between 0 and 1 and identical for natives and immigrants. The value of skills is the same for all natives irrespective of the cost and the same is true for immigrants. All workers will choose to train if their cost is lower or equal to the value of skills for them.

The value of regaining skills for a given share of low skilled unemployed of origin J that decide to train γ^J is defined as

$$\begin{aligned}
\rho Z^J\left(\gamma^J\right) &= \rho U_h^J\left(\gamma^J\right) - \rho U_l^J\left(\gamma^J\right) \ , \\
&= \rho U_h^J\left(\gamma^J\right) - \frac{\rho}{(\rho+sa)}\left[2w_{jl} - y_l + saU_h^J\left(\gamma^J\right)\right] \ , \\
&= \rho\left[2w_h^J\left(\gamma^J\right) - y_h\right] - \frac{\rho}{(\rho+sa)}\left[2w_{jl} - y_l + sa\left(2w_h^J\left(\gamma^J\right) - y_h\right)\right] \\
&= \frac{\rho}{(\rho+sa)}\left\{\left[2w_h^J\left(\gamma^J\right) - y_h\right] - \left[2w_l^J\left(\gamma^J\right) - y_l\right]\right\}.
\end{aligned}$$

Workers choose to train as long as $\rho Z^J \geqslant c_{i.}$ Let $\widehat{c^J}$ be the cost of the marginal low skilled unemployed of origin J that chooses to train, so that $\rho Z^J = \widehat{c^J}$. Given that c_i is uniformly distributed between 0 and 1 for $J = N,\ I$, the proportion of workers of origin J that chooses to train is equal to $\widehat{c^J}$. So far, we have called this proportion γ^J. This means that the equilibrium condition that determines the optimal proportion of low skilled unemployed choosing to train is $\rho Z^J\left(\gamma^J\right) = \widehat{c^J} = \gamma^J$. The optimal proportion is then solved as a fixed point:

$$\frac{\rho}{(\rho+sa)}\left\{\left[2w_h^J\left(\gamma^J\right) - y_h\right] - \left[2w_l^J\left(\gamma^J\right) - y_l\right]\right\} = \gamma^J, \qquad J = N, I. \tag{17}$$

Incorporating equation (17) into the model for natives and immigrants, we can solve for the optimal choice in our numerical exercise.

If discrimination prevails in the high productivity sector, skills are more valuable for natives than for immigrants, so they choose to train to a larger extent. Consequently, $\gamma^N > \gamma^I$ when $d_h > 0$ and $d_l = 0$. If discrimination instead exists in the low productivity sector only, the value of being able to regain skills is highest for low skilled immigrants. Training means that they can escape the sector where they are discriminated against and move into a sector where productivity is larger and where they are as likely to get jobs as natives. This means that $\gamma^I > \gamma^N$ when $d_l > 0$ and $d_h = 0$.

Figures 3 and 4 show the results of the comparative statics analysis of increasing discrimination in one sector at a time in the presence of discrimination in both sectors when the decision to train is endogenous. We assume that $d_s = 0.25$ in the sector where discrimination is constant.

As discrimination in the high productivity sector increases, the value of skills decreases for all workers, so less of them choose to train. The effect is much stronger for immigrants who directly suffer from discrimination. When $d_h > d_l$, then $\gamma^N > \gamma^I$. When d_h is much lower than d_l, then $\gamma^I > \gamma^N$. But natives choose to train to a higher extent than immigrants already when $d_h < d_l$. The reason for this is that discrimination has a larger impact on wages in the high productivity sector than in the low productivity sector, as wages in the high productivity sector are relatively higher.

As discrimination in the low productivity sector increases, the value of skills increases for all workers. As a consequence, more workers of both origins choose to train. The effect is much stronger for immigrants. When d_l is low relative to d_h, then $\gamma^N > \gamma^I$. When d_l is much larger than d_h, then $\gamma^I > \gamma^N$. But natives still choose to train to a higher extent than immigrants when $d_l > d_h$, until the difference in discrimination becomes sufficiently high. This is the case for the same reason as above: discrimination has a larger impact on wages in the high productivity sector than in the low productivity sector, as wages in the high productivity sector are relatively higher.

The numerical analysis shows that when the same level of discrimination prevails in both sectors, $d_l = d_h = 0.25$ and the share of immigrants increases, the effect of d_h prevails and the value of skills decreases for all workers. This means that less workers of both origins choose to train and the optimal share is higher for natives than for immigrants for all shares n.

5 Conclusion

We have formulated a model of employer discrimination within a search and wage-bargaining setting, where workers are subject to the risk of losing skills during a spell of unemployment. We have allowed low skilled workers to regain skills both during employment and during training while unemployed. Discrimination was assumed to take the form of a share of interviewers that refuses to offer a job to immigrants. Based on these assumptions, we have analysed the equilibrium implication of discrimination and how the economy responds to higher discrimination facing high and low productivity workers and a larger share of immigrants.

Discrimination directly reduces an immigrant worker's transition out of unemployment and thereby deteriorates her outside option in the wage-bargaining situation. Consequently, discrimination causes wages received by immigrants to be lower than wages received by natives, even when immigrants face a non-discriminating employer. A lower transition rate also implies that immigrants suffer from higher unemployment rates, despite receiving lower wages. As immigrants experience more unemployment, they also face a higher risk of losing their skills. Therefore, the economy ends up with a higher proportion of immigrants than natives in low productivity jobs.

When discrimination increases in the high productivity sector, unemployment increases and skilled sector wages fall. Skilled immigrants' labour market outcomes are affected to a larger extent than those of natives. The share of skilled immigrants decreases more than that of skilled natives.

When the share of discriminating interviewers in the low productivity sector

increases, low skilled workers face lower wages and higher unemployment. Low skilled immigrants are once more worse hit by discrimination than low skilled natives. However, skilled workers accept lower wages facing a worsened outside option and thereby, there is a fall in the unemployment rate they face. More discrimination in the low productivity sector enhances the share of skilled natives and immigrants.

An increase in the share of immigrants in the economy exacerbates the negative impacts on labour market performance due to discrimination. If discrimination could be eliminated, an increase in the share of immigrants would have no effect in this model.

Even when we assume discrimination to only exist in one sector of the economy, its negative effects spread to all workers in both sectors. The effect is stronger for immigrants, especially those that are directly discriminated against, but natives also suffer, even if they work in the sector in which discrimination is absent.

Finally, we endogenized the decision to train in order to regain skills while unemployed. When only high skilled workers face discrimination, skills are more valuable for natives as they are more likely to keep them. Therefore, more natives than immigrants choose to train and regain skills. If, instead, low skilled workers are subject to discrimination, immigrants value skills more than natives, as skills allow them to escape discrimination. Hence, a relatively larger number of immigrants than natives regain skills.

Even when we assume discrimination to only exist in one sector of the economy, its negative effects spread to all workers in both sectors. The effect is stronger for immigrants, especially those that are directly discriminated against, but natives also suffer, even if they work in the sector in which discrimination is absent.

6 Bibliography

Arai M., H. Regnér and L. Schröder (2000), "Invandrare på den svenska arbetsmarknad", bilaga 3 till Näringsdepartamentets Mångfaldsprojekt.

Bertrand, M. and S. Mullainathan (2003), "Are Emily and Greg More Employable than Lakisha and Jamal? A Field Experiment on Labor Market Discrimination", No 9873, NBER Working Papers.

Borjas G. and S. Bronars (1989), "Consumer Discrimination and Self-employment," Journal of Political Economy, 97(3), pp. 581-605.

Black D. (1995), "Discrimination in an Equilibrium Search Model", Journal of Labor Economics, 13(2), pp. 309-333

Carlsson, M. and D.-.O Rooth (2006), "Evidence of Ethnic Discrimination in the Swedish Labor Market Using Experimental Data", IZA Discussion Papers No. 2281.

Flabbi L. (2004), "Gender Discrimination Estimation in a Search Model with Matching and Bargaining", Georgetown University, Department of Economics WP No 04-08.

Larsen, B., (2001), "Minimum Wages, Technological Progress and Loss of Skill", European Economic Review, 45, pp. 1521-1544.

Millard, S.P. and D.T. Mortensen (1997), "The Unemployment and Welfare Effects of Labour Market Policy: A Comparison of the USA and UK", in Snower, D. and G. de la Dehesa, (eds), Unemployment Policy: Government Options for the Labour Market. Oxford University Press, Oxford.

Nielsen, H., S., M. Rosholm, N. Smith and L. Husted (2004), "Qualifications, Discrimination, or Assimilation? An Extended Framework for Analysing Immigrant Wage Gaps", Empirical Economics, Springer, 29(4), pp. 855-883.

Pissarides, C.A. (1986), "Unemployment and Vacancies in Britain", Economic Policy, 3, pp. 499-559.

Reitz, J.G. (2001), "Immigrant Skill Utilization in the Canadian Labour Market: Implications of Human Capital Research", Journal of International Migration and Integration, 2(3), pp. 347-378.

Riach, P. and J. Rich (1991), "Testing for Racial Discrimination in the Labour Market", Cambridge Journal of Economics, 15(3), pp. 239-56.

Rosén, Å. (1997), "An Equilibrium Search-Matching Model of Discrimination", European Economic Review, 41, pp. 1589-1613.

Waisman, G. and B. Larsen (2007), "Do Attitudes towards Immigrants Matter?", mimeo.

Appendix 1

In Section 4, subsection 4.1, we relax the assumption that $\gamma = \sigma a$. This makes the model non-recursive and makes it impossible for us to obtain analytical solutions for the comparative statistics. But we can still solve the model numerically. The equilibrium wages when $\gamma \neq \sigma a$ are:

$$w_l^J = \frac{\left\{ \begin{array}{c} \left[\begin{array}{c} \left(2\left(\rho+\sigma\right)\left(\rho+\lambda+\gamma\right)+\left(\rho+\gamma\right)f_h^J\right)* \\ \left(y_l\left(\rho+\sigma+f_l^J\right)\left(\rho+\lambda+\gamma\right)+\left(\gamma-\sigma a\right)\left(f_h^J y_h - f_l^J y_l\right)\right) \end{array} \right] \\ -\left(\gamma-\sigma a\right)f_h^J\left(y_h\left(\left(\rho+\sigma\right)\left(\rho+\lambda+\gamma\right)+\left(\rho+\gamma\right)f_h^J\right)+\lambda f_l^J y_l\right) \end{array} \right\}}{\Omega},$$

$$w_h^J = \frac{\left\{ \begin{array}{c} -\lambda f_l\left(y_l\left(\rho+\sigma+f_l^J\right)\left(\rho+\lambda+\gamma\right)+\left(\gamma-\sigma a\right)\left(f_h^J y_h - f_l^J y_l\right)\right) \\ +\left[\begin{array}{c} \left(\left(2\left(\rho+\sigma\right)+f_l^J\right)\left(\rho+\lambda+\gamma\right)+f_l^J\left(\sigma a-\gamma\right)\right)* \\ \left(y_h\left(\left(\rho+\sigma\right)\left(\rho+\lambda+\gamma\right)+\left(\rho+\gamma\right)f_h^J\right)+\lambda f_l^J y_l\right) \end{array} \right] \end{array} \right\}}{\Omega},$$

where $\Omega = \left\{ \begin{array}{c} \left[\begin{array}{c} \left(\left(2\left(\rho+\sigma\right)+f_l^J\right)\left(\rho+\lambda+\gamma\right)+f_l^J\left(\sigma a-\gamma\right)\right)* \\ \left(\left(2\left(\rho+\sigma\right)\left(\rho+\lambda+\gamma\right)+\left(\rho+\gamma\right)f_h^J\right)\right) \end{array} \right] \\ -\lambda f_l^J\left(\gamma-\sigma a\right)f_h^J \end{array} \right\}.$

The shares of natives among the unemployed becomes:

$$\phi_h = \frac{1}{1+\frac{1-n}{n}\frac{(\gamma+af_l(1-d_l))}{(\gamma+af_l)}\kappa},\ \phi_l = \frac{1}{1+\frac{1-n}{n}\kappa},$$

where

$$\kappa = \frac{\left(\left(\sigma+f_l\right)\lambda+\left(\sigma+f_h\right)\left(\gamma+af_l\right)\right)}{\left(\sigma+f_l\left(1-d_l\right)\right)\lambda+\left(\sigma+f_h\left(1-d_h\right)\right)\left(\gamma+af_l\left(1-d_l\right)\right)}.$$

The unemployment rates are defined by the same functions as before; they are only affected by the changes in the transition rates.

Figure 1: Effect on wages of an increase in the probability of regaining skills when unemployed, γ, when discrimination prevails in both sectors ($d_h = d_l = 0.25$).

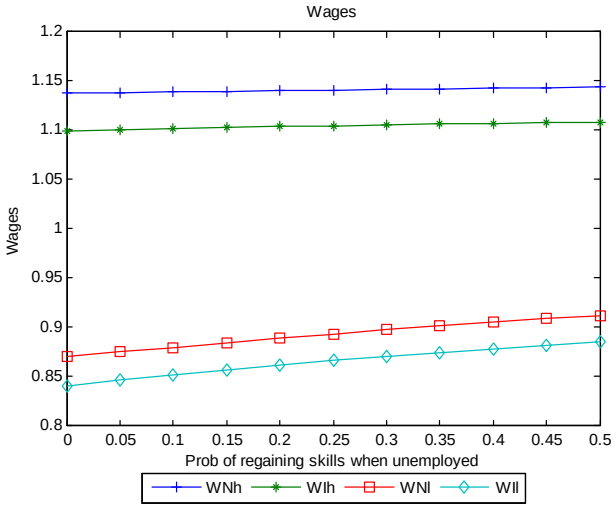


Figure 2: Effect on the unemployment rates of an increase in the probability of regaining skills when unemployed, γ, when discrimination prevails in both sectors ($d_h = d_l = 0.25$).

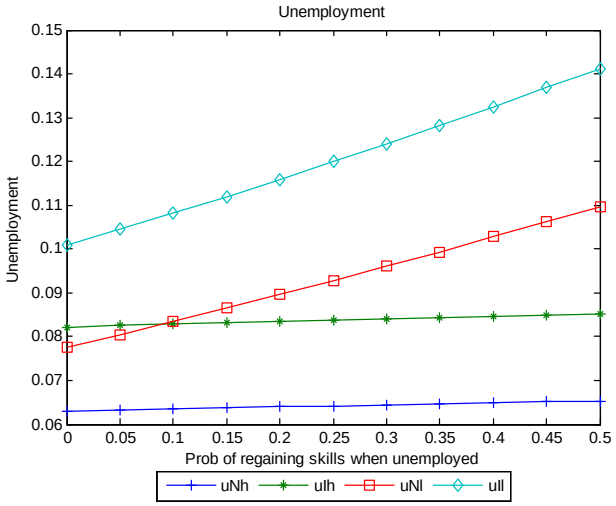


Figure 3: Effect on the probability of regaining skills by training (γ) of an increase in the level of discrimination in the high productivity sector. The level of discrimination in the low productivity sector is assumed to be constant at $d_l = 0.25$.

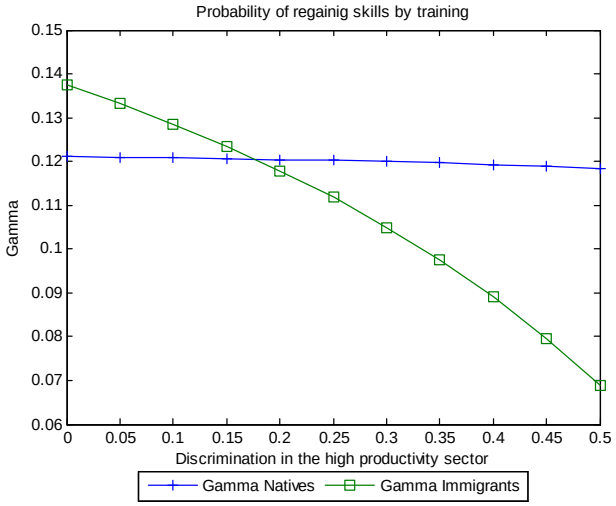
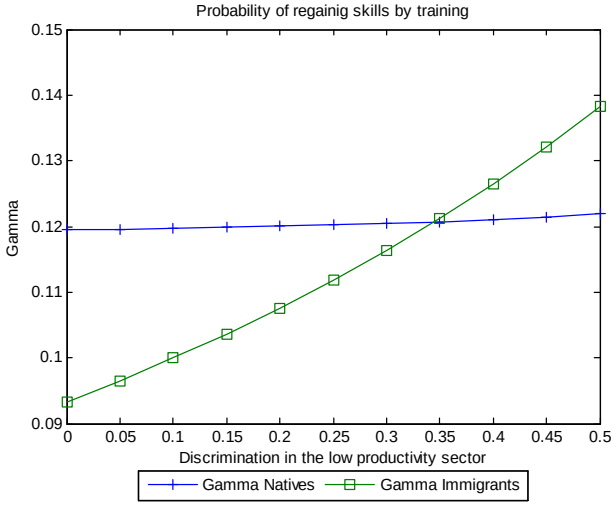


Figure 4: Effect on the probability of regaining skills by training (γ) of an increase in the level of discrimination in the low productivity sector. The level of discrimination in the high productivity sector is assumed to be constant at $d_h = 0.25$.



The Stockholm University
Linnaeus Center for
Integration Studies (SULCIS)

SULCIS is a multi-disciplinary research center focusing on migration and integration funded by a Linnaeus Grant from the Swedish Research Council (VR). SULCIS consists of affiliated researchers at the Department of Criminology, the Department of Economics, the Department of Human Geography, the Department of Sociology and the Swedish Institute for Social Research (SOFI). For more information, see our website: **www.su.se/sulcis**

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