Theories of Persistent Inequalities

Human capital, inequality, and growth: A local perspective

Roland Bénabou a,b,c*

a MIT, Dept. of Economics, 50 Memorial Drive, Cambridge, MA 02139-4307, USA
b NBER, Cambridge MA, USA
c CEPR, London, UK

Abstract

A recent body of work has demonstrated the crucial role played by local human capital externalities and local school funding in generating socio-economic segregation, persistent poverty, and low aggregate income or productivity growth. We present a simple model which captures the main insights from this literature, and prove three general propositions. First, minor differences in education technologies, preferences, wealth, or minor imperfections in capital markets, can lead to a high degree of stratification. Second, stratification makes inequality in education and income more persistent across generations; the same is true for total wealth, provided the rich succeed in capturing the rents created by their secession. Finally, this polarization or urban areas can be very inefficient, especially in the long run.

Key words: Inequality; Education; Growth; Stratification

JEL classification: D31; O40; I22

1. Introduction

A recent body of work, both theoretical and empirical, has demonstrated the potentially crucial role played by local human capital externalities in generating socio-economic segregation, persistent income inequality across generations, and inefficiently low levels of aggregate income or productivity growth. These local interactions may operate through direct spillovers such as those documented by educators and sociologists (peer or neighborhood

* I am grateful to Olivier Blanchard, Peter Diamond, Michael Kremer and Julio Rotemberg for useful comments. Financial support from the NSF is gratefully acknowledged.
effects, role models, norms, etc.) and often gathered under the heading of ‘social capital’, or through the effects of a community’s financial resources and political equilibrium on the funding of its schools. In either case, education takes on the features of a club or local public good, and the manner in which society stratifies becomes a key determinant of both income distribution and aggregate performance.

Rather than survey the literature, which the space available here would not allow us to do adequately, we present instead a very simple model in which the main issues and insights are easily demonstrated and related to some of the relevant papers. These include Loury (1977, 1987), De Bartolome (1990), Borjas (1992a,b), Bénabou (1993a, 1992), Durlauf (1992, 1993), Lundberg and Startz (1992) and Fernandez and Rogerson (1992, 1993), among others. The model is a stripped-down version of Bénabou (1993b). That paper also contains more general versions of the results reported here (with the proofs, which we omit), a more complete review of the literature (especially empirical), and some policy implications.

2. A basic model

There is a continuum of families, with unit measure. Parents are of two types, A and B (rich and poor, White and Black, etc.), in proportions \( n \) and \( 1-n \), and endowed with human capital \( h_A > h_B \). They all reside in a metropolitan area composed of two towns or communities, \( j = 1,2 \), each of which holds a fixed number \( l/2 \) of land plots or housing units; all land belongs to absentee landowners, a neutrality assumption. The proportion of A agents in community \( j \) is denoted \( x_j \), and community 1 is defined as the richer one: \( x_1 \geq 2n - x_2 = x_2 \). There are two periods. A parent with type \( h \in \{ h_A, h_B \} \) living in a community with percentage \( x \) of rich households and paying \( \rho \) in land rent enjoys utility:

\[
V(h, x, \rho) \equiv \max_{\rho} \{ U(c, c', h') = U(\omega(h) + d - \rho, y(h) - P(h, d), F(h, L(x)) \}
\]  

(1)

In the first period, she consumes \( c \) and pays rent \( \rho \) out of her initial resources \( \omega(h) \), plus borrowing \( d \). The interest rate \( r(h, d) \) may depend on her type and on the amount borrowed or saved. In the second period, the amount \( c' \) available for consumption or bequest (both interpretations are possible) equals second period income \( y(h) \), minus debt repayment \( P(h, d) \equiv d(1 + r(h, d)) \). Finally, the child’s human capital \( h' \) is determined by that of the parent (through at-home learning), and by the quality of education in the chosen community, measured some increasing function \( L(x) \) of the local distribution of human capital.

There are two channels through which this distribution can matter. The
first and simplest one is pure 'social capital' spillovers, of the type mentioned earlier. We assume \( L(x) \geq 0 \), \( L(0) = h_B \) and \( L(1) = h_A \), so that \( L(x) \) can be interpreted as an average (not necessarily arithmetic) of local residents' human capital levels; its value \( L(n) \) over a representative sample of the population will be denoted \( L \). A key issue is whether, in a mixed school or neighborhood, it is the stronger individuals who tend to 'pull up' the average to their level, or the weaker ones who 'drag it down' to theirs. These benefits or costs from heterogeneity are reflected in the concavity or convexity of \( L(x) \), which will be an important determinant of the efficiency of equilibrium. The second channel through which community composition matters is decentralized school expenditures \( E(x) \). We do not model here local spending and taxation decisions; see the full model in Benabou (1993b). We point out instead a simple way in which (1) can incorporate the effect of community resources on local public goods spending. Let \( h' = F(h, E(x)) \), and let each town finance its school by taxing residents on their labor income (say, \( y(h) = h \)) at the same fixed rate \( \tau^* \). This can be derived as the unanimous outcome of voting when preferences are logarithmic (Glomm and Ravikumar, 1992). Per pupil expenditures are then \( E(x) = \tau^* L(x) \), where \( L(x) = x h_A + (1-x) h_B \) is mean income in the community, and \( \omega(h) \) is then simply replaced by \( \omega(h) - \tau^* h \) in (1); hence the result. Note that in contrast to the pure spillover model, this one necessarily relies on capital market imperfections, since schools must be financed out of parents' income.

3. Causes of stratification

In period 1, parents choose a community \( C^j, j = 1, 2 \), so as to maximize the resulting utility \( V(h, x^j, \rho^j) \). When will equilibrium in the land market result in stratification? Intuitively, whenever the (human capital) rich are willing or able to bid more than the poor for land in a richer community. Formally, this is a standard single-crossing condition of iso-utility-curves, or bid-rents, in the space of community quality and price:

\[
R_x(h, x, \rho) = \frac{\partial V}{\partial x} \bigg|_{(x^*, \rho^*) = (x, \rho)} = V_x(h, x, \rho) - V_{\rho}(h, x, \rho) \quad \text{increases with } h. \tag{2}
\]

In that case, the slightest divergence from the symmetric equilibrium \( x^1 = x^2 = n \) triggers a cumulative process: rich agents outbid poor ones for land in community 1, thereby further raising \( x^1, \rho^1 \) and lowering \( x^2, \rho^2 \). This leads to further migration of the rich to \( C^1 \) and concentration of the poor in \( C^2 \), until at least one community is completely homogeneous.

**Proposition 1.** (1). If \( R_x(h, x, \rho) > 0 \) for all \( (x, \rho) \), the unique stable equilibrium is stratified: if \( n \leq 1/2 \), all the rich live in community 1 \( (x^1 = 2n, x^2 = 0) \); if
n ≥ 1/2, all the poor live in community 2 \((x^1 = 1, x^2 = 2n - 1)\). The symmetric equilibrium \(x^1 = x^2 = n\) is unstable. (2). If \(R_{h,x}(h,x,\rho) < 0\) for all \((x,\rho)\), the unique equilibrium is completely integrated (i.e. symmetric), and it is stable.

We therefore examine the marginal rate of substitution between first-period consumption and child education. Using the Euler equation for the optimal level of borrowing \(\bar{d}\), we have

\[
R_x(h, x, \rho) = \frac{U_1(c, c', h')}{U_2(c, c', h')} \cdot \frac{F_L(h, L(x))}{P_{d}(h, d)} \cdot L(x).
\]

(3)

Inspection of (3) yields the following, intuitive results (see Bénabou (1993b) for proofs):

**Proposition 2.** Stratification can result from even the smallest degree of:

1. Complementarity between parental education and community quality: \(F_{hL}(h, L) > 0\).
2. Imperfections in credit markets, resulting in a higher opportunity cost of funds for poor families \((\partial P_{d}(h, d)/\partial h < 0)\), when better educated families have higher financial resources \((\omega'(h) > 0, y'(h) > 0)\).
3. Differences in lifetime wealth \((z'(h) = w'(h) + y'(h)/(1 + r) > 0)\), given that education is a normal good \((U_{h,h} \text{ increasing in } z)\).

The simplest case is by far the first one, with linear utility and perfect capital markets: \(U = c + (c' + h')/(1 + r)\). The bid-rent then simplifies to \(R_x(h, x, \rho) = F_L(h, L)E(x)/(1 + r)\), and stratification occurs if families with higher human capital are more sensitive to neighborhood or school quality than those with lower human wealth. If \(n < 1/2\), there are \(B\) agents in both communities, and the equilibrium rent differential is \(\rho - \rho^2 = (F(h_B, L(2n)) - F(h_B, L(0)))/(1 + r)\); if \(n > 1/2\), there are \(A\) agents in both communities, and \(\rho - \rho^2 = (F(h_A, L(1)) - F(h_A, L(2n - 1)))/(1 + r)\). When \(n = 1/2\), perfect segregation is sustained by any differential between these two values. Note that the result is independent of the distribution of financial resources \((\omega, y)\). Thus, in contrast to most of the inequality literature, redistributive policies have no effect on either the distribution of educational attainment or the efficiency of equilibrium.

The second result shows how differences in families’ ‘ability’ to pay complement those in ‘willingness’ to pay for school or community quality. There are a variety of imperfections in loan markets, due to asymmetric information or tax distortions, which raise the opportunity cost of funds for the poor. These include: (a) increasing marginal cost of borrowing \(P(d) = d(1 + r(d))\), \(P', P'' > 0\), such as a wedge between lending and borrowing rates; (b) borrowing constraints, \(d \leq \bar{d}\), which make the Euler condition underlying (3) an inequality at low levels of wealth; (c) tax subsidies to home
ownership relative to renting (interest deductions), when only wealthy families can afford a down payment.

The second channel through which financial resources matter, and this even with perfect credit markets, is by changing parents' relative preferences for education relative to old age consumption or financial bequest. If education is a normal good, the marginal rate of substitution \( \frac{U'/U''}{(c', c', h')} \) which results from optimal borrowing decisions tends to increase with lifetime wealth \( z(h) = \omega(h) + \gamma(h)/(1 + r) \), leading again to segregation if \( z'(h) > 0 \). It should be emphasized that no matter how small wealth differences and credit market imperfections are, they can lead to stratification.

Two other important sorting mechanisms were omitted for brevity. The first one is the standard 'voting with one's feet' of Tiebout (1956): agents flock to communities with a higher proportion of their own type, since decisions over taxation and spending on public goods (e.g. schools) are closest there to their preferred choices. The second one, particularly relevant when poor and rich belong to different ethnic groups, includes any practices (from discrimination in the housing market to outright harassment) which raise the cost to a poor family, relative to a rich one, of moving into a rich community. Having identified these multiple sources of stratification, we shall from here on focus mostly on the simplest case: \( V(h, x, \rho) = z(h) - \rho + F(h, L(x))/(1 + r) \), with \( F_{hL} > 0 \). This is only for expositional purposes, as the points made under these assumptions are quite general (see Bénabou, 1993b).

4. Implications for aggregate productivity

Is it efficient for different classes to segregate in education? Leaving distributional issues to the next section, we focus here on aggregate productivity of the whole metropolitan area. A community with a fraction \( x \) of rich households generates a net surplus equal to \( S(x)/2 \), where

\[
S(x) \equiv xF(h_A, L(x)) + (1-x)F(h_B, L(x)).
\] (4)

When the city stratifies, the net output of community 1 increases by \( S(x^1) - S(n) \), while that of community 2 declines by \( S(n) - S(2n-x^1) \), where \( x^1 = \min \{ 2n, 1 \} \). Gains in the rich community therefore dominate losses in the poor one if \( S \) is convex; the reverse is true if \( S \) is concave. We therefore compute:

\[
2S' = F(h_A, L) - F(h_B, L) + (x F_L(h_A, L) + (1-x) F_L(h_B, L))L';
\]

\[
2S'' = 2(F_L(h_A, L) - F_L(h_B, L)L' + (x F_{LL}(h_A, L) + (1 - x) F_{LL}(h_B, L))L' + (1 - x) F_{LL}(h_B, L))(L')^2 + (x F_L(h_A, L) + (1-x) F_L(h_B, L))L',
\] (5)
where \( L = L(x) \), etc. The first term in \( S'' \) is positive, reflecting an efficiency gain from stratification, if a well-educated family benefits more than a less educated one from an increase in community or school quality: \( F_{hL} > 0. \)

The second term measures how the marginal productivity of community quality (for the average resident) varies with its level: when \( F_{LL} < 0 \), there are decreasing returns, hence an efficiency loss from stratification. The last term measures where a marginal well-educated family contributes most to raising the quality of the community: if \( L' < 0 \), such a family is much less valuable in the already well-educated community which it joins than it was in the education-poor community which it abandons; hence another loss from stratification.

**Proposition 3.** Agents segregate or integrate depending on \( F_{hL} \geq 0 \), no matter how small. The equilibrium can be very inefficient, if \( F_{LL} \) or \( L'' \) are large in absolute value and have the opposite sign of \( F_{hL} \).

Note that the potential for inefficiently low output is even greater when \( F_{hL} < 0 \) and stratification results from credit market imperfections, wealth effects or discrimination, which are unrelated to the productivity of education. On the other hand, standard local public goods (e.g. purchased school inputs \( E(x) \)) will lead to efficient sorting, in the absence of other externalities or imperfections (Tiebout, 1956). When both \( E(x) \) and \( L(x) \) affect education, stratification therefore involves a tradeoff, which is examined in De Bartolome (1990) and Bénabou (1993b). Finally, while we are mostly interested in the case where the city becomes polarized, Proposition 3 also shows how inefficient mixing can occur.

5. Implications for inequality

We now turn to the distribution of gains and losses from stratification. A recurrent theme in the literature, starting with Loury (1977, 1987), is that racial or socio-economic segregation makes inequality more persistent, by compounding disparities in educational inputs at the family and community levels. A proper analysis of persistence requires a dynamic setting. In Bénabou (1993b) we extend the model presented here to overlapping generations, and prove Claims 1 and 2 below; but the underlying intuitions can already be outlined in the present two-period model. Assuming \( n = 1/2 \) for simplicity, we see that inequality in children's attainment and income is indeed larger than if families had remained integrated:

\[ \text{One half of } 2(F_{hL}(\alpha, L) - F_{hL}(\alpha, L))L(x)dx \text{ represents the private gains from trade accruing to a pair of } A \text{ and } B \text{ agents which trade places between communities with compositions } x \text{ and } x+dx. \text{ The other half is external: a marginal rise in } L \text{ is more valuable, ceteris paribus, in the community with more } L\text{sensitive agents; see the expression for } S'. \]
$$\frac{h_A'}{h_B'} = \frac{F(h_A, h_A')}{F(h_B, h_B')} > \frac{F(h_A, \bar{L})}{F(h_B, \bar{L})}. \quad (6)$$

We explain below how this can give rise to ghettos or poverty traps. But first we make clear that the general argument about increased persistence rests on plausible but often implicit assumptions about the appropriate measure of inequality, and the net cost to the rich of separating themselves from the poor. Indeed, better communities and schools come at the cost of higher rents or taxes. Comparing the total wealth of children (human capital plus bequest), or more generally the utility levels of parents, may therefore not lead to the same answer as the standard comparison of educational achievements or earnings:

**Proposition 4.** Stratification need not increase inequality between rich and poor families’ total wealth $c' + h'$ or utility levels. When $n < 1/2$, it is indeed the case that $F(h_A, L') - F(h_B, L') - (1 + r)(\rho^1 - \rho^2) > F(h_A, \bar{L}) - F(h_B, \bar{L})$. But when $n > 1/2$, the inequality is reversed, and when $n = 1/2$, the ranking is ambiguous.

The result follows directly from the values of the equilibrium differential $\rho^1 - \rho^2$ described below Proposition 2, together with $F_{hL} > 0$ and $L' > \bar{L} > L^2$. In the absence of bequests, i.e. if all of $c'$ is consumed in old age, the costs of education are absorbed into parental consumption. But it is then debatable whether one should focus on child inequality or on family inequality. The more fundamental question, however, becomes more apparent if we do interpret $c'$ as a financial bequest, and compare children’s total wealth $c' + h'$, which incorporates the difference between the rents paid and received by their parents. What is the net cost paid by the rich to separate themselves from the poor? Who owns the assets or property rights which make segregation possible, and appropriate the rents which it may create? In Proposition 4, the capital gains $\rho^1 - \bar{\rho}$ and losses $\rho^2 - \bar{\rho}$ accrue to outside landowners, or equivalently to all city residents in equal proportions. It is essentially through less neutral allocations (the $A$’s own relatively more of community 1, the $B$’s of community 2) that stratification will increase inequality in total wealth.

In practice, the rich do appear successful in capturing the capital gains which their secession creates, leaving the corresponding losses to the poor. This may be because they hold the relevant scarce factors (e.g. prime real estate), or because the poor are latecomers (immigrants), or through various collective practices which raise, even temporarily, the relative cost to the poor of joining or remaining in a community which is appreciating. Prime among these – at least historically – is racial segregation. More recent devices such as zoning regulations discriminate instead on the basis of income (Durlauf, 1992, 1993; Wheaton, 1993; Fernandez and Rogerson, 1993). We shall therefore make from here on the standard assumption that human wealth inequality translates into total wealth inequality, without any rent dissipation.
A shown by (6) and confirmed empirically by Borjas (1992a, b), segregation tends to slow down convergence in education and income levels. But it can even magnify small initial disparities, leading to very unequal long-run outcomes. This is the case when $F(h, L)$ has decreasing returns in $h$ alone, but increasing returns in $(h, L)$ jointly over some range. Clearly, if $h_A$ and $h_B$ lie on opposite sides of an unstable fixed point of the equation $h^* = F(h^*, h^*)$, then under perfect segregation $h'_A > h_A$ but $h'_B < h_B$. Under integration, inequality is always reduced (see (6)), but what happens to the levels of human capital depends on the sensitivity of $L$ to heterogeneity.

Claim 1. Stratification can trap poorer families in a steady-state of low human capital and income, while for richer families these variables keep growing. Under the same conditions, integration would have lead to convergence (eliminating inequality) and sustained growth for all families.

The idea that local increasing returns, realized only through segregation, constitute the mechanism through which ghettos or local poverty traps arise and persist, is one of the main insights of the literature (Benabou, 1993a, 1992; Durlauf, 1992, 1993; Lundberg and Startz, 1992).² Another important idea is that stratification can even hurt the productivity and income of richer dynasties, when, in addition to local interactions in education, the different classes interact at the global, or economy-wide level in the production of goods or knowledge. This may result from technological spillovers (Tamura, 1991a, b), complementarities in the labor market (e.g., some are managers, others workers – no market failure is required; Bénabou (1993a, 1992)), or inter-community externalities (Cooper, 1992). A simple way of capturing such this interdependence (see the papers for micro models) is to write individual output or marginal product as

$$y(h) = G(h, H),$$

(7)

where $H$ is an economy-wide index of human capital and $G$ some aggregator. Clearly, one can now have $h'_A > h_A$ and $h'_B < h_B$ and yet $y(h'_A) < y(h_A)$ and $y(h'_B) < y(h_B)$. Intuitively, the combination of highly trained managers and workers with low levels of literacy and numeracy may not be very efficient. More generally, in a dynamic setting, the secession of managerial dynasties can prevent worker dynasties from acquiring the skills necessary to keep up, so that productivity growth slows down and may even die out. When

² Tamura (1991b) and Galor and Tsiddon (1992) present models which combine increasing returns at the individual (country or family) level with an economy-wide technological externality, through which the rich eventually lift the poor out of poverty. The implicit assumption is that the rich do not segregate (i.e., limit interactions to their own group), as they do when given the opportunity in our model.
education uses real resources, this also feeds back on the accumulation of human capital.

Claim 2. Stratification can lead to a long-run level – or even growth rate – of human capital and income which is lower, for all dynasties, than under integration.

As intuition suggests, the relative sensitivity to heterogeneity of the local and aggregate indices \( L \) and \( H \) is a key determinant of the costs and benefits of stratification and so is the degree of complementarity in \( G \); see Bénabou (1992). But the potential for 'self-defeating secession' is a very robust and general feature of models with multi-level interactions and mobility (Bénabou, 1993a). It implies that society may face an intertemporal tradeoff. In the short run, stratification can lead to gains for the rich in excess of the losses of the poor, so that overall growth increases \( (S' > 0 \) in Section 4). Over time, however, the greater heterogeneity of the segregated economy can act as a drag on growth and hurt all dynasties.

6. Conclusion

We used a simple model to demonstrate three very general propositions. First, even minor differences in education technologies, preferences, or wealth, as well as minor imperfections in capital markets, can lead to a high degree of stratification. Second, stratification makes inequality in education and income more persistent across generations; the same is true for total wealth, provided the rich are able to capture the rents created by their secession. Finally, the social polarization of urban areas can be very inefficient, both from the point of view of aggregate growth and in the Pareto sense, especially in the long run.

References

Borjas, G., 1992b, Ethnicity, neighborhoods, and human capital externalities, Mimeo. (University of California, San Diego, CA) Sep.
Cooper, S., 1992, A positive theory of income redistribution, Mimeo. (Stanford University, Stanford, CA) July.


Durlauf, S., 1993, Neighborhood feedbacks, endogenous stratification, and income inequality, Mimeo. (University of Wisconsin, Madison, WI) April.


Tamura, R., 1991b, From decay to growth: A dynamic equilibrium model of income distribution, Mimeo. (University of Iowa, Iowa City, IA) Nov.
