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Abstract

Mismatches in the labor market, specifically because of underrepresentation of various population groups, carry significant economic cost. In this paper we argue, using a simple analytical model, that an additional cost component is related to the effect of such underrepresentation on incentives to invest in human capital, which results in a mutual feedback relationship between the labor market and the skill acquisition market and may lead to economy's divergence. Further, under increasing returns to scale in human capital, it is shown that an initially advantaged group has an incentive to minimize the bias against the disadvantaged group, and that political enfranchisement is the means to achieve a commitment to such a policy. It is argued that this is consistent with empirical regularities.

JEL Classification: N/A

Keywords: N/A

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Misallocation of Talent and Human Capital: Political Economy Analysis

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Abstract

Mismatches in the labor market, specifically because of underrepresentation of various population groups, carry significant economic cost. In this paper we argue, using a simple analytical model, that an additional cost component is related to the effect of such underrepresentation on incentives to invest in human capital, which results in a mutual feedback relationship between the labor market and the skill acquisition market and may lead to economy's divergence. Further, under increasing returns to scale in human capital, it is shown that an initially advantaged group has an incentive to minimize the bias against the disadvantaged group, and that political enfranchisement is the means to achieve a commitment to such a policy. It is argued that this is consistent with empirical regularities.

JEL: D31, D72, J71, J78, O11

Keywords: talent mismatch; group bias; human capital; political enfranchisement.

1. Introduction

Both historically and contemporarily various population groups have been underrepresented in high paying occupations. Thus, women and blacks in the US have traditionally and until relatively recently been underrepresented in high skill professions (Hsieh et al., 2018). Jacobson, 1998, presents a fascinating account of the evolution of discrimination, including in the labor market, against immigrant groups; Neumark, 2018, surveys the vast literature on labor market discrimination, in hiring among other forms. The resulting mismatch between people's innate abilities and their occupational assignments can be costly for the economy. Studies estimating the requisite efficiency cost conclude that the reduction of occupational barriers directed toward population groups has contributed significantly to the US wage growth in the last quarter of the past century (Hsieh et al., 2018) and elsewhere. Cavalcante and Tavares, 2016, specifically estimate that discrimination against women has resulted in significant output losses across countries. For example, their calibrations show that discriminatory biases against women account for the entire difference in output per capita between Ireland and Saudi Arabia on one hand and the US on the other hand.

Occupational mismatches may well have broader implications, affecting children academic aspirations and schooling choices. Thus, in anticipation of poor prospects of getting jobs in high skill occupations, children in disadvantaged households may opt out of school or make selection of school subjects that lead to relatively low paid occupations. This is consistent with the well documented observation that girls tend to be underrepresented in STEM subjects, both in school and in college (Friedman-Sokuler and Justman, 2016, Fryer and Levitt, 2010, Gemici and Wiswall, 2014). More specifically, Reuben et al., 2017, find that there are systematic differences in earnings expectations across genders and that, further, these differences leas to different college choices. Consequently, the cost for economic growth of barriers toward population groups in high skill occupations may even be higher than the one suggested in the literature, because of the causal relationship between labor market distortions and education choices that affect human capital accumulation.

In this paper, one of our objectives is to integrate mismatch frictions in high skill occupations in a simple analytical framework, where human capital accumulation takes place in anticipation of labor market mismatches. This, in particular, enables us to explore the consequence of such frictions on the long run economic development, as anticipation of occupational mismatch affects incentives to acquire skills, which, in turn, has growth consequences. Labor market frictions in the forms of a bias against a population group in assignment to high skill jobs, affect the incentive for skill acquisition generating a feedback effect. Consequently, we find that, if the existing bias in the assignment of high skill jobs strongly favors the advantaged group, the economy may diverge, with only the advantaged group's members eventually getting into high skill occupations, and output growth lagging as a result.

Our more novel goal, perhaps, is to study the political economy behind underrepresentation of population groups in high skill occupations. Specifically, we explore the incentives of the politically powerful population group to affect such underrepresentation. We find that under increasing returns to scale in human capital, commitment to affirmative action, whereby labor market biases are reduced and traditionally underrepresented groups are given a higher probability of getting high skill jobs, may be beneficial for the politically powerful group. The reason is that bias reduction unleashes the potential for skill acquisition by the disadvantaged group and generates a higher level of output, which may constitute more than an adequate compensation for a smaller share of the output the advantaged group obtains. This finding may explain more inclusive labor market policies toward various population groups as economies advance, whereby there is arguably more proclivity for human capital to exhibit strong increasing returns. It is consistent with Galor et al., 2009, that documents the historical adverse effect of land inequality on unleashing human capital accumulation when the latter becomes a significant production factor. It is complementary to other potential mechanisms for a bias reduction, such as the change in beliefs. For example, Lagerlof, 2003, argues that if everybody expects families to behave in a discriminatory manner by educating their sons more than their daughters, it is optimal for parents to do so; a change in beliefs may, therefore, change the equilibrium towards no-discrimination.

The next question we address is the mechanism through which a commitment to the reduction of biases can be materialized, as without such a commitment underrepresented households will not invest in human capital, and the bias will persist. One such mechanism we consider is that of the expansion of voting franchise to the previously disenfranchised population groups. An example of such that seems to be consistent with the presented model is women suffrage, which took place in the first half of the last century. While to the best of my knowledge, there is no clear causal evidence on the effect of such on women skill acquisition and getting into skilled occupation, it is noteworthy that these took place at a much higher rate in early 20^{th} century than before, suggesting a link between women political rights and their economic assimilation. Indeed, the Second Industrial Revolution (roughly 1870-1914) generated technological and organizational innovations conducive to skill accumulation; we suggest that women suffrage that chronologically followed closely may have been a response to an increase in skill premium. Goldin, 1990, provides a detailed historical account of the interrelationship between social and economic changes on one hand and women occupational structure on the other hand in the US.

Overall, the results should be helpful in order to appreciate the general equilibrium effects of labor market biases against population groups, as well as the incentives of politically dominant groups to perpetuate these biases or relinquish them. Further, they may be helpful in understanding the effect of political mechanisms on such biases, as they relate to human capital accumulation.

Related literature and paper's plan

Our main theoretical argument is akin to the one made in Galor and Moav, 2006, where the advantaged group (of capitalists in that context) finds it beneficial to promote education of the disadvantaged (the workers) when human capital becomes important in the production process. Our contribution relative to this work is in proposing a framework where population groups differing by identity markers – gender, race, or ethnicity – interact and, more importantly, in exhibiting political franchise as a vehicle of creating a credible commitment to the elimination of group biases. This additional set of obtained results, pertaining to the rebalancing of political power, complements Bertocchi's, 2011, where women enfranchisement is viewed as a tool for enhancing the political support for the provision of public goods. Whereas we share with this paper the view that an advantaged group may find it in its best interest to enfranchise the disadvantaged one, the rationale for this is very different here. Bowles et al., 2014, focus on networks effects in schooling, from which we abstract here, although integrating this element in our framework would constitute a natural and potentially interesting extension of the analysis. Our basic setup that focuses on labor misallocation is related to Bernasconi and Profeta, 2012, and Uchida, 2018, which also provide its theoretical modeling, albeit ignoring group biases, which constitute our main interest.[1] Another important related line of work explores efficiency consequence of affirmative action, Coate and Loury, 1993, Cornell and Welch, 1996, and Conde-Ruiz, 2017. In particular, the latter contribution argues that quotas for disadvantaged population groups have the potential to overturn pre-existing discrimination bias; that paper's argument is complementary to the one presented here.

[1] In a different vein, Acemoglu, 1995, and Murphy et al., 1991, explore another kind of labor misallocation that results from excessive rent seeking versus production.

One feature of our analysis that is absent from all this work and constitutes an additional contribution of this paper is the view of political suffrage as a commitment device to ensure the reduction of group bias, which is articulated here. As is argued later in the paper, this view is consistent with the historical evolution of political franchise, whose timing followed the increased importance of human capital for advanced economies. With respect to this political economy aspect, the paper is related to some earlier work, such as Bourguignon and Verdier, 2000, Gradstein, 2000. In these papers, however, the initially enfranchised rich "buy out" the poor by subsidizing their education, thus reducing future redistributional pressure. This paper's mechanism differs in at least two respects. First, the issue here is not redistributional threats, but rather misallocation in the labor market, which may adversely affect the advantaged population group, so the context, hence, the scope of applications, are very different. Second, we consider explicit extension of the franchise – which in the above papers occurs as a by product of the poor becoming more educated. In this regard, our contribution is related to Acemoglu and Robinson, 2000, where voting franchise is extended to alleviate threats of revolution. Clearly, however, our mechanism is different and is arguably more consistent with relatively peaceful political transitions, such as women franchise, or, in some cases, the extension of voting rights to small ethnic minorities. Gradstein, 2007, is more closely related with regard to peaceful political transitions, but, again, the incentive for franchise extension here – inducing a more efficient allocation in the labor market – is very much different from the one considered in that paper.

The rest of the paper proceeds as follows. The next section introduces the baseline model, whose analysis is presented in Section 3. Section 4 explores its dynamic and steady state implications. Section 5 deals with the endogenization of the job assignment bias. Section 6 explores how the devolution of political power may help to create a commitment for the bias reduction; Section 7 contains a discussion of some central assumptions and results; and Section 8 concludes.

2. Baseline model

Consider an economy that operates over discrete periods t and is populated in each period by a measure 1 of successive households, indexed i, each consisting of a parent and a child. There are two types of jobs, those that require high skills and those that can be performed by low skilled adults. The households come in two immutable identity types, Red (R) and Blue (B), and we assume for simplicity that their proportions are equal, ½ each. s_{jt}, j=R,B, will denote the respective shares of skilled workers among each of the types, and $S_t = (s_{Rt}+s_{Bt})/2$ is the fraction of skilled workers in the population. The initial shares, s_{R0} and s_{B0} are given, and we assume that $s_{R0} > s_{B0}$, so that the red households are more skilled. Whereas several interpretations of identity come to mind, such as race, ethnicity, or social class, a natural one is given by the gender marker, and portions of our analysis are relevant for this application.

Each adult worker assigned to a low skilled job uses a constant returns to scale technology, generating one unit of output. The production function at high skilled jobs is $F(H_t) = AH_t^{\gamma}$ where H_t is the number of workers performing such jobs; A>1. We will focus on the case of increasing returns to scale, $\gamma>1$.[2] This is particularly interesting in the context of skilled production because of the standard complementarity of human capital; as discussed more in detail below, it is consistent with theoretical growth models and with related empirical work.[3] For now, we point out that this assumption is central in standard endogenous growth theories, e.g., Lucas, 1988, 1990, Kremer, 1993, Romer, 1986. Letting S_t denote the aggregate share of skilled workers and assuming that only those can perform

[2] We discuss empirical evidence pertaining to this assumption below. In a more microfounded framework, suppose that the production function of each individual (competitive, profit maximizing) firm displays decreasing returns to scale and that there exists an economy wide spillover effect, through A, from employing skilled workers, as, for example, is carefully documented in Guo et al., 2018; this would lead to the described specification.

[3] This assumption is essential for the political portion of the paper, which derives the assignment bias endogenously and is not needed to derive equilibrium for an exogenously given level of assignment bias.

jobs requiring high skill, we have: $H_t \leq S_t$. Low-skilled jobs can be performed by both high-skill and low-skill workers, while high-skilled jobs can only be performed by high skilled workers. The price of final output is normalized to one. The wage of workers doing a low skill job is equal to their marginal product, 1, and we let w_t denote the wage of workers in high skill jobs.[4] The zero profit condition ensures that $w_t = F(H_t)/H_t$.

High skilled jobs are allocated between red and blue skilled workers. In particular, we assume that, because of the standard matching frictions in the labor market, only a fraction of skilled people can find a skilled job. Assuming for concreteness and without loss of insight that this fraction is one half, the probability of a red skilled worker to get a high skilled job is denoted $p(s_{Rt-1}, s_{Bt-1})$, and $p(s_{Bt-1}, s_{Rt-1}) = 1 - p(s_{Bt-1}, s_{Rt-1})$is the probability of a blue skilled worker to get a high skilled job; where p increases in s_{Rt-1} and decreases in s_{Bt-1}, and $p(s, s) =1/2$. The implications is that, for as long as $s_{Rt-1} > s_{Bt-1}$, there is a pro-red assignment bias, $p(s_{Rt-1}, s_{Bt-1})>1/2$. In other words, the no bias case is the one where the probability of a member of each population group to get a high skilled job assignment is equal, independently of the distribution of skills in the previous generation. In contrast, a pro-red bias if the direct outcome of this group's ability to skew assignment in favor of their children. One rationalization for the stipulated pro-red bias in the assignment of skilled jobs is that skills are not (fully) observable, and statistical discrimination applies (Arrow, 1973, Phelps, 1972). Stereotypes and cultural norms may play a role too, see Campa et al., 2011, Ibarra, 1992, and Reskin and McBrier, 2000, documenting this. Children of skilled red parents may be seen as more productive than children of skilled blue parents. Somewhat closer to this paper's spirit, it is possible that market job assignment entails social networking, see Akerlof and Michaillat, 2016, Montgomery, 1991, whereby the more skilled red households favorably affect the placement of their children in high skill occupations via social influence. The role of social connections in job search has been explored in, e.g., Calvo-Armengol and Jackson, 2004. We complement

[4] We assume that identity based discrimination among population groups, red and blue, can only be expressed via hiring, not via wages; this is obviously a simplification, but is also realistic in a context whereby the former is harder to detect, document and claim in courts.

this latter channel subsequently in this paper and endogenize the bias, by assuming that job assignment is done via a political process whereby red households are dominant. Adopting a reduced form specification of the group bias enables us to explore other issues of interests here, such as the political economy of its evolution, which is our main focus below.

We let *a* denote individual ability and C(*a*) the cost of acquiring skills through investment in human capital by an individual child with ability *a*, C'<0, C">0: the cost decreases with ability, but the rate of the decrease (in absolute value) diminishes. This assumption is consistent with empirical findings on high economic returns of investment in disadvantaged children, see e.g., Carneiro and Heckman, 2003. We further assume through normalizing that C belongs to the unit interval, and C(1)=0, C(0)=1. (In a related work, Bowles et al., 2014, and Loury, 1977, stipulate communal spillover effects in skill acquisition, from which we abstract here, as well as from credit constraints, in order to focus on other channels; at the cost of additional complexity, these could in principle be subsumed in the proposed framework.) Also, assuming that this cost decreases in parental human capital would only reinforce the results. Indeed, Carneiro and Heckman's, 2003, results can be interpreted as implying the importance of abilities acquired in early life (as opposed to innate manner) that depend on parental characteristics; the implications of this interpretation in our framework are similar to the assumed one. More generally, our main results hold whenever there is a mutual feedback between labor market frictions and skill acquisition decisions.

The cdf of *a* among each of the groups, red and blue, in each period is, again, for simplicity normalized to be uniform in the unit interval. More specifically, this assumption is made in order to generate a clean equilibrium analysis, and nothing of substance is lost as a result. As skill acquisition is costly, workers performing high skilled jobs should earn at equilibrium more than those assigned to low skilled jobs; hence, $w_t = w(S_t) > 1$.

Parental utilities are derived from their children expected future wage less the cost of human capital investment, if such is taking place; time discounting is assumed away for simplicity. It then follows that the expected utility of a red parent whose child, with ability *a*, acquires skills is

$$U_{Rt}(\text{skilled child}) = w(S_t)\, p(s_{Rt-1}, s_{Bt-1}) + 1 - p(s_{Rt-1}, s_{Bt-1}) - C(a) \qquad (1a)$$

and for the blue parents, likewise:

$$U_{Bt}(\text{skilled child}) = w(S_t)\, p(s_{Bt-1}, s_{Rt-1}) + 1 - p(s_{Bt-1}, s_{Rt-1}) - C(a) \qquad (1b)$$

The respective utilities in the case of no skill acquisition are just equal to the wage in the non-skill sector of 1.

Each period t is divided into two sub-periods. In the first of these, the parents make skill acquisition decisions on behalf of their children; these decisions shape children human capital; at the sub-period's end the children grow into adults. In the second sub-period, job assignment of the now grown adults takes place; production occurs; the workers are paid their wages; and new generation of children is born. We will be interested in the resulting time consistent equilibrium.

3. Equilibrium Analysis

In each period t, skill acquisition decisions are made in anticipation of subsequent job assignment. They balance the cost of acquiring skills with the expected future wage differential between skilled and unskilled jobs. Consequently, the cutoff values of the ability parameter are given as follows:

$$C(a_{Rt}) = w(S_t)\, p(s_{Rt-1}, s_{Bt-1}) - p(s_{Rt-1}, s_{Bt-1}) \qquad (2a)$$

$$C(a_{Bt}) = w(S_t)\, p(s_{Bt-1}, s_{Rt-1}) - p(s_{Bt-1}, s_{Rt-1}) \qquad (2b)$$

where the right hand side represents the expected wage differential between getting a high skill versus a low skill job.

Inverting (2) we obtain:

$$a_R(S_t, s_{Rt-1}, s_{Bt-1}) = C^{-1}(w(S_t)\, p(s_{Rt-1}, s_{Bt-1}) - p(s_{Rt-1}, s_{Bt-1})) \quad (3a)$$

$$a_B(S_t, s_{Bt-1}, s_{Rt-1}) = C^{-1}(w(S_t)\, p(s_{Bt-1}, s_{Rt-1}) - p(s_{Bt-1}, s_{Rt-1})) \quad (3b)$$

Note that, for a given S_t, a_R decreases (increases) in s_{Rt-1} (s_{Bt-1}) and in $p(s_{Rt-1}, s_{Bt-1})$; and the opposite holds for a_B.

Then, recalling the simplifying uniform distribution assumption, we can write:

$$s_{Rt} = 1 - a_{Rt} = 1 - C^{-1}(w(S_t)\, p(s_{Rt-1}, s_{Bt-1}) - p(s_{Rt-1}, s_{Bt-1})) \quad (4a)$$

$$s_{Bt} = 1 - a_{Bt} = 1 - C^{-1}(w(S_t)\, p(s_{Bt-1}, s_{Rt-1}) - p(s_{Bt-1}, s_{Rt-1})) \quad (4b)$$

We now address the issue of the effect of skilled job assignment rules on the aggregate skill level. An essential element here is our assumption that the cost of skill acquisition, while decreasing, is convex in ability. In particular, we obtain the following result (with the proof in the appendix):

Proposition 2. The aggregate skill level, hence, a period output, increases in $p(s_{Rt-1}, s_{Bt-1})$ when it is smaller than ½ and decreases in $p(s_{Rt-1}, s_{Bt-1})$ when it is larger than ½; it is highest when the probabilities of being assigned to a skilled job are the same for the red and blue group members, $p(s_{Rt-1}, s_{Bt-1})=1/2$.

A direct implication of this result is to an affirmative action type of a policy in the process of skill acquisition. Such policies are commonplace in many countries in the context of college admissions, whereby disadvantaged minorities get reservation quotas. Suppose, therefore, that the process guarantees equal skill acquisition across the two population groups, $s_{Rt}=s_{Bt}$. This then implies that $p(s_{Rt-1}, s_{Bt-1})= p(s_{Bt-1}, s_{Rt-1})=1/2$. The equilibrium of skill acquisition will then be determined from

$$s_{Rt} = s_{Bt} = S_t = 1 - C^{-1}((w(S_t) - 1)/2) \quad (5)$$

Comparing with (4), because s_{Rt} there increases in $p(s_{Rt-1}, s_{Bt-1})$, the fraction of skilled among the red households will now be reduced, and among the blue households – will be increased. Further, Proposition 2 implies that the aggregate level of skills S_t is now higher.

We can also determine the welfare effect of such a policy. It follows that blue households that acquire skills both without and with the policy are better off in the latter case – because the level of skills is higher and they also face a higher chance of getting a skilled job. Also, blue households that did not acquire skills without the policy, but do so with it are better off; and those never acquiring skills are indifferent. Thus, blue households are never worse off with the policy and some (with high ability children) are better off. Likewise, red household never acquiring skills (with less able children) are neutral with respect to the policy. Those who would have acquired skills without the policy, but do not with it are, however, worse off. Finally, there are red households (with able children) that engage in skill acquisition in both cases. For those, there is a tradeoff as the presented policy enhances aggregate skills, from which their children stand to benefit as a result of higher wages; but, on the other hand, chances of being assigned skilled jobs are now smaller.

The policy, as well as that examined below, does have redistributional consequences, and its implementation hinges upon the distribution of political power in the population. In the following, we therefore, focus more closely on the political process as the means of resolving this redistributional issue.

4. Evolution and the steady state analysis

We can generally write the economy's trajectory as follows:

$$s_{jt} = \phi(s_{Rt-1}, s_{Bt-1}),\ j=R,B \qquad (6)$$

The economy's steady state is defined as: $(s_{Rt}, s_{Bt}) = (s_{Rt-1}, s_{Bt-1}) = (s_R, s_B)$ for all $t>0$, and in principle, there may exist multiple steady states.

To further simplify the analysis, we assume in the following a specific functional form of the assignment probabilities:

$$p(s_{Rt}, s_{Bt}) = s_{Rt}^{\beta}/(s_{Rt}^{\beta} + s_{Bt}^{\beta}),\ p(s_{Bt}, s_{Rt}) = s_{Bt}^{\beta}/(s_{Rt}^{\beta} + s_{Bt}^{\beta}),\ \beta>0 \qquad (7)$$

$p(s_{Rt}, s_{Bt})$ increases in (s_{Rt}/s_{Bt}) and is concave in this ratio whenever $\beta<1$; and symmetrically holds for $p(s_{Bt}, s_{Rt})$. This functional form has been commonly used in the contest literature (see e.g., Rosen, 1986, for an internal labor market application; Skaperdas, 1996, provides an axiomatization of this functional form). Indeed, assignment to skilled occupations in our context can be viewed as a contest among the respective members of the two groups. The larger is β the more significant is the bias in the labor market in favor of the advantaged red group. The particular bias form in (7) is not crucial for the analysis and is essentially a convenient way to parametrize the assignment bias.[5]

These assumptions enable a simple analysis of the economy's evolution and its steady state. In particular, from (4) the ratio of skilled people in the two groups is

$$s_{Rt}/s_{Bt} = [1–C^{-1}(w(S_t)\, p(s_{Rt-1}, s_{Bt-1})- p(s_{Rt-1}, s_{Bt-1}))] / [1- C^{-1}(w(S_t)\, p(s_{Bt-1}, s_{Rt-1})- p(s_{Bt-1}, s_{Rt-1}))] =$$
$$[1–C^{-1}((w(S_t)-1)\, p(s_{Rt-1}, s_{Bt-1}))] / [1- C^{-1}((w(S_t)-1)\, p(s_{Bt-1}, s_{Rt-1}))] \quad (8)$$

and we can now define the steady state ratio of skills in the two groups as $(s_{Rt}/s_{Bt}) = (s_{Rt-1}/s_{Bt-1})$. Differentiation of (8) establishes that the right hand side is concave in (s_{Rt-1}/s_{Bt-1}) when $\beta<1$ and is convex in (s_{Rt-1}/s_{Bt-1}) when $\beta>1$. It then follows that when $\beta>1$ the ratio (s_{Rt}/s_{Bt}) diverges toward infinity (i.e., $s_R=1$, $s_B=0$). In contrast, when $\beta<1$, the ratio converges to:

$$s_R/s_B= [1–C^{-1}((w(S)-1)((s_R/s_B)^{\beta}/((s_R/s_B)^{\beta}+1))] / [1- C^{-1}((w(S)-1)\, ((1/\, ((s_R/s_B)^{\beta}+1))] \quad (9)$$

whereby S is defined as follows:

$$S = [2–C^{-1}((w(S)-1)p)-C^{-1}(w(S)-1)(1-p)]/2, \text{ and } p = (s_R/s_B)^{\beta}/\, ((s_R/s_B)^{\beta} + 1) \quad (10)$$

[5] A more general formulation would have $p(s_{Rt}, s_{Bt}, \beta)$ and $p(s_{Bt}, s_{Rt}, \beta)$. With appropriate assumptions, in particular, entailing signs of cross partial derivatives, our analysis would go through, at the expense of more involved derivations.

Further, the larger β the larger is the steady state ratio s_R / s_B (and the smaller the steady state aggregate skill level S). When $\beta=0$, $s_R = s_B$; $p(s_{Rt}, s_{Bt})=1/2$; and S is maximal.
Based on Proposition 2, S in (10) can also be seen to increase for $p<1/2$ and decrease for $p>1/2$, being minimal at the end points.

Evaluating S at such an end point, we obtain that

$S = [2 – C^{-1}((w(S)-1))]/2 < ½,$

which is the steady state level of skills when $\beta>1$. Summarizing,

Proposition 3. Under our assumptions, depending on whether β exceeds or is smaller than 1, the economy may either diverge or converge to a unique steady state; aggregate skill level and output are larger in the latter case.

It is noteworthy that, under divergence, income differences are across the groups (and identical within each group); in contrast, under convergence, income difference across the groups are smaller, but there are differences within each group. Divergence is obtained when the pro-red bias in the labor market is sufficiently high, resulting in a mutually reinforcing feedback between the labor market and skill acquisition. Specifically, the labor market bias implies that the red acquire skills, whereas the blue less so; this then reinforces the dominance of the former in high skill occupations, etc. The opposite dynamics results under convergence, i.e., when the pro-red bias is small.
We can interpret the case of $\beta < 1$ as reflecting affirmative action in the labor market in providing historically underrepresented population groups extra representation in skilled jobs.

5. Endogenizing the assignment of skilled jobs

We next endogenize the assignment of skilled jobs. To do so, we assume that this is governed by a political process in which the members of the more skilled group R are decisive. This could be rationalized, for example, because of a higher propensity of more educated (or affluent) individuals to be active in political processes.[6] Evidence of such is

[6] Alternatively, we could assume a reduced form of the political process that allocates a higher weight to the members of the more skilled group; qualitatively, this would not change the results, although the relative size of the groups would matter.

documented in Nie et al., 1996, Verba and Nie, 1972, and Wolfinger and Rosenstone, 1980; as well as in more recent work paying careful attention to causality, Mayer, 2011, and Sondheimer and Green (2010). Alternatively, political dominance of the red households could be an historically shaped reality (such as in the case of male suffrage), and/or they could constitute a majority in a trivial model extension. The political process determines in each period p, the probability of a red group skilled worker to get a high skilled job.

We will distinguish between two scenarios, which we first describe in general terms. Under one scenario, a commitment to p is impossible to make, hence, p is selected after the households have made their costly skill acquisition. Under the commitment scenario, p is selected prior to skill acquisition. In each case, we will be interested in time consistent equilibrium. It will be somewhat useful to employ the parametrized form of p, whereby the political decision will be on the parameter. To do so, we redefine:

$$p(s_{Rt-1}, s_{Bt-1}) = s_{Rt-1}^{\beta t}/(s_{Rt-1}^{\beta t} + s_{Bt-1}^{\beta t}),\ \beta_t \geq 0 \qquad (11)$$

stipulating that β_t is determined in period t by the red group individuals, where $\beta_t \leq \beta$, and β is large and, in particular, larger than 1. β_t can be interpreted as the pro-red bias in the assignment rule of skilled jobs, which cannot exceed the ceiling of β.

Under the no commitment scenario, the analysis is straightforward. Once the individuals have made their skill acquisition decisions, the red group households are interested in maximizing their young members' chances to get high skill jobs. In other words, they vote to set p as high as possible; or, alternatively, given (12), for given skill choices, they set in each period β_t in order to maximize (11); consequently, for as long as $s_{Rt-1}>s_{Bt-1}$, β_t is set to be as high as possible, $\beta_t = \beta$. The economy will then diverge, as indicated in Proposition 3, so that in the steady state all and only red group households become skilled. It will be useful to calculate the resulting utility of the red households; from (1a), as in the long run, $p(s_R, s_B)=1$, $s_R=1$, $s_B=0$, we obtain:

$$w(1/2) - C(a) \geq 0 \qquad (12)$$

The much more interesting case is the one with commitment. Under commitment, β_t is determined in period t by the red group households in anticipation of the skill

acquisition decisions and upon getting to know the ability of their offspring. In other words, the sequence of events is as follows. First offspring abilities are realized; then red households vote on β_t, and it is determined by their majority vote; then skill acquisition choices are made by all households; finally, job assignments of the young is made.

As skill acquisition and job assignments for a given β_t have been essentially explored above, we turn to the determination of the political equilibrium. Consider first the preferred choice of β_t by red households assuming that they anticipate their children to acquire skills. Differentiating (1a) while using the specification in (11) we obtain the following internal first order condition:

$$w'(S_t)(dS_t/d\beta_t)\, s_{Rt-1}{}^{\beta t}/ (s_{Rt-1}{}^{\beta t}+s_{Bt-1}{}^{\beta t}) + [w(S_t)-1][d(s_{Rt-1}{}^{\beta t}/ (s_{Rt-1}{}^{\beta t}+s_{Bt-1}{}^{\beta t}))/d\beta_t] = 0 \qquad (13)$$

We let b_t denote the solution of (13). Recalling that the production function exhibits increasing returns to scale, so that $w'(S_t)>0$, the first term in the left hand side in (13) is negative, and the second term is positive (details in the appendix). The first term represents the adverse effect of a pro-red skilled job assignment on the aggregate skills and the resulting wage compensation. The second term captures the beneficial effect for the red households of a biased job assignment. (In the no commitment case, only the expression in the brackets in the second term was present – hence, at equilibrium β_t assumed its maximal value.) In particular, if $w'(S_t)$ is sufficiently large, that is, if increasing returns in production are significant, then the former term becomes more dominant; in other words, totally differentiating (13) while using the second order condition implies that the favored value of b_t decreases in w': $db_t/dw' < 0$. In particular, if w' is large enough, the favored value satisfies $b_t<1$.

Now, recall that whether skill acquisition in a red household takes place or not is determined by (2); using (11) this can be written as:

$$C(a_{R1}) = (w(S)-1))\, s_{Rt-1}{}^{\beta t}/ (s_{Rt-1}{}^{\beta t} + s_{Bt-1}{}^{\beta t}) \qquad (14)$$

implying that a_{Rt} is a decreasing function of β_t. We let $\underline{\beta}_t(a)$ denote the minimal value of the pro-red bias that makes a household with a child's ability *a* just indifferent between

acquiring skills or not; in other words, $a = a_{Rt}$ and $\underline{\beta}_t(a)$ is a decreasing function. This implies that the preferred β_t equals $\underline{\beta}_t(a)$ if the latter is larger than b_t; and it equals b_t if the opposite holds, in other words, $\beta_t = \text{Max}\{\underline{\beta}_t(a), b_t\}$. As β_t is (weakly) monotonic in a, the household whose child has the median ability, a=1/2, is decisive, and the equilibrium is given by $\beta_t = \text{Max}\{\underline{\beta}_t(1/2), b_t\}$. Clearly, from (13) $\underline{\beta}_t(1/2)$ decreases in wages of skilled labor, $w(S_t)$; and if the latter are sufficiently high, $\underline{\beta}_t(1/2)<1$.

Summarizing,

Proposition 4. The politically dominant group may have an incentive to commit to a low bias in the assignment of high skill jobs, in order to benefit from the resulting higher level of skills in the economy. In particular, if the compensation for skilled labor is sufficiently high and increasing returns to scale are steep, the equilibrium bias will be low enough to generate convergence over time. In the absence of such commitment ability, divergence takes place, with red households dominating high skill occupations.

In many countries, commitments to a low bias have been attempted through various policy initiatives and legislation. Thus, in the US, the Executive Order 10925 of 1961 requiring that government employers ""take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, creed, color, or national origin" can be viewed as an attempt at such a commitment.

6. Reallocation of political power to induce commitment to low bias

We have seen that commitment to low bias in the labor market can potentially benefit the advantaged red group in our context. The important question then is: how can reduction of such a bias be made credible? In other words, what prevents reduction of the bias to be undone ex post? One possibility might be an independent court system focused on equal opportunities in the labor market. Another possibility, that we now explore, is the reallocation of political power in favor of the disadvantaged group.

In other words, suppose that, in each period t, after children abilities become known, red households decide whether to retain political power or to relegate it to the disadvantaged blue households. Then skill acquisition takes place, upon which a majority

vote among the politically dominant group determines β_t; and the rest is as in the preceding analysis.

The equilibrium analysis proceeds backwards. If the red households retain political power, the equilibrium outcome is as above: $\beta_t = \beta$, and the economy will diverge, so that in the steady state only the red get skilled; their utility then is given by (12). In contrast, if the blue households become politically dominant, upon skill acquisition, they will set β_t to its minimal level of 0, implying that $p(s_{Rt-1}, s_{Bt-1}) = p(s_{Bt-1}, s_{Rt-1}) = ½$.

The equilibrium (and the steady state) of skill acquisition will then be determined from:

$$s_{Rt} = s_{Bt} = S_t = 1 - C^{-1}(w(S_t) - 1)/2) \qquad (15)$$

where $S_t > 1/2$. Now, if the ability cutoff determined by (15) is such that a majority of red households do not get skilled, then relegation of political power will never take place. A more interesting case, therefore, is the one where – for example, because of high wages in skilled occupations or a relatively low cost of skill acquisition – a majority of red households get skilled when $\beta_t = 0$ (and, a fortiori, when $\beta_t = \beta$). Then in the long run, the utilities of this majority are given by:

$$w(S)/2 + ½ - C(a) \qquad (16)$$

where $S>1/2$ is determined from (15). Comparing with (14), we obtain that if the differential $w(S)-w(1/2)$ is sufficiently large, then the initially politically dominant red households will choose to relegate political power to the blue households thereby creating a commitment to the minimal level of group bias, $\beta_t = 0$.

To summarize,

Proposition 5. With steep increasing returns to scale and high wages in skilled occupations, the initially politically dominant group may find it in its best interests to relegate political power to an initially disenfranchised group, in order to create a commitment for the elimination of the bias in skilled occupations.

7. Discussion

One of the central assumptions in our model – which is essential for the political economy argument of the paper – is that of increasing returns to scale in the accumulation of human capital. The available empirical evidence in this regard can be divided into three categories based on the scope of potential spillovers of human capital accumulation. The bulk of evidence is that education exhibits positive social returns. While there is less consensus about the magnitudes of these returns, most recent evidence seems to suggest that these are significant and substantial. We now review this evidence.

Human capital externalities

Team production: Kremer, 1993, provides theoretical underpinnings behind increasing returns of scale in team production and discusses implications. Mas and Moretti, 2009, Moretti, 2004a, in their respective empirical studies detect significant spillover effects. It seems that in close knit social interactions, these effects are robust.

Local (regional) spillovers: Rauch, 1993, in an early paper finds significant social returns of education, whereby workers in cities with better educated workforce earn substantially more than workers in less skilled city environment. Acemoglu and Angrist, 2001, however, employing compulsory schooling legislation as an instrumental variable in the context of the US states find much smaller, albeit marginally significant social returns. Moretti, 2004b, on the other hand, suggests that a one percentage point increase in a city's college share raises the wage of workers in that city significantly by about 0.4-1.9%.

Aggregate (national) level: Increasing returns to scale in the production of human capital, generated via spillover effects, such as through learning, innovation etc., are an important building block in endogenous growth theories (see Lucas, 1988, 1990), so assessing them is essential. Lucas himself argued that "… there are group interactions that are central to individual productivity and that involve groups larger than the immediate family and smaller than the human race as whole." Still, empirical evidence on aggregate, say, nation-wide, human capital externalities that are crucial according to the theory in order to account

for cross country differences in growth rates, has been wanting. Some recent work attempts to fill this void.

Gennaioli et al. (2013) present overwhelming evidence that human capital fosters development through entrepreneurial education and human capital externalities. With such significant human capital externalities, workers in rich countries would accumulate more human capital over the life cycle than those in poor countries; indeed, Lagakos et al., 2018, finds that life cycle wage growth is steeper in countries with higher education levels, which is consistent with this implication. An even more direct supportive evidence is provided in a recent paper Guo et al., 2018. Using an instrumental variable strategy in the context of structural estimation deduced from a theoretical model, the paper finds that one more year of average schooling at the U.S. state level raises individual wage by highly significant 6-8%. Further, based on this reduced form estimate, it is estimated that the elasticity of a typical firm's productivity with respect to the average human capital (schooling) of an economy is 0.121.

Application to gender and women suffrage

One of our main results (summarized in Proposition 5) is broadly consistent with the expansion of women suffrage that took place in most Western countries in the first half of the twentieth century.[7] Within a generation, this constitutional change was followed by a gradual increase in women representation in high skill occupations. Further, as documented in Doepke and Tertilt, 2009, women suffrage coincided with the growing demand for human capital; with the expansion of compulsory schooling for all; and with the growing fraction of educated women. Influential observers make the point that these developments were pre-dated by the Second Industrial Revolution, roughly between 187-1914, which changed the nature of the production process generating economies of scale in manufacturing (Mokyr, 1990). These were both technological – emergence of networks in electricity, transportation, and communication - and organizational, such as mass production by interchangeable parts technology. Some scholars (see Whitfield, 2001) suggest that these developments were responsible for a significant expansion of voting

[7] Some colonies and subnational units introduced women suffrage even before. Independent countries started introducing women suffrage before World War I, and many more did so post World War I. Whether the war impeded or accelerated the process is still debated among gender historians (DuBois, 1998).

franchise, in particular, women suffrage. Thus, our proposed framework is consistent with the link between the demand for skills generated through novel technological and organizational structures generated in the course of the Second Industrial Revolution and the extension of women suffrage in its aftermath. Bertocchi, 2011, presents an alternative argument for the enfranchisement of women, induced by the objective of furthering the provision of public goods.[8]

While the extension of voting franchise to women in the US was achieved by 1920s, as noted in Doepke et al., 2012, it took a generation to achieve legal gender equality in the context of labor markets. Women continued, with gradually diminishing severity, to face labor market restrictions, under the pretense of protective legislation, through 1960s, and they were finally curtailed as a consequence of the Civil Rights Act of 1964. As documented in Hsieh et al., 2018, 94 percent of doctors and lawyers as late as in 1960 were still white men; by 2010, the fraction was just over 60 percent. Goldin, 1990, depicts the picture of a narrowing gender gap across time in the US, in education, in occupations, and in pay, linking it to political and social forces that imposed the change.

8. Conclusion

It has been noted that barriers to entering skilled occupations faced by various population groups have appreciable adverse wage growth effects. This paper argues with a simple analytical framework that, when the effect of these barriers on skill acquisition is taken into account, misallocation has additional consequences. Further, there is a mutual feedback relationship between the labor market and the education market, implying the possibility of the economy's divergence whereby only members of initially privileged group occupy high skill jobs. This is consistent with existing evidence documenting gender differences in the choice of subjects in schools in colleges, whereby male students significantly more than female students have tended to choose those that lead to high paying occupations.

[8] One reason for why enfranchisement is a more effective commitment device than direct elimination of the bias emphasized here is that it is harder to undo. Another possibility would be that elimination of the bias results in a backlash against the underprivileged group, as argued in Coate and Loury, 1993.

Yet, under increasing returns to scale in the skilled sector, there may exist an incentive for the advantaged group to commit to reducing biases thereby ensuring stronger growth and income convergence across population groups. We have also explored a channel for this incentive to materialize, by the advantaged group relinquishing political power in favor of the disadvantaged one, thereby creating a commitment for bias reduction. An important implication of our analysis is that as economies modernize and production becomes skill oriented, there are stronger incentives for the elimination of biases against population groups. This, in turn, may induce the need for associated deep political changes, providing representation to traditionally disenfranchised groups. These results are consistent with the increased inclusiveness in the labor market as economies mature.

While the presented framework generates a rich set of insights, it can also be a useful platform to explore additional relevant issues. Thus, one possible extension of the above analysis is to embed it in a full fledged economic growth model. This would allow for a dynamic perspective on the evolution of group bias. Another interesting extension would be to consider direct group biases in the acquisition of human capital, such as through discrimination in schools or colleges, the implication of which would be differential costs of human capital acquisition across population groups. Such an extension would be valuable for interpreting the model in terms of racial or ethnic bias, as opposed to the current gender bias interpretation. Finally, considering how integration versus segregation policies interact with group biases in the labor market would provide further important insights as to the effectiveness of eliminating such biases in the presence of network frictions.

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APPENDIX

Proof of Proposition 1. Aggregating equations (4), we obtain:

$$S_t = [2–C^{-1}(w(S_t)p(s_{Rt-1}, s_{Bt-1})-p(s_{Rt-1}, s_{Bt-1}))-C^{-1}(w(S_t)p(s_{Bt-1}, s_{Rt-1})- p(s_{Bt-1}, s_{Rt-1}))]/2 \quad (A1)$$

where S_t belongs to the unit interval. When $1<\gamma<2$, the right hand side in (A1) increases and is concave in S_t; our assumptions on the cost function guarantee that it is positive when $S_t=0$ and is smaller than 1 when $S_t=1$. It follows that there is a unique solution of (A1) under this assumption. This is an internal solution, at which $w(S_t)>1$. Further, since a_R decreases (increases) in s_{Rt-1} (s_{Bt-1}); and the opposite holds for a_B, this proves the last part of the claim.

Proof of Proposition 2. Denoting $p = p(s_{Rt-1}, s_{Bt-1})$, we write:

$$S_t = [2 – C^{-1}((w(S_t)-1)p) - C^{-1}(w(S_t)-1)(1-p)]/2 \quad (A2)$$

Differentiating with respect to p we obtain:

$$dS_t /dp = [– C^{-1'}((w(S_t)-1)p) ((w(S_t)-1) + C^{-1'}(w(S_t)-1)(1-p)) ((w(S_t)-1)]/2 \quad (A3)$$

and the first order condition clearly holds whenever p=1/2. Our assumption that C”>0 guarantees that this is the argmax. Since skilled jobs are more valuable in productivity terms than unskilled, it follows that aggregate output is also maximized when p=1/2.

Proof of the claims that follow equation (13).

Consider

$$d(s_{Rt-1}^{\beta t}/ (s_{Rt-1}^{\beta t} + s_{Bt-1}^{\beta t}))/d\beta_t = [1/(1 + (s_{Rt-1}/ s_{Bt-1})^{\beta t})] (s_{Rt-1}/ s_{Bt-1})^{\beta t} \ln (s_{Rt-1}/ s_{Bt-1}) > 0$$

which (as $w(S_t)>1$) goes to show that the second term in the left hand side of (14) is positive.

The above result implies that $p(s_{Rt-1}/ s_{Bt-1}) = s_{Rt-1}^{\beta t} / (s_{Rt-1}^{\beta t} + s_{Bt-1}^{\beta t})$ increases in β_t; this, in turn, implies, based on Proposition 2, that $dS_t/d\beta_t < 0$, proving that the first term is negative, provided that $w'(S_t)>0$.