A double-edged sword: credit market imperfections, stereotyping, and education subsidies

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Abstract

We examine a framework with statistical discrimination where potential workers differ along both race (black and white) and class (rich and poor) lines, and poor workers of either race must access an imperfect credit market if they wish to get educated. We show that the greater average income level of the whites translates into more stringent labour market standards, as well as lower utility faced by all black workers. These labour market outcomes have consequences in the loan market, and leads to higher interest rates, as well as higher default rates for black workers. Further, any stereotyping by prospective employers exacerbates the twin problems faced by poor blacks: poorer labour market prospects and also higher interest rates in the credit market. These results are consistent with empirical findings that poor minorities indeed face worse terms in the credit market. Turning to policy, while small educational subsidies targeted at the poor reduce interest rates for poor workers, and improve labour market outcome for all workers, a large enough subsidy may be counter-productive as it may lead to labour market stereo-typing in certain economies, when not only are the rich blacks worse off, but even the poor blacks may be adversely affected.

JEL No.: J71, J78, D78, D82.
Key Words: Credit market; discrimination; education subsidy; stereotyping.

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1 Introduction

The literature suggests that minorities in general face discrimination, including higher interest rates, in the loan market. Blanchard, Zhao and Yinger (2008) find evidence for credit market discrimination against black owners of small businesses, both in interest rates, as well as in loan denial rates (discrimination in loan denial rates against black small business owners was more intense for black business owners with low personal wealth). In the US, roughly four out of five black college students take loans to help them defray their educational costs, as opposed to a much smaller fraction of white students; they also end up with much more debt, finding it harder to get jobs or repay. Significantly, they also pay higher interest rates on their loans, and also face higher unemployment rates after college.[1,2] This paper argues that such loan market distortions are intimately connected to labour market outcomes, income inequality and informational imperfections in the credit market, so that studying the loan market in isolation could be counter-productive.

One policy tool aimed at ameliorating these loan market distortions is educational subsidy, something that has become common practice in many countries, in particular for the poorer members of minority communities. In the US, the United Negro College Fund directly gives scholarships to disadvantaged African-Americans; it also funds Historically Black Colleges and Universities (http://www.collegescholarships.org/ grants/african-american.htm). While Federal Pell grants are targeted at students who are financially very poor, rather than only to poor black students, it is often availed of by them.[3] In India, there is a policy of the government reimbursing banks the interest due on educational loans taken by poor students from scheduled castes and tribes.[4]

Given these stylized facts, we seek to develop a framework that can examine the

[1]https://www.americanprogress.org/issues/race/news/2013/05/16/63533/borrowers-of-color-need-more-options-to-reduce-their-student-loan-debt/

[2]The literature also talks about other measures of discrimination, including loan denial. Blanchflower, Levine and Zimmerman (2003), for example, find that blacks are twice as likely to be refused loans as whites and face relatively poor credit market conditions. Cavalluzzo, Cavalluzzo and Wolken (2002) also find substantial differences in loan denial rates between white and African-American small business owners, and also find that in the most competitive lending markets, African Americans paid roughly 1.06 percentage points more in interest rates than whites. Storey (2004) examines the credit market in Trinidad and Tobago and finds higher denial rates for African Americans, inferring possible discrimination.

[3]https://www.washingtonpost.com/news/wonk/wp/2015/05/19/minorities-and-poor-college-students-are-shouldering-the-most-student-debt/

[4]See http://indiatoday.intoday.in/education/story/education-loan-interest-for-sc-st-students-to-be-recompensed-by-the-central-government/1/401397.html. In New Zealand, scholarships at some leading universities such as the University of Auckland are targeted towards Maoris (Sowell 2004, Commission for Racial Equality, 2006) while in Israel, blacks receive state-sponsored university tuition. In China, ethnic minority students enrolled in ethnic minority-oriented specialties receive a monthly stipend.

interconnections between distortions in the labour and the credit market, further using it to examine the role of education subsidies. We use a framework with statistical discrimination,[5] where potential workers are divided along racial ("white" and "black"), as well as class lines ("rich" and "poor"), with the minority group (blacks) being on average poorer than the majority group (whites). The employers observe the identity of the workers, as well as an imperfect signal of their skills, but not their class, and may or may not have negative stereotypes about minority group workers. Poor workers of both racial groups face educational costs that are effectively higher than those facing others, as they lack funds of their own and need to borrow in an imperfect credit market in order to acquire education. Lenders observe group identity, i.e. both identity and class, and have no taste for discrimination; however, they are aware of the borrowers' future job prospects, and are also aware of whether employers hold stereotypes about them. Given limited liability, poor workers can only repay if they get a job. Since lenders cannot observe the job allocation without spending additional resources, their opportunity cost of lending increases, which translates into relatively higher interest rates for the poor.

We show that the interlinkage between the market for educational loans and the labour market creates interesting effects. One central result is that white workers face less stringent tests in the labour market while being assigned to more paying jobs. This happens since class is not observable by firms, so that from the point of view of firms, rich and poor workers are pooled together. Further, the fact that poor borrowers face higher expected interest costs and consequently acquire less skill, means that firms think that on average white workers are more likely to be skilled, as the whites are richer on the average. We demonstrate that this in turn implies that white workers have higher utility relative to the black workers. Moreover, white workers acquire more skill vis-á-vis the black workers on the average. Interestingly, there can be equilibria where both rich and poor black workers acquire more skill relative to their white counter-parts, despite white workers acquiring more skill on the average.

Note that the fact that black workers face more stringent labour market tests imply that that poor black borrowers are more likely to default since they are less likely to be assigned to paying jobs and thus earn enough to pay back their loans. The loan market of course factors this in while making loan offers, and consequently poor black workers face less favourable terms in the credit market. Next we demonstrate that if black workers face stereotyping in the labour market, then such stereotyping further increases the interest rates that poor minorities pay on their educational loans, so that the gap in interest rates, as well as default rates between black and white workers widen further. Note that these results are consistent with the loan market distortions that Blanchard, Zhao and Yinger (2008) point out, as well as the

[5] Interestingly, Blanchard, Zhao and Yinger (2008) discuss suggestive evidence that the discrimination observed by them is statistical rather than prejudice-driven.

evidence discussed earlier that suggests that black student borrowers are less able to repay their loans, and are more likely to be unemployed after college. Further, note that in this framework loan market distortions are closely intertwined with those in the labour market, thus buttressing our basic point that these two markets need to be examined together.

We then examine the role of education subsidies targeted at the poor in dealing with these issues. Interestingly enough, the outcome depends on the magnitude of such subsidies. We find that as long as such subsidies are not too large (so that there is no regime switch from one equilibrium to another), a targeted subsidy not only improves outcomes in the loan market, reducing interest rates for poor borrowers, in consonance with our basic point, it has beneficial implications for *all* workers in the labour market, whether rich or poor, black or white, who face less stringent cutoffs. The impact of large subsidies is however more nuanced as these create the possibility of regime switch, with consequent implications for labour market stereotyping. In fact such subsidies may even generate stereo-typing in the labour market if such stereotyping is not "poverty driven" (in a sense formalized later), while eliminating it in other economies. The welfare implications are complex in case a large subsidy leads to stereotyping, depending on both identity and class; while all white workers gain, rich black workers are, in fact, worse off. The effect on poor black workers is ambiguous. These results some implications for the political economy of education subsidy, suggesting that while small education subsidies are likely to garner support across the board, large subsidies may face some opposition from the black community itself, in particular the rich blacks.

We also examine some extensions of the baseline framework including allowing for a vanishing middle class, and considering a scenario where firms can observe both identity and class. We find that if members of the middle class exhibit upward mobility, then this generates beneficial effects in both the labour, as well as loan markets for all workers, not just the middle class. Whereas is they demonstrate downward mobility then these effects are reversed. Finally, we argue that even if firms can observe both identity and class, many of our central results go through qualitatively, though not all of them do.

Apart from the empirical literature mentioned earlier, our paper is connected to the theoretical literature on discrimination. This includes Arrow (1972) and Phelps' (1973) work on statistical discrimination, as well as earlier models of taste-driven discrimination (Becker 1969, Welch 1976). Fang and Moro (2010) provides an excellent survey which incorporates more recent theories of discrimination, including not just those driven by coordination failures (as in Coate and Loury, 1993), but also by other factors such as informational externalities (e.g. Moro and Norman, 2004). In particular our work extends the well known Coate and Loury (1993) framework by introducing income heterogeneity, as well as an imperfect credit market. In contrast to the present paper however, Coate and Loury (1993) focus on affirmative action, showing how policies intended to reduce discrimination can have unintended side effects by generating self-fulfilling negative stereotypes.

Another related paper is Guha and Roy Chowdhury (2017) who compare identity-based and class-based affirmative action in a society polarized along both race and class lines. In the current paper, we look at a similarly polarized society but introduce an imperfect educational loan market and focus on targeted educational subsidies, while abstracting from affirmative action. Moro and Norman (2003) also focuses on affirmative action, showing that discriminatory equilibria may arise in a model of endogenous human capital formation and endogenous wages, and that while affirmative action may enhance the target group's incentives to acquire skills, it does not necessarily improve their welfare or remove differences between the target and non-target groups. Finally Hendel, Shapiro and Willen (2005) show that financial aid in education may sometimes worsen income inequality. In their model, an individual without a college degree may, in the absence of financial aid, be either poor but capable, or not capable enough to enter college. However, with widespread financial aid, not having a college degree is a clearer signal of low ability and is interpreted by employers as such, thus ultimately leading to greater income inequality between high and low ability individuals.

The rest of the paper is organised as follows. In Section 2 we lay out the framework of our model. Section 3 characterizes the equilibria, while in Section 4 we examine the impact of education subsidies. Next Section 5 discusses extensions. Finally, we conclude in Section 6.

2 Framework

The economy is divided along both identity and class lines, i.e. individuals can be either black (B) or white (W), which constitutes their identity, or rich (R) or poor (P), which defines their class. Thus this economy comprises four kinds of workers, λ_{WR} rich white, λ_{WP} poor white, λ_{BR} rich black and λ_{BP} poor black workers, and a large number of firms. The number of workers is normalised to 1, so that $\sum_{i,j} \lambda_{ij} = 1$. Let $\mu_{iR} = \frac{\lambda_{iR}}{\lambda_{iR}+\lambda_{iP}}$ denote the fraction of rich and $\mu_{iP} = \frac{\lambda_{iP}}{\lambda_{iR}+\lambda_{iP}}$ denote the fraction of poor workers in the i-th group, $i \in \{B, W\}$. We assume that the whites are richer on the average in that $\mu_{WR} > \mu_{BR}$. All agents are risk neutral.

The workers are randomly matched to firms, with all workers finding a match. Following the matching process, the firms assign workers to either of two tasks, 1 or 2, where task 1 requires skill, whereas task 2 does not. In task 1, the payoff of the principal is x_q (> 0) if the worker is skilled, and $-x_u$ (< 0) otherwise. Further, task 1 carries a positive wage of w, where $w < x_q$. In task 2 on the other hand, both the wages and returns are normalised to zero. While firms can observe group identity, i.e. whether a worker is black or white, they cannot observe their income levels, i.e.

whether a worker is rich or poor.[6]

For all groups, acquiring the requisite skill is costly. This cost c is idiosyncratic and distributed over $[0, \infty)$ according to the distribution function $G(c)$ (and density function $g(c)$), where $G(c)$ is continuously differentiable and identical for all four groups. Poor workers, unlike the rich workers, do not have the assets or income to fund education on their own and must borrow in order to do so. The credit market is imperfect in that while lenders can observe group identity, i.e. both identity and class, as well as the exact realization of c, they cannot observe if any borrower, including a poor one, has been assigned to task 1 or not (note that given limited liability assignment to task 2 rules out the possibility of loan repayment since task 2 pays zero and the poor have no assets of their own). However, a lender can obtain this information by spending some additional amount. Let the total costs of lending an amount c and verifying the information regarding task allocation be cm, where $m > 1$ is a measure of the imperfection in the credit market. In equilibrium, this cost is passed on to borrowers.

For every worker assigned to firms, the firms can observe whether the worker is black or white, but they cannot observe the worker's income level, her type i.e. c, or if she has acquired the necessary skill. The firms however do observe a signal regarding their skill level. The signal s, where $s \in [0, 1]$, has distribution $F_q(s)$ if the agent is *q*ualified (i.e. acquired the requisite skill), and $F_u(s)$ if the worker is *u*nqualified. Both $F_q(s)$ and $F_u(s)$ are twice continuously differentiable so that the associated density functions, $f_q(s)$ and $f_u(s)$ respectively, are well defined and continuous for all s. Finally, let

$$\phi(s) = \frac{f_u(s)}{f_q(s)},$$

be well defined for all s, and positive for all $0 < s < 1$. The signal is informative in that a higher s signals that the agent is more likely to be qualified. This is formalised as

Assumption 1. $\phi(s)$ *satisfies the monotone likelihood ratio property (henceforth MLRP), i.e.* $\phi(s)$ *is decreasing in* s. *Further, it satisfies the Inada conditions* $\lim_{s \to 0} \phi(s) = \infty$ *and* $\lim_{s \to 1} \phi(s) = 0$, *and there exists* $\tilde{s}$, *where* $0 < \tilde{s} < 1$, *such that* $\phi(s) \geq 1$ *iff* $s \leq \tilde{s}$.

We then specify the utility function of the firms, as well as the workers. The payoff to a firm arising out of a worker assigned to task 1 equals

$$\begin{cases} x_q - w, \text{ if the worker is skilled,} \\ -x_u - w, \text{ otherwise,} \end{cases}$$

[6] For completeness, we shall later briefly analyze the case where firms can observe both identity and class.

and equals zero if the worker is assigned to task 2.

Next consider the utility of a worker. The utility of a rich worker, either black or white, with educational cost c is

$$\begin{cases} w - c, \text{ if she is skilled and assigned to task 1,} \\ -c, \text{ if she is skilled and assigned to task 2,} \\ w, \text{ if she is unskilled and assigned to task 1,} \\ 0, \text{ otherwise.} \end{cases}$$

Consider a poor worker of type c and identity i. The credit market offers a loan schedule whereby a loan of c attracts a gross interest of $I_i(c)$. Given that the borrower has no income, she repays if and only if she is assigned to task 1. Thus, her utility is

$$\begin{cases} w - I_i(c), \text{ if she takes loans, gets skilled, and is assigned to task 1,} \\ w, \text{ if she is unskilled and assigned to task 1,} \\ 0, \text{ otherwise.} \end{cases}$$

The timeline is as follows. Nature moves first, choosing the level of c for every worker. The workers themselves get to observe their own level of c, but the firms do not. Then the workers decide whether to acquire the skill required for task 1, or not. In case a poor worker decides to acquire skill, she approaches the credit market for a loan, when the credit market can observe her realization of c. In the next stage the workers are matched to firms, when a firm gets to observe a signal regarding the skill level of a worker assigned to it. Finally, the firms decide on task allocation.

The firms' decisions: Consider a firm facing a worker with *identity* i, $i \in \{W, B\}$. Firms believe that any worker with identity i and income level j, $j \in \{P, R\}$ is skilled with probability π_{ij}. Given that the firms cannot observe a worker's class, a firm's *ex ante* belief (i.e. before observing any signal) that a worker with identity i is skilled is

$$\pi_i \equiv \sum_{j \in \{R,P\}} \mu_{ij} \pi_{ij}. \tag{1}$$

Thus a firm's belief that a particular worker with identity i, $i \in \{B, W\}$, *and emitting signal* s, is skilled is given by

$$A(\pi_i, s) \equiv \frac{\pi_i f_q(s)}{\pi_i f_q(s) + (1 - \pi_i) f_u(s)}. \tag{2}$$

Hence the firm assigns this worker to task 1 if and only if its expected profits from doing so exceed the profit from assigning her to task 2 (which is normalised to zero), i.e. $A(\pi_i, s)(x_q - w) - (1 - A(\pi_i, s))(x_u + w) \geq 0$, i.e.

$$r \equiv \frac{x_q - w}{x_u + w} \geq \frac{1 - \pi_i}{\pi_i} \phi(s). \tag{3}$$

Given assumption 1, the firms' decision is characterised by a cutoff $s_i \equiv s(\pi_i)$ such that all workers with a signal greater than s_i are assigned to task 1, where s_i solves:

$$r \equiv \frac{x_q - w}{x_u + w} = \frac{1 - \pi_i}{\pi_i} \phi(s_i). \tag{4}$$

From MLRP it follows that $s(\pi_i)$ is decreasing in π_i. Consequently the graph of $s(\pi)$, denoted by EE, is negatively sloped in $s - \pi$ space (see Figure 1).

The workers' decision: Next consider the decision problem facing a worker of type i, who believes that firms will assign her to task 1 if and only if she emits a signal of s_i, or higher. Denote $\beta(s) \equiv w(F_u(s) - F_q(s))$. It is straightforward to check that $\beta(0) = \beta(1) = 0$, so that $G(\beta(0)) = G(\beta(1)) = 0$. Further, given MLRP, $G(\beta(s)) \geq 0$ and single peaked, and increasing if and only if $\phi(s) > 1$, i.e. $s < \tilde{s}$ (see assumption 1).

First consider rich workers. Such a worker with cost c and identity i acquires the skill if and only if her expected income from getting skilled, i.e. $w(1 - F_q(s_i)) - c$, exceeds that from not getting skilled, i.e. $w(1 - F_u(s_i))$. Hence we have that

$$c \leq \beta(s) \equiv w(F_u(s) - F_q(s)). \tag{5}$$

Recalling that c has a distribution $G(c)$, the proportion of rich workers with identity i getting educated

$$\pi_{iR} = G(\beta(s_i)), \; i = 1, W. \tag{6}$$

Given the properties of $\beta(s)$, note that the graph of $\pi_{iR}(s_i)$ in the $s - \pi$ space, call it WW_{iR}, $i = B, W$, is inversely U-shaped, WW_{WR} coincides with WW_{BR}, and hence denoted by WW_R, with both attaining a maximum at $\tilde{s}$ (see Figure 1).

We next turn to the decision problem facing a poor worker with identity i. Recall that they have access to a competitive but imperfect credit market that offers a loan schedule whereby a loan of c attracts a gross interest of $I_i(c)$. Given that firms assign all poor workers with a signal greater than s_i and identity i to task 1, a poor worker who takes a loan of c and gets skilled, can repay if and only if she is assigned to task 1, which happens with probability $1 - F_q(s_i)$. Thus, the lender's expected returns are $I_i(c)(1 - F_q(s_i))$. The zero profit condition in the competitive loan market states that the expected cost of making a loan of c, i.e. cm, must equal the expected return $I_i(c)(1 - F_q(s_i))$. This ensures that

$$I_i(c)(1 - F_q(s_i)) = cm. \tag{7}$$

Consequently a poor worker with cost c borrows the requisite amount and acquires the skill if and only if $w(1-F_q(s_i)) - I_i(c)(1-F_q(s_i)) \geq w(1-F_u(s_i))$, i.e. $\beta(s_i) \geq I_i(c)(1-F_q(s_i)) = cm$. Thus, denoting $\hat{\beta}(s) \equiv \frac{\beta(s)}{m}$, the proportion of poor workers with identity i acquiring education is

$$\pi_{iP} = G(\hat{\beta}(s_i)). \tag{8}$$

The graph of $\pi_{iP}(s_i)$ in the $s-\pi$ space, call it WW_P (since WW_{BP} coincides with WW_{WP}), is also inversely U-shaped and has a maximum at $\tilde{s}$ (see Figure 1). Further, given that $m > 1$, WW_{iP} lies below WW_{iR}, $i = B, W$.

3 The Analysis

We are now in a position to define the notion of an equilibrium.

Definition 1. *A configuration* $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) > \equiv (\bar{s}_B, \bar{\pi}_{BP}, \bar{\pi}_{BR}, \bar{I}_B(c); \bar{s}_W, \bar{\pi}_{WP}, \bar{\pi}_{WR}, \bar{I}_W(c))$ *constitutes an* equilibrium *if and only if (a) the loan market clears, and, for all groups* BP, BR, WP, WR*, (b) given a cutoff* $\bar{s}_i$*,* $i = B, W$*, the proportion of workers with identity* i *and income* j *acquiring the skill is* $\bar{\pi}_{ij}$*, and (c) given the level of skill acquisition* $\bar{\pi}_{ij}$*, a cut-off of* $\bar{s}_i$ *maximises firm profits. That is* $\forall i = B, W$*,*

$$\begin{aligned}
\pi_{iR} &= G(\beta(s_i)), && (9)\\
\pi_{iP} &= G(\hat{\beta}(s_i)), && (10)\\
s_i &= s(\sum_{j\in\{P,R\}} \mu_{ij}\pi_{ij}), && (11)\\
cm &= I_i(c)(1-F_q(s_i)). && (12)
\end{aligned}$$

We next recast these equilibrium conditions in a manner that is more amenable to further analysis.

Definition 2. *Let* $< s'_i, \pi'_i, I'_i(c) > \equiv (s'_B, \pi'_B, I'_B(c); s'_W, \pi'_W, I'_W(c))$ *solve*

$$\begin{aligned}
\pi_i &= \mu_{iR}G(\beta(s_i)) + \mu_{iP}G(\hat{\beta}(s_i)),\ i = B, W, && (13)\\
s_i &= s(\pi_i),\ i = B, W, && (14)
\end{aligned}$$

and (12).

The next proposition simplifies the analysis significantly by establishing a close link between an equilibrium $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ and this vector $< s'_i, \pi'_i, I'_i(c) >$ satisfying (12), (13), and (14). This allows us the approach the analysis in two steps, first solving for $< s'_i, \pi'_i, I'_i(c) >$, and then using it to construct a corresponding equilibrium $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$.

Proposition 1. *Let assumption 1 hold.*

(a) If $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ *constitutes an equilibrium then* $< s_i', \pi_i', I_i'(c) >$*, where (a)* $s_i' = \bar{s}_i$*, (b)* $\pi_i' = \sum_j \mu_{ij}\pi_{ij}'$*, where* $\pi_{iR}' = G(\beta(s_i'))$ *and* $\pi_{iP}' = G(\hat{\beta}(s_i'))$*, and (c)* $I_i'(c) = \bar{I}_i(c)$*, solves (13) and (14).*

(b) If $< s_i', \pi_i', I_i'(c) >$ *solves (12), (13) and (14), then* $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$*, where (a)* $\bar{s}_i = s_i'$*, (b)* $\bar{\pi}_{iR} = G(\beta(s_i'))$ *and* $\bar{\pi}_{iP} = G(\hat{\beta}(s(\pi_i'))$*, and (c)* $\bar{I}_i(c) = I_i'(c)$*, constitutes an equilibrium.*

Proof. (a) Let $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ constitute an equilibrium. First note that by construction $\pi_i' = \sum_j \mu_{ij}\pi_{ij}' = \mu_{iR}G(\beta(s_i')) + \mu_{iP}G(\hat{\beta}(s_i'))$. Thus π_i' satisfies (13). Further, by construction $s_i' = \bar{s}_i$, so that $\pi_{iR}' = G(\beta(s_i')) = \bar{\pi}_{iR}$ and $\pi_{iP}' = G(\hat{\beta}(s_i')) = \bar{\pi}_{iP}$. Thus

$$s_i' = \bar{s}_i = s(\sum_{j\in\{P,R\}} \mu_{ij}\bar{\pi}_{ij}) = s(\sum_{j\in\{P,R\}} \mu_{ij}\pi_{ij}') = s(\pi_i'),$$

so that (14) is satisfied.

(b) Next suppose $< s_i', \pi_i', I_i'(c) >$ solves (12), (13) and (14). First observe that by construction

$$\begin{aligned}\bar{\pi}_{iR} &= G(\beta(s_i')) = G(\beta(\bar{s}_i)),\\ \bar{\pi}_{iP} &= G(\hat{\beta}(s_i')) = G(\hat{\beta}(\bar{s}_i)),\end{aligned}$$

so that (9) and (10) are satisfied. Next we observe that

$$\bar{s}_i = s_i' = s(\pi_i') = s(\mu_{iR}G(\beta(s_i')) + \mu_{iP}G(\hat{\beta}(s_i'))) = s(\mu_{iR}\bar{\pi}_{iR} + \mu_{iP}\bar{\pi}_{iP}),$$

so that (11) is satisfied. Finally, (12) is satisfied by construction. □

Given Proposition 1, we can equivalently work with any $< s_i', \pi_i', I_i'(c) >$ that solves (12), (13) and (14), generating the corresponding equilibrium $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ from it. Further, while solving for $< s_i', \pi_i', I_i'(c) >$, one can decompose the analysis further, first solving for (s_i', π_i'), $i = B, R$ from (13) and (14), and then use (12) to solve for $I_i'(c)$. For brevity, we shall refer to a configuration $< s_i', \pi_i', I_i'(c) >$ that solves (12), (13) and (14) as an equilibrium as well.

Let WW_i, $i \in \{B, W\}$, denote the graph of (13). Note that we can mimic our earlier analysis to show that WW_i is inversely U-shaped, attaining a maximum at $\tilde{s}$. The following lemma shows that WW_W lies uniformly above WW_B for all $0 < s < 1$ and is important in what follows.

Lemma 1. $\pi_W(s) > \pi_B(s)$ *for all* $0 < s < 1$.

Proof. From (13) we have that

$$\begin{aligned}\pi_W(s) &= \mu_{WR} G(\beta(s)) + \mu_{WP} G(\hat{\beta}(s)) \\ &> \mu_{BR} G(\beta(s)) + \mu_{BP} G(\hat{\beta}(s)),\end{aligned}$$

where the inequality follows since (i) the whites are richer on the average, i.e. $\mu_{WR} > \mu_{BR}$, and (ii) $G(\beta(s)) > G(\hat{\beta}(s))$ for all $0 < s < 1$ given that $m > 1$. □

We shall focus on equilibria $< s_i', \pi_i', I_i'(c) >$ that are *locally stable* in that the absolute value of the slope of EE exceeds that of WW_i. For brevity we shall henceforth refer to any locally stable equilibrium simply as equilibrium.

We shall be interested in two classes of equilibria, those with and without stereo-typing. As in Coate and Loury (1993), in equilibria with stereo-typing the black workers are held to a standard that is 'too' high.

Definition 3. *An equilibrium $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ is said to involve* stereo-typing *if (a) there exists some other equilibrium which has a lower cut-off s_B for the black workers, whereas (ii) there exists no other equilibrium where white workers have a lower cutoff s_W.*

We next consider equilibria without stereo-typing where no racial group is held to standards that are very high.

Definition 4. *An equilibrium $< \bar{s}_i, \bar{\pi}_{ij}, \bar{I}_i(c) >$ involves* no stereo-typing *if there exists no other equilibrium that has a strictly lower cutoff s_i for any of the groups, $i \in \{B, W\}$.*

Note that by definition there is exactly one non-stereo-typing equilibrium.

It is clear that there can be multiple stereo-typing equilibria. In Figure 1 we consider a case where there are at most two stable equilibria for any group with identity i. In Figure 1, $(\bar{s}_W = s_W', \bar{s}_B = s_B')$ constitutes the non-stereotyping equilibrium, and $(\bar{s}_W = s_W', \bar{s}_B = s_B'')$ constitutes a stereotyping equilibrium.

The following assumption will be used in Proposition 2(e) below. This essentially ensures that the EE curve passes below the WW_P curve, and hence below the WW_B and WW_R curve at $s = \tilde{s}$ for all m.

Assumption 2. $\frac{\phi(\tilde{s})}{\phi(\tilde{s})+r} < G(\hat{\beta}(\tilde{s}))$.

We first compare the outcomes for the black and the white workers under any equilibrium, stereo-typing, or non-stereo-typing. We argue that the fact that white workers are richer on the average, i.e. $\mu_{WR} > \mu_{BR}$, ensures that the white workers face less stringent tests (i.e. lower signal cutoffs) while being assigned to task 1. We then demonstrate that this also ensures that any white worker of type c has higher

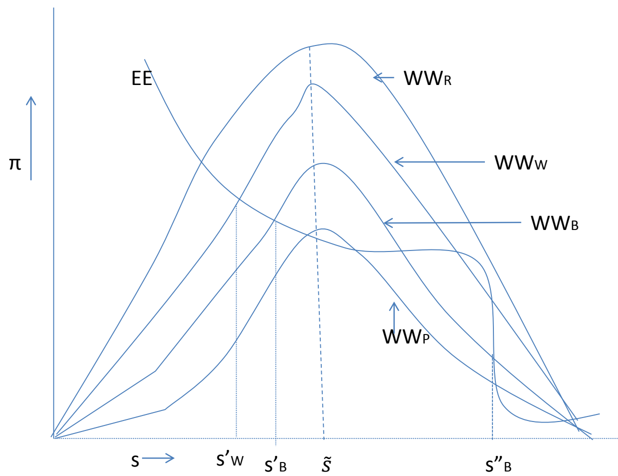

Figure 1: Non stereotyping and stereotyping equilibria

utility vis-á-vis any black worker of type c belonging to the same class. Further, poor black workers face higher interest rates compared to their white counterparts. Moreover, on the average, white workers acquire more skill vis-á-vis the black workers. Interestingly, under assumption 2, both rich and poor black workers acquire more skill relative to their white counter-parts in a non-stereo-typing equilibrum, despite white workers acquiring more skill on the average. Finally, the fact that poor black workers face stricter cutoffs of course imply that poor black workers are more likely to default since they are less likely to be assigned to task 1.

As discussed earlier in the introduction also, these results find some resonance in reality, in particular Blanchard, Zhao and Yinger (2008) who find that black owners of small businesses face higher interest rates, as well as evidence suggests that black student borrowers are less able to repay their loans, and are more likely to be unemployed after college.

Proposition 2. *Let Assumption 1 hold.*

(a) Any worker of class j, $\mathsf{j} \in \{\mathsf{P}, \mathsf{R}\}$, type c and facing a certain cutoff signal, has a higher expected income compared to any other worker (including herself) of the same class and type, who faces a higher signal cutoff.

(b) In any equilibrium white workers face less stringent cutoffs for being assigned to task 1, and any white worker of type c has a higher welfare compared to a type c black worker of the same class.

(c) *In any equilibrium poor white workers face lower interest rates vis-á-vis poor black workers.*

(d) *In any equilibrium, white workers acquire more skill vis-á-vis the black workers on the average, i.e.* $\bar{\pi}_W > \bar{\pi}_B$.

(e) *Let assumption 2 hold as well. In the non-stereo-typing equilibrium, both rich and poor black workers acquire more skill relative to their white counterparts, i.e.* $\bar{\pi}_{Wj} < \bar{\pi}_{Bj},\ j = P, R$.

Proof. (a) Consider any two equilibria, $< s_i', \pi_i', I_i'(c) >$ denoted E1, and $< s_i'', \pi_i'', I_i''(c) >$ denoted E2. For ease of notation, without loss of generality we consider a poor black worker of type c across these two equilibria, and let $s_B' < s_B''$. We shall argue that the poor black worker prefers E1 over E2. Further, it is straightforward to see that the argument holds if we compare this poor black worker under E1, with a poor white worker of type c under E2.

We begin by observing that from (7), under both equilibria any poor borrower with education cost c faces the same *expected* interest cost of cm. Thus any difference in utility will not arise from interest rate differential across equilibria, but from labour market prospects alone. We divide all black workers, both poor and rich, into two classes.

(A) First consider a black worker who takes the same decision regarding skill acquisition under both equilibria, i.e. they either acquire the skill under both E1 and E2, or refuse to do so under both equilibria. Given that their level of skill is the same under both equilibria, they prefer E1 over E2 since, given that $s_B' < s_B''$, they have a greater chance of being assigned to task 1 under E1.

(B) Next consider black workers whose skill acquisition decision change across the two equilibria. Let $u_{Bk}(c, x, s, Ej)$ denote the utility of a black worker, $k = P, R$, with cost c under equilibrium Ej facing a cutoff signal of s, and taking a skill acquisition decision $x \in \{Y, N\}$, with Y (resp. N) denoting that she decides to acquire (resp. not acquire) the skill.

(i) First, consider a black worker, whether poor or rich, who acquire the skill under E2, but not under E1. Then for such a worker

$$\begin{aligned} u_{Bk}(c, N, s_B', E1) &\geq u_{Bk}(c, Y, s_B', E1) && (15)\\ &> u_{Bk}(c, Y, s_B'', E2), && (16)\end{aligned}$$

where the first inequality follows from a revealed preference argument and the second inequality from the fact that $s_B' < s_B''$ and that expected costs of education are the same across equilibria for this worker. Thus this individual is strictly better off under E1.

(ii) Next, consider black workers who acquire the skill under E1, but not under

E2. Then for such a worker

$$\begin{aligned} u_{Bk}(c, Y, s'_B, E1) &\geq u_{Bk}(c, N, s'_B, E1) \quad (17) \\ &> u_{Bk}(c, N, s''_B, E2). \quad (18) \end{aligned}$$

Thus all black workers are strictly better off under E1 relative to E2.

Finally, it straightforward to see that this argument extends for comparisons across rich workers as well. This follows because a worker of type c, the expected cost of getting skilled is c for all rich workers and cm for all poor workers across all equilibria.

(b) Given that EE is negatively sloped, and that WW_B lies below WW_W (Lemma 1), we have that in any (stable) equilibrium $\bar{s}_W < \bar{s}_B$ (see Figure 1). Consequently, from Proposition 2(a) it follows that the utility level of a white worker of type c exceeds a black worker of type c and the same income class.

(c) Follows from the first part of Proposition 2(b), and equation (7).

(d) Mimicking the argument in part (b) of this proposition, we have that in any (stable) equilibrium, $\bar{\pi}_W > \bar{\pi}_B$ (see Figure 1).

(e) Recall that Assumption 2 ensures that the EE curve lies below the WW_P curve at $s = \tilde{s}$, which in turn guarantees that the non-stereotyping equilibrium occurs on the increasing portion of both WW_P and WW_R. Therefore, given that $\bar{s}_W < \bar{s}_B$, and that WW_R and WW_P are both increasing for a non-stereo-typing equilibrium, it follows that $\bar{\pi}_{Bj} > \bar{\pi}_{Wj}$, $j = P, R$ (see Figure 1). □

Proposition 3 below compares across the two classes of equilibria, demonstrating that poor black workers not only face a higher interest rate, but also face more stringent tests under any stereo-typing equilibrium relative to that under the non-stereo-typing equilibrium. Consequently the utility of all poor black workers is lower under a stereo-typing equilibrium. Again these results are consistent with the results discussed in the introduction including Blanchard, Zhao and Yinger (2008).

Proposition 3. *Let assumption 1 hold.*

(a) The equilibrium interest rate $\bar{I}_B(c)$ is higher under any stereotyping equilibrium compared to that under the non-stereotyping equilibrium for black workers.

(b) All black workers prefer the non-stereo-typing equilibrium over any stereo-typing equilibrium.

Proof. Consider a non-stereo-typing equilibrium $< s'_i, \pi'_i, I'_i(c) >$, and a stereo-typing equilibrium $< s''_i, \pi''_i, I''_i(c) >$.

(a) Consider a black worker. Note that by definition, the cutoff signal for this worker under any stereo-typing equilibrium is greater than that under the non-stereotyping equilibrium, i.e. $s'_B < s''_B$. The result then follows from (7).

(b) Follows from part (a) of Proposition 2 and the fact that $s'_B < s''_B$ and $s'_W = s''_W$. □

Next, we look at some interesting comparative static exercises, in particular the effects of an increase in credit market imperfections, as well as the effect of black workers graduating from the poor to the rich class. We find that an increase in credit market inefficiency hurts *all* workers, and not just the poor workers. The reason is that firms cannot distinguish between rich and poor borrowers, so the consequent pooling worsens outcomes for all workers. Further, a reduction in income inequality among black workers improves outcomes for *all* black workers, again for a similar reason.

Proposition 4. *Let assumption 1 hold.*

(a) An increase in credit market inefficiency, m, results in a higher cutoff for all workers, as well as a higher interest rate for all poor workers.

(b) An increase in credit market inefficiency, m, makes all workers worse off.

(c) When more black workers become affluent, i.e. μ_{BR} increases, the cutoff signal for black workers becomes less stringent, so that all black workers are better off. Further, the interest rates paid by poor blacks also decrease, though the expected interest payment remains unaltered. The gap in the average skill levels acquired by white and black workers, i.e. $\pi_W - \pi_B$ also decreases.

Proof. (a) An increase in m shifts down WW_P, and thus WW_i, where $i = B, W$, with no impact on EE; this increases the firms' cutoff signal s_i in any equilibrium. Given (7), this necessarily increases $\bar{I}_i(c)$, the equilibrium interest rate.

(b) From part (a) of this proposition, recall that an increase in m increases the cutoff signal level for all workers. Further, an increase in m increases the expected interest payment cm for a poor worker of type c. The result now follows from Proposition 2(a) with both the effects, i.e. an increase in the cutoff signal and an increase in expected interest payment, having a negative effect on utility.

(c) From Lemma 1, it is easy to see that an increase in μ_{BR} causes an upward shift of the WW_B curve, while the WW_W curve remains unchanged. Thus the intersection point of the EE and WW_B curve also shifts leftward, leading to a reduction in the cutoff signal faced by all blacks. From (7), this also reduces the interest rates poor blacks pay on their loans. However, for a poor black worker of type c, expected interest payments remain unchanged at cm, as the lower interest rate is exactly offset by the higher probability of repayment (which in turn stems from the lower cutoff). Finally given that WW_B shifts up, and the WW_W curve remains unchanged, the gap in the average skill levels acquired by white and black workers for a given cutoff decreases. □

3.1 Credit market imperfections and stereotyping

We then examine if credit market imperfections can themselves generate stereo-typing. The following definition which leads to a typology regarding the nature of stereo-typing is useful for this exercise.

Definition 5. *We say that stereo-typing is* credit market driven *if and only if* EE *intersects* $\mathsf{WW_R}$ *from above exactly once.*

It seems natural to interpret m as a measure of credit market imperfections. The terminology then follows from the fact that when m is small and close to 1 (so that credit market inefficiencies are not too severe), $\mathsf{WW_P}$ will be very close to $\mathsf{WW_R}$. In this case, both $\mathsf{WW_W}$ and $\mathsf{WW_B}$ will also be very close to $\mathsf{WW_R}$, so that no stereo-typing equilibrium exists whenever stereo-typing is credit market driven (see Figure 2). Alternatively, it may be equally natural to assume that recovery of loans gets more difficult with increasing poverty, so that one can interpret m to be an indicator of poverty, and then the case where EE intersects $\mathsf{WW_R}$ from above exactly once, can also be thought of as representing poverty driven stereo-typing.

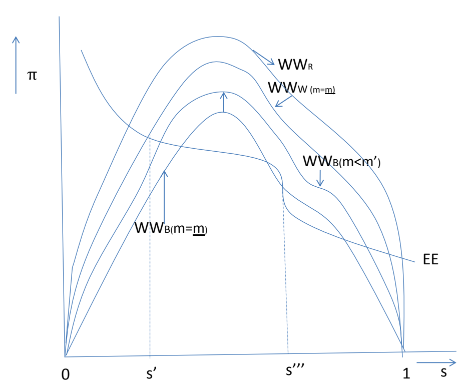

Figure 2: Credit market inefficiencies generating stereotyping

The following assumption is required in Proposition 5 below.

Assumption 3. *There exists* $\underline{\mathsf{m}} > 1$ *such that for* $\mathsf{m} = \underline{\mathsf{m}}$, EE *intersects* $\mathsf{WW_B}$ *from above more than once.*

Suppose stereo-typing is credit market driven. Then given assumption 3 there exists $\mathsf{m}' > 1$, such that no stereo-typing equilibrium exists whenever $1 \leq \mathsf{m} \leq \mathsf{m}'$, whereas such stereotyping exists for m close to $\underline{\mathsf{m}}$. This follows from continuity since (a) for $m = 1$, WW_P coincides with WW_R - so that both WW_W and WW_B also coincide with WW_R - and no stereo-typing equilibrium exists given that stereo-typing is credit market driven, and (b) at $\underline{m}$, a stereo-typing equilibrium necessarily exists given assumption 3. This scenario is illustrated in Figure 2. In this Figure, when $m = \underline{m}$, a stereotyping equilibrium exists with blacks facing a cutoff of s''', while whites face a cutoff of s'. For any $m < m'$ however, WW_P shifts up - and hence so does WW_B - so that the only stable equilibrium is a non-stereotyping one. Summarising we have the next proposition.

Proposition 5. *Let assumptions 1 and 3 hold. If stereo-typing is credit market driven, then an increase in credit market inefficiency from $m = 1$ to $m = \underline{m}$ can itself generate labour market stereo-typing.*

The relation between credit market inefficiency and labour market stereo-typing is a nuanced one though. In fact, we show that there exist economies where, starting from a situation where stereo-typing exists, an increase in credit market inefficiency may actually eliminate stereo-typing. We need assumption 4 below for our next result.

Assumption 4. *There exists $\overline{m} > 1$, such that for $m = \overline{m}$, EE intersects WW_B from above exactly once.*

Consider a situation where stereo-typing is not credit market driven, so that we consider a different economy compared to the one considered in Proposition 5. Then for $m = 1$ a stereo-typing equilibrium exists. Then as m increases from 1, for all m close to $\overline{m}$ no stereo-typing equilibrium exists. This is illustrated in Figure 3. Here, when $m = \overline{m}$, the only stable equilibrium is non-stereotyping, involving a cutoff signal of s'' for poor blacks. However, for m sufficiently small the WW_B curve shifts up sufficiently so that there is now one non-stereotyping equilibrium (with poor blacks facing a lower cutoff, s^*), as well as a stereotyping one (with poor blacks facing a higher cutoff, s''''). We thus have our next result.

Proposition 6. *Let assumptions 1 and 4 hold. If stereo-typing is not credit market driven, then an increase in credit market inefficiency from $m = 1$ to $\overline{m}$ can eliminate stereo-typing.*

Intuitively, when $m = \overline{m}$, poor black workers' incentives for skill acquisition are so low that when firms set a high cutoff signal, the level of skill acquisition falls short of the employers' beliefs. Thus, there is no equilibrium at high levels of the cutoff signal, and the only stable equilibrium for poor blacks involves a relatively low cutoff. However, a large improvement in credit market efficiency reduces their costs of skill acquisition, ensuring that even when the cutoff is high, enough poor blacks get educated to justify the employers' beliefs. This generates a multiplicity of stable equilibria, and consequently the possibility of stereotyping.

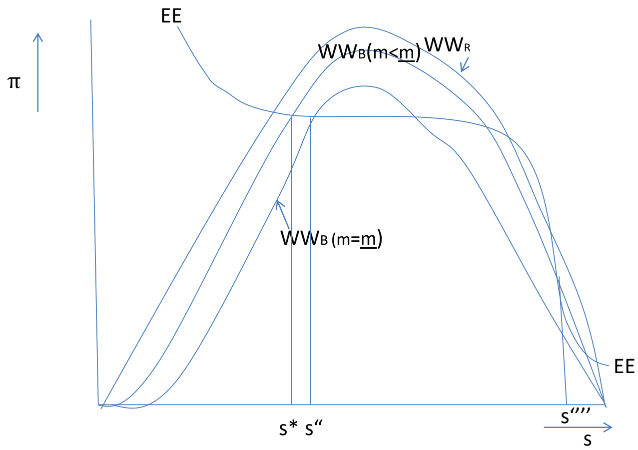

Figure 3: Credit market inefficiencies eliminating stereotyping

4 Targeted education subsidy

We next examine the effect of education subsidies targeted at the poor. We examine if such subsidies can help improve their welfare, as well as eliminate stereo-typing. As the introduction highlights, many countries are pursuing such policies. Such subsidies are likely to be less politically divisive than affirmative action policies, since, unlike the latter, educational subsidies do not directly affect the job prospects of non-target groups. This presents us with another reason for examining them.

Consider an education subsidy targeted at poor workers. We formalize it as a subvention given directly to banks for every unit of expenditure incurred by them while lending to poor workers. Denoting this subsidy by S, formally such a subsidy causes a reduction in m to $m(S)$, where $m(0) = m$ (the no-subsidy case), and $m'(S) < 0$. Given that there are competing demands for government resources, we assume that the subsidy is not too large, in that it is less than $\underline{S}$, where $m(\underline{S}) = 1$. We begin by showing that such a subsidy would cause a decrease in the interest rates and increase the utility of *all* workers, whether poor or rich, and black or white.

Proposition 7. *Let assumption 1 hold. Under any equilibrium a targeted education subsidy causes a fall in the interest rate $\bar{I}_i(c)$, $i = B, W$, and increases labour market prospects for all workers. Further, the utility of all workers increases.*

Proof. With a subsidy of S, m decreases to $m(S)$, so that WW_P shifts upwards.

This results in an upward shift in both WW_W and WW_B. Thus, given that the equilibrium is locally stable, this implies that the firm's cutoff signals for both groups decrease. Recall from (7) that in any equilibrium the gross interest is given by

$$I_i(c)(1 - F_q(\bar{s}_i)) = cm, \; i = B, W,$$

so that with a decline in m, and a decline in the cutoff signal (and therefore a rise in $1 - F_q(\bar{s}_i)$), the equilibrium interest rate $\bar{I}_i(c)$ necessarily declines. Such a subsidy is beneficial to poor borrowers on two counts. First, from (7) the expected interest costs decrease to $cm(S)$, and there is also a decrease in the cutoff value of the signal. We can now claim from Proposition 2(a) that such a lowering of the cutoff, as well as of the expected interest costs, increases the utility of poor workers. The rich workers gain as the cutoff signal declines. □

We next examine if a large enough education subsidy can help eliminate stereotyping in the labour market. Given that an education subsidy essentially ameliorates the cost of accessing the credit market for poor workers, our next result follows straightaway from the analysis in the preceding sub-section.

Summarizing this discussion we obtain our next proposition.

Proposition 8. *Let assumption 1 hold.*

(a) If stereo-typing is credit market driven and assumption 3 holds, then a sufficiently large education subsidy eliminates labour market stereotyping. This leads to an increase in utility for poor workers.

(b) If stereo-typing is not credit market driven and assumption 4 holds, then a sufficiently large educational subsidy can lead to labour market stereo-typing. The welfare implications of moving from a non-stereotyping to a stereotyping equilibrium are nuanced, while all white workers gain, rich black workers are worse off. The effect on poor black workers is ambiguous.

Proof. (a) The first part of the argument follows from Proposition 5 earlier. Given that assumption 3 holds, we can define S' so that $m(S') = m'$ (where recall that for any $m \leq m'$, no stereo-typing equilibrium exists given that stereo-typing is credit market driven). Thus no stereo-typing equilibrium exists whenever $S \geq S'$ (so that $m \leq m'$), whereas such stereotyping exists for S sufficiently small so that $m(S)$ is close to $\underline{m}$ (see Figure 2).

Note that poor workers gain both because of less stringent cutoffs in the labour market (since by definition the non-stereo-typing equilibrium has less stringent labour market cutoffs compared to all stereo-typing equilibria, see Figure 2), as well as a lower expected interest payment (which falls from cm to $cm(S)$ from (7)). Rich workers also gain because of less stringent cutoffs than before (as the WW_W curve moves up due to the subsidy, its intersection with EE moves to the left).

(b) The first part of the argument follows from Proposition 6 earlier, since with an increase in S, WW_P moves up and approaches WW_R as S approaches $\underline{S}$ (and hence, WW_B also approaches WW_R) (Figure 3).

The welfare implications now depend on both identity and class. While poor black workers gain from the fact that expected interest goes down to $cm(S)$, they are hurt by the fact that they face higher cutoffs in the labour market given that the non-stereo-typing equilibrium has less stringent labour market cutoffs compared to all stereo-typing equilibria. Thus the welfare implications are ambiguous for these workers. However, rich black workers are strictly worse off since while they face more stringent cutoffs following a switch to a stereotyping equilibrium, they accrue no direct benefits from lowered interest costs. Finally, turning to white workers, while poor ones gain from both less stringent cutoffs (since they do not face stereotyping), and lowered interest costs, rich ones gain from less stringent cutoffs. □

Thus, Propositions 7 and 8 together show that the outcome of education subsidies targeted at the poor seems to depend on the magnitude of such subsidies. We find that as long as such subsidies are not too large (so that there is no regime switch from one equilibrium to another), a targeted subsidy not only improves outcomes in the loan market, reducing interest rates for poor borrowers, it has beneficial implications for *all* workers in the labour market, whether rich or poor, black or white, in that all workers face less stringent cutoffs. This follows since with a decline in the average cost of skill acquisition, more of the poor workers get skilled. Knowing this, firms subject all workers to less stringent tests, as they are more skilled on the average. This in turn increases the utility level of all workers. The impact of large subsidies is however more nuanced as these create the possibility of regime switch, with consequent implications for labour market stereotyping. In fact such subsidies may even generate stereo-typing in the labour market if such stereotyping is not poverty driven, while eliminating it in other economies. Note that our analysis suggests that while small education subsidies are likely to be supported by all groups irrespective of identity or class, large subsidies may face some opposition from in particular the rich blacks.

The possibility that education subsidy can itself generate stereo-typing has parallels with Coate and Loury's (1993) results on patronization under affirmative action wherein they show that an affirmative action policy can itself cause employers to hold negative beliefs about minorities. Note though the results differ in that while in Coate and Loury (1993), employers hold black workers to a low cutoff post affirmative action (because they are pessimistic about the proportion of blacks who will acquire skills), in our setup, employers hold poor black workers to a higher cutoff in a post-subsidy stereotyping equilibrium.

Finally, consider an education subsidy targeted at poor blacks, and not all poor workers, both black and white. Then of course it will benefit the black workers only, either rich or poor, as long as it does not cause any regime switch. In case of any regime switch it may adversely affect the black workers if it leads to stereo-typing.

5 Discussion

We next discuss some extensions of the baseline framework.

5.1 A middle class

We first extend the analysis to allow for a middle class (denoted M), where all members of the middle class have the same wealth W, where $0 < W < 1$, with cost of education c being distributed according to $G(c)$. Let λ_{ij} and μ_{ij} have the same interpretations as before, with $j \in \{P, M, R\}$ now. We assume that $\mu_{WM} > \mu_{BM}$, i.e. relative to population size, the whites have a larger middle class vis-á-vis the blacks (recall whites have a relatively larger rich class as well). We are interested in analysing the impact of a 'vanishing' middle class as seems to be happening in some countries. Temin (2017), for example, documents this phenomenon for the US, arguing that American society is becoming polarized between the rich and the poor, with few families in the middle. While in 1971, the middle class (defined as families whose income was between two-thirds of the national median to double the national median) accounted for three-fifths of national income, their share had fallen to two fifths by 2014.

Note that a fraction $G(W)$ of the middle class workers have $c < W$ and can therefore finance their education out of their own wealth. Thus, the WW curve for these individuals corresponds to the WW_R curve. However, a fraction $1 - G(W)$ cannot pay their full educational costs solely out of their own wealth, and need to borrow the shortfall $c - W$. For these individuals, the effective cost of education is $W + (c - W)m$ as they have to borrow an amount $c - W$ in an imperfect credit market where, as before, $m > 1$ captures the extent of the imperfections. Then, such a middle class individual of group i acquires education only if $\beta(s_i) > W+(c-W)m$, i.e. $\hat{\beta}(s_i)+W\frac{m-1}{m} > c$. Thus, the WW graph of these individuals, denoted WW_M, is defined by $\pi(s) = G(\hat{\beta}(s) + W\frac{m-1}{m})$. Unlike the WW_R and WW_P curves, this curve has a positive intercept, but peaks at $\tilde{s}$ like the other curves.

Now, the WW_W and WW_B curves are defined differently. The WW_W curve is given by

$$\pi_W(s) = [\mu_{WR}+G(W)\mu_{WM}]G(\beta(s))+(1-G(W))\mu_{WM}G(\hat{\beta}(s)+W\frac{m-1}{m})+\mu_{WP}G(\hat{\beta}(s)).$$

Similarly, the WW_B curve is given by

$$\pi_B(s) = [\mu_{BR}+G(W)\mu_{BM}]G(\beta(s))+(1-G(W))\mu_{BM}G(\hat{\beta}(s)+W\frac{m-1}{m})+\mu_{BP}G(\hat{\beta}(s)).$$

Given that $\mu_{WM} > \mu_{BM}$ and $\beta(s) > \hat{\beta}(s)$, from a comparison of the preceding two equations it is easy to see that the graph of WW_W curve still lies above that of WW_B. Hence, as before, blacks face higher cutoffs.

Turning to the issue of a vanishing middle class, first suppose that the middle class becomes poor, so that μ_{iM} decreases with a corresponding increase in μ_{iP}, while μ_{iR} remains unaltered. Then, this would increase the weight on the WW_P curve in the computation of both the WW_W and WW_B curves, so that both curves would shift down.[7] Thus both black and white workers would face more stringent cutoffs, as well as acquire less skill on the average. Further, since $\mu_{BP} > \mu_{WP}$, the WW_B curve would shift down relatively more. Consequently, there would be a tendency for the gap in cutoffs between the whites and blacks to widen. Whether it actually does so or not would of course depend on the slope of the EE curve around the equilibrium.

Next suppose the middle class disappears because its members become rich. Then mimicking the preceding argument one can show that WW_W and WW_B shifts up, so that both black and white workers would face less stringent cutoffs, as well as acquire more skill on the average. Further, since $\mu_{WM} > \mu_{BM}$, this would shift up WW_W compared to WW_B, which would again tend to increase the disparity between the cutoffs of the two classes.

Thus the broad result seems to be that if the middle class is becoming richer (respectively poorer), then it has a beneficial (respectively harmful) effect on all borrowers in the labour market, and consequently in the loan market as well.

5.2 Firms can observe both identity and income

For robustness, we next consider an economy where firms can observe not just identity, but the income of the workers as well. Given that income is observable, the WW_W and WW_B curves are irrelevant to the analysis: only the WW_R, the WW_P, and the EE curves are relevant. We analyse this case in detail in an earlier version of the paper, and many of the results are qualitatively the same under these two scenarios.[8] For example, if stereo-typing is credit market driven, then, as in the baseline model, an education subsidy can eliminate stereotyping. If, however, stereo-typing is driven by identity concerns, then an education subsidy can generate labour market stereo-typing. There are some important differences though, arising essentially from the fact that under the baseline model, from the viewpoint of the firms, rich workers, with their relatively higher skill levels, are pooled together with

[7] The equation for WW_W changes to $\pi_W(s) = \mu_{WR}G(\beta(s)) + [\mu_{WM} + \mu_{WP}]G(\hat{\beta}(s))$, and similarly, that for WW_B changes to $\pi_B(s) = \mu_{BR}G(\beta(s)) + [\mu_{BM} + \mu_{BP}]G(\hat{\beta}(s))$. Thus, all the individuals who contributed to the WW_M curve, and some of those who contributed to the WW_R curve, now are weighted in the WW_P curve, which is lower than both WW_R and WW_M. Thus, both WW_W and WW_B shift down.

[8] The details are available on request.

the poor ones, whose skill level is lower. This links the outcomes for the rich and poor workers in equilibrium, a link that is absent in case income levels are observable. In particular, in the baseline model even rich black workers fare worse compared to their white counterparts. Relatedly, in the baseline model, a change in income distribution, as well as credit market imperfections affect even the rich workers. Neither of these would happen if the income level is observable.

6 Conclusion

We examine a framework with statistical discrimination where potential workers differ along both race (black and white) and class (rich and poor) lines, and poor workers of either race must access an imperfect credit market if they wish to get educated. We show that the greater average income level of the whites translates into more stringent labour market standards, as well as lower utility faced by all black workers. These labour market outcomes have consequences in the loan market, and leads to higher interest rates, as well as higher default rates for black workers. Further, any stereotyping by prospective employers exacerbates the twin problems faced by poor blacks: poorer labour market prospects and also higher interest rates in the credit market. These results are consistent with empirical findings that poor minorities indeed face worse terms in the credit market. Turning to policy, while small educational subsidies targeted at the poor reduce interest rates for poor workers, and improve labour market outcome for all workers, a large enough subsidy may be counter-productive as it may lead to labour market stereo-typing in certain economies, when not only are the rich blacks worse off, but even the poor blacks may be adversely affected.

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