ASHOKA UNIVERSITY

Ashoka University Economics
Discussion Paper 78

Towards a Theory of Behavioral Poverty Traps

April 2022

Dyotona Dasgupta, O.P. Jindal Global University
Anuradha Saha, Ashoka University

https://ashoka.edu.in/economics-discussionpapers

ASHOKA UNIVERSITY
Plot No. 2, Rajiv Gandhi Education City,
National Capital Region,
P.O.Rai, Sonepat, Haryana 131029

Towards a Theory of Behavioral Poverty Traps

Dyotona Dasgupta* Anuradha Saha†

CLICK HERE FOR THE LATEST VERSION

April 15, 2022

Abstract

In a dynamic setting, we build a theoretical model to capture the macroeconomic implications of parental biases on poverty traps and income inequality. Less privileged parents have biased perceptions about 'self-efficacy'. Perceived self-efficacy is shaped by socio-economic backgrounds. We find that biases increase the extent of poverty trap. Without any biases, there exists a poverty trap only when the parental warm glow is low. With biases, there emerges a poverty trap even for moderate warm glow. For high parental warm glow, there may exist a poverty trap. Income inequality in presence of biased parents is always (weakly) higher.

Keywords: Perceived self-efficacy, Behavioral Bias, Human Capital Investment, Poverty Trap.
JEL Codes: J62, D91, E2

*Corresponding author. Jindal Global Business School, O.P. Jindal Global University, Sonipat Narela Road, Near Jagdishpur Village, Sonipat, Haryana 131001 India. E-mail: dasgupta.dyotona@gmail.com

†Ashoka University, Plot 2 Rajiv Gandhi Education City, Sonepat, Haryana 131029. India. E-mail: anuradha.saha@ashoka.edu.in.

1 Introduction

Perceptions about self-efficacy, a behavior well-documented in the psychological literature (Cervone and Peake (1986), Gramzow et al. (2001), to name a few), play an important role in investment decisions. These choices, in turn, have long-run implications on the aggregate economy such as the emergence of a poverty trap or exacerbating inequality. Our paper builds a theoretical model to capture the macroeconomic implications of biased perceptions about self-efficacy. Perceived self-efficacy is an individual's belief about her own ability. Such beliefs may be shaped by her life experiences and by the success or failure of people who she perceives as similar to herself. For example, a farmer may believe that an educated child from their community is unlikely to get a high-skilled job because they have not seen such examples in their community. Even if a policy maker provides them information about promising job opportunities, the farmer may not believe it. This paper models such beliefs and depicts their long run effects in limiting socio-economic opportunities.

In our model, uneducated people are biased and pessimistic about their future.[1] We compare this economy's findings with the case where no one is biased. Since parents make the decision of educational investments, we find that the weight on future or parental warm glow (δ) plays an important role in the outcomes. Figure 1 shows a summary of our findings – biases expand the range of poverty traps. Figure 2 depicts that, for a given warm glow parameter, biases increase the steady-state mass of families which are in a poverty trap. It also depicts that, for any bias, lower warm glow pushes larger mass of population into a poverty trap. Essentially, behavioral anomalies interact with resource constraints to magnify the expected mass of population in poverty traps, as well as worsens income inequality.

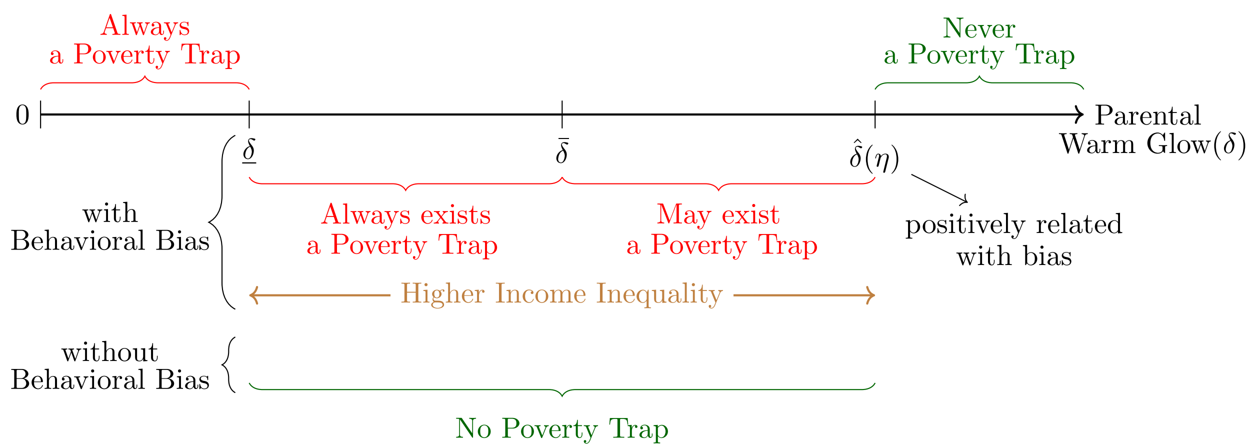

Figure 1: Implications of Behavioral Bias: A Steady State Overview [colored]

[1] Dasgupta and Saha (2021) builds a more general framework where educated people can also be biased.

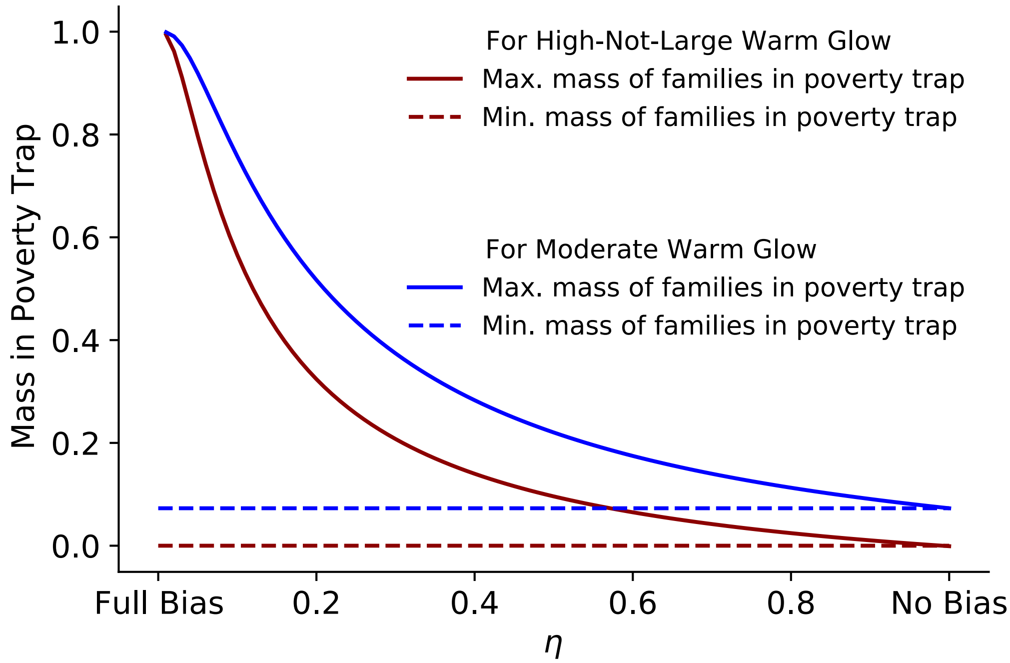

Figure 2: Range of Population Mass in Poverty Trap [colored]

2 Model

In an economy, there are two sectors – skilled and unskilled. The production function in the skilled sector is AL_{St}^{ϕ}, where L_{St} is the mass of skilled workers, $\phi \in (0,1)$ captures DRS and $A \geq 1$ is productivity. The production function in the unskilled sector is L_{Ut}. The skilled workers earn the wage and divides the profit of the skilled sector among themselves equally, hence, the income of a skilled worker is $AL_{St}^{-(1-\phi)}$. As, the unskilled sector makes no profit, the income of an unskilled worker is just her wage, 1. The total mass of workers is normalized to 1. We find that the income of a skilled worker is higher than an unskilled worker.

Education is necessary but not sufficient to get a job in the skilled sector. An educated individual becomes a skilled worker with probability $\beta \in (0,1)$. Education is costly – the fixed cost of education is $\bar{s}$. A parent derives utility from her own consumption, c_t, and 'conjectured' income, $E\omega_{t+1}$, of her only child.

$$\max_{i=\{0,1\}} \frac{(c_t)^{\sigma}}{\sigma} + \delta \frac{(E\omega_{t+1})^{\sigma}}{\sigma}, \quad \sigma < 0 < \delta, \quad \text{subject to} \quad c_t + \mathbb{1}_i \cdot \bar{s} = m_t$$

where i takes the value 1 when the parent invests in her child's education, otherwise 0.

The conjectured income, $E\omega_{t+1}$, of a child is the income which the parent thinks that her child would earn in the next period. It depends on the conjectured probability with which an educated child becomes a skilled worker and the estimated incomes of skilled workers. While everyone knows that the true probability of an educated child to become a skilled worker is β, uneducated workers are *biased*. They believe that their educated children would become skilled workers with probability

$\eta\beta$, where $\eta \in [0,1)$ captures their biases. Note, lower η implies higher biases. Uneducated workers are otherwise rational – their estimated skilled income of her child is consistent with their beliefs. Educated workers are not biased and believe that the probability of any educated child getting a skilled job is β.

In period t, a skilled worker earns $A(\beta N_t)^{-(1-\phi)}$, where N_t is the mass of educated persons. When she believes that all uneducated parents, all educated-unskilled parents and all other skilled parents invest with probability μ_{ut}, μ_{nt} and μ_{st} respectively, she invests in her child's education, *if and only if*

$$\frac{\left(A(\beta N_t)^{-(1-\phi)} - \bar{s}\right)^{\sigma}}{\sigma} + \delta \frac{\left[\beta \cdot A\Big[\beta\big[\mu_{st} \cdot \beta N_t + \mu_{nt} \cdot (1-\beta)N_t + \mu_{ut} \cdot (1-N_t)\big]\Big]^{-(1-\phi)} + (1-\beta)\right]^{\sigma}}{\sigma} \geq \frac{\left(A(\beta N_t)^{-(1-\phi)}\right)^{\sigma}}{\sigma} + \frac{\delta}{\sigma}, \tag{1}$$

when μ_{st} is a fraction, the above condition holds with equality.
Similarly, at period t, an educated-unskilled worker invests in her child's education if and only if

$$\frac{(1-\bar{s})^{\sigma}}{\sigma} + \delta \frac{\left[\beta \cdot A\Big[\beta\big[\mu_{st} \cdot \beta N_t + \mu_{nt} \cdot (1-\beta)N_t + \mu_{ut} \cdot (1-N_t)\big]\Big]^{-(1-\phi)} + (1-\beta)\right]^{\sigma}}{\sigma} \geq \frac{1}{\sigma} + \frac{\delta}{\sigma}, \tag{2}$$

when μ_{nt} is a fraction, the above condition holds with equality.
Finally, an uneducated parent with behavioral bias η invests in her child's education if and only if

$$\frac{(1-\bar{s})^{\sigma}}{\sigma} + \delta \frac{\left[\eta\beta \cdot A\Big[\beta\big[\mu_{st} \cdot \beta N_t + \mu_{nt} \cdot (1-\beta)N_t + \eta\mu_{ut} \cdot (1-N_t)\big]\Big]^{-(1-\phi)} + (1-\beta\eta)\right]^{\sigma}}{\sigma} \geq \frac{1}{\sigma} + \frac{\delta}{\sigma}, \tag{3}$$

when μ_{nt} is a fraction, the above condition holds with equality..

An equilibrium, $\langle \mu_{ut}, \mu_{nt}, \mu_{st} \rangle$, is defined such that (i) no parent has an incentive to deviate unilaterally and (ii) the conjectured income, and hence the expected returns from investment, for any type of parent is consistent with their own beliefs.

Without any bias, investment decisions among different types of workers differ only because of differences in income.[2] The inclusion of behavioral biases is an additional dimension for workers to differ in their investment decisions. As the income of skilled worker is higher than the income of an unskilled, whenever at an equilibrium, an *unbiased unskilled* worker invests with a positive probability, the skilled workers invest with probability one.

At the steady state, the mass of educated, hence the mass of skilled workers remain constant.

[2] Observe (2) and (3) become the same without any bias (when $\eta = 1$).

However, the education and job status of a family may change over time. We say that a steady state has a poverty trap, if a positive mass of families remain uneducated forever. Thus, these families can never work in the skilled sector and remain poor forever.

2.1 High Warm Glow

We, first, consider a society where the warm glow parameter is high $\delta \geq \bar{\delta} \equiv \dfrac{(1-\bar{s})^{\sigma}-1}{1-(A\beta^{\phi}+1-\beta)^{\sigma}}$. This range of high warm glow parameter is defined such that, in the absence of biases, all workers invest with certainty. In fact, we find that for any unbiased individual, investing with probability one is a strictly dominating strategy. Thus, with behavioral bias, only two types of steady states are possible: (a) without a poverty trap – all parents invest with probability one, (b) with a poverty trap – only educated invest with probability one and uneducated never invest.

The steady-state properties are determined by the degree of parental warm glow and biases. Pessimism makes biased parents less keen to invest. A very biased (low η) parent, even with high (but not very large) warm glow, does not invest. Given the degree of bias and the mass of educated persons in the economy, (η, N), there is a threshold of parental warm glow below which biased parents do no invest in their children's education. Higher the bias or larger the mass of educated persons (which lowers skilled incomes), lower is the incentive to invest for biased parents at a given parental warm glow. Based on these attributes, we define thresholds for warm glow and N which characterize the conditions where biases create a poverty trap.

Definition 1. *For any $\eta \in [0,1)$, we define two thresholds. First, given mass of educated workers, we define a threshold for warm glow parameter, $\hat{\delta}(\eta, N)$. Second, given warm glow parameter, we define a threshold for mass of educated workers, $\hat{N}(\eta, \delta)$. At each of these thresholds an uneducated worker is indifferent between investing and not investing when all educated workers invest with probability one, and all other uneducated workers do not invest. Mathematically, from* (3)

$$\hat{\delta}(\eta, N): \quad \frac{(1-\bar{s})^{\sigma}}{\sigma} + \hat{\delta}\frac{[\beta\eta A(\beta N)^{-(1-\phi)} + (1-\beta\eta)]^{\sigma}}{\sigma} = \frac{1}{\sigma} + \frac{\hat{\delta}}{\sigma},$$
$$\hat{N}(\eta, \delta): \quad \frac{(1-\bar{s})^{\sigma}}{\sigma} + \delta\frac{[\beta\eta A(\beta \hat{N})^{-(1-\phi)} + (1-\beta\eta)]^{\sigma}}{\sigma} = \frac{1}{\sigma} + \frac{\delta}{\sigma}.$$

Observe, for any $\eta \in [0,1)$, $\hat{N}(\eta, \bar{\delta}) = \left[\frac{1}{\eta}\left(1 - \frac{1-\eta}{A\beta^{-(1-\phi)}}\right)\right]^{-\frac{1}{1-\phi}}$. And, if $\hat{N}(\eta, \bar{\delta}) < 1$, then $\hat{\delta}(\eta, N) > \bar{\delta}\ \forall N \in (\hat{N}(\eta, \bar{\delta}), 1]$. The parametric condition $\hat{N}(\cdot) < 1$ ensures that, even for high warm glow, there exists a range of N, the mass of educated, at which the uneducated workers do not invest in their children's education.

Proposition 1. Steady State for High Warm Glow

1. *On the existence of behavioral poverty trap.*

   (a) *Without any biases, $\eta = 1$, there is no poverty trap – all parents invest with probability one.*

(b) *With behavioral biases, suppose* $\eta \in (0,1)$ *is such that* $\left[\frac{1}{\eta}\left(1-\frac{1-\eta}{A\beta^{-(1-\phi)}}\right)\right]^{-\frac{1}{1-\phi}} < 1$. *When the warm glow parameter is not very large:* $\delta \in [\bar{\delta}, \hat{\delta}(\eta, 1))$ *and the mass of educated workers is larger than* $\hat{N}(\eta, \delta)$*, there is a poverty trap – all educated invest with probability one and no uneducated invest. For* $\delta \geq \hat{\delta}(\eta, 1)$*, there does not exist any poverty trap.*

2. *Income inequality is weakly higher with behavioral biases.*

We collect all the the proofs in the Appendix.

In an economy without any biases and for high parental warm glow, all parents invest with certainty and there is no poverty trap. However, when parents are biased, Proposition 1. (part 1.(b)) provides conditions where they do not invest. Therefore, even when parental warm glow is high, biases could produce a poverty trap where the uneducated do not invest in education and remain uneducated and unskilled forever. Interestingly, biased parents do not invest when the mass of educated is higher than $\hat{N}(\eta, \delta)$. It is as if a large mass of educated individuals discourages the handful of uneducated workers from investing and entraps them in a behavioral poverty trap.

Figure 3 depicts a numerical example where the true probability of success is 0.9 but biased parents believe it to be 0.63 (or $\eta = 0.7$).[3] Even for warm glow as high as $\delta = 0.89$, about 5% of the population ends up in a poverty trap (i.e. $\hat{N}(0.7, 0.89) = 0.958$).

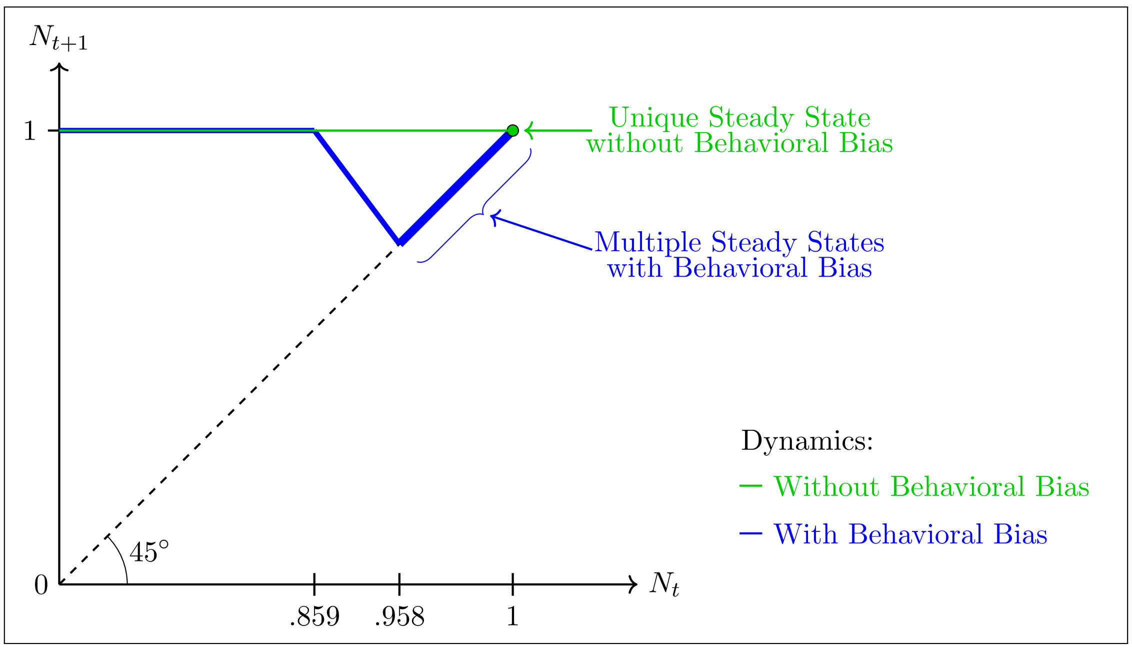

Figure 3: Dynamics and Steady States: High Warm Glow (the figure is not to scale) [colored]

[3]Recall, higher η signifies lower bias, $\eta = 1$ being no bias at all.

2.2 Moderate Warm Glow

The range of moderate warm glow parameter, $\delta \in (\underline{\delta}, \bar{\delta})$, is defined such that, in the absence of biases, unskilled workers do not invest with certainty. We, first, depict, and then discuss the main result of this section.

Proposition 2. Steady State for Moderate Warm Glow

1. *On the existence of behavioral poverty trap.*
   (a) *Without any behavioral bias, $\eta = 1$, there is no poverty trap – all skilled workers invest with probability 1 and all unskilled workers invest with a fractional probability.*
   (b) *With behavioral bias $\eta \in [0, 1)$, there always exists a poverty trap – all educated invest with probability one and no uneducated invest.*
2. *In any steady state with behavioral bias, as long as the educated-unskilled are investing with a positive probability, income inequality is weakly higher.*

The above proposition establishes that in the absence of biases, there exists a unique steady state at which all skilled parents invest with certainty and all unskilled invest with a strict fractional probability. Therefore, in the steady state there exists a positive mass of uneducated. However, as they invest with a positive probability, their descendants of uneducated can become skilled workers (i.e. earn higher incomes) with a positive probability. Thus, there is no poverty trap without behavioral bias. In contrast, in an economy with behavioral anomalies, no matter how small the bias is, there always exists a steady state where the biased uneducated parents never invest. Hence, those families remain poor forever.

In Figure 4, we depict the previous numerical example ($\eta = 0.7$) for a moderate warm glow (in particular $\delta = 0.51$) and find 8-14% of the population remain in a poverty trap. For some initial conditions, $N_t (\in [.703, .72]$ for example), there are multiple equilibria. Due to behavioral anomalies, there are multiple steady states and at each of them there is a poverty trap, i.e. the descendants of an uneducated worker always remains uneducated.

3 A Discussion

This paper, we believe, is one of the first steps towards a theory of behavioral poverty traps. Such poverty traps are fundamentally different from other kinds of poverty traps as they may be hard to detect and correct. The seminal paper Galor and Zeira (1993), in a traditional framework, establishes the existence of poverty trap due to imperfect credit markets and fixed costs of education. Our model without behavioral bias is similar to Galor and Zeira (1993) in terms of fixed cost of education but, unlike theirs, parental incomes are sufficient to pay for the cost of education. Without biases, in our framework, there is no poverty trap when the parental warm glow is not low. However, in the presence of behavioral anomalies there is an emergence of poverty trap even

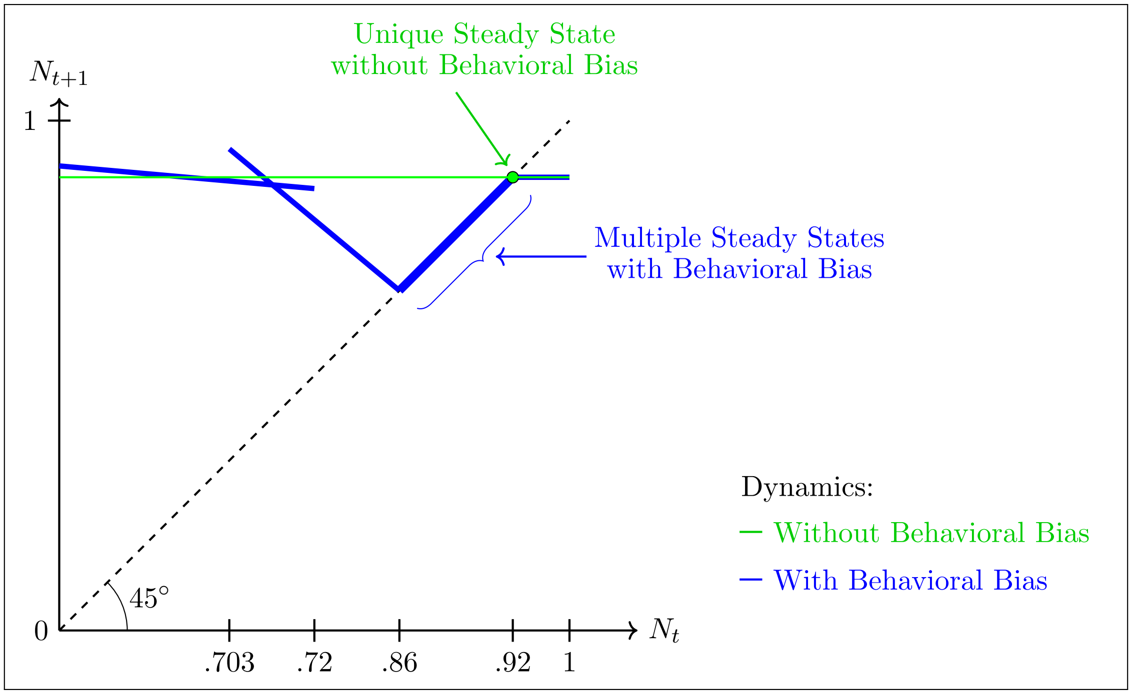

Figure 4: Dynamics and Steady States: Moderate Warm Glow (the figure is not to scale) [colored]

when parental warm glow is not low: There always exists a poverty trap when parental warm glow is moderate, while for high warm glow, there may be one. This paper conclusively shows that behavioral constraints magnify resource constraints. The two may interact to entrap more people in persistent poverty.

References

Cervone, Daniel and Philip K Peake, "Anchoring, Efficacy, and Action: The Influence of Judgmental Heuristics on Self-efficacy Judgments and Behavior," *Journal of Personality and Social Psychology*, 1986, *50* (3), 492.

Dasgupta, Dyotona and Anuradha Saha, "Perception, Biases and Inequality," *Ashoka University Economics Discussion Paper*, 2021, (72).

Galor, Oded and Joseph Zeira, "Income Distribution and Macroeconomics," *Review of Economic Studies*, 1993, *60*, 35–52.

Gramzow, Richard H, Lowell Gaertner, and Constantine Sedikides, "Memory for in-group and out-group information in a minimal group context: The self as an informational base.," *Journal of Personality and Social Psychology*, 2001, *80* (2), 188.

Appendix

Proof of Proposition 1 *(a)* It is sufficient to show that for $\delta \geq \bar{\delta}$, unskilled workers invest with probability 1 even at the minimum income of a skilled workers. The minimum possible income of a skilled worker is $A\beta^{-(1-\phi)}$. Now, without any bias $\eta = 1$, eq. (2) and (3) become the same, and at $\bar{\delta}$, we get

$$\bar{\delta}\left[\frac{[\beta \cdot A\beta^{-(1-\phi)} + (1-\beta)\cdot 1]^{\sigma}}{\sigma} - \frac{1}{\sigma}\right] = \frac{1}{\sigma} - \frac{(1-\bar{s})^{\sigma}}{\sigma}.$$

Since the the utility from investment is strictly increasing in δ, the probability of investment remains 1 for $\delta \geq \bar{\delta}$.

(b) As observed above, the condition $\left[\frac{1}{\eta}\left(1 - \frac{1-\eta}{A\beta^{-(1-\phi)}}\right)\right]^{-\frac{1}{1-\phi}} < 1$ ensures that at such η, $\hat{\delta}(\eta, 1) > \bar{\delta}$, and $\hat{N}(\eta, \bar{\delta}) < 1$. Thus, we must have $\forall \delta \in [\bar{\delta}, \hat{\delta}(\eta, 1)]$, $0 < \hat{N}(\eta, \delta) < 1$ because $\hat{N}(\eta, \delta)$ decreases with δ.

For $\delta \in [\bar{\delta}, \hat{\delta}(\eta, 1))$, from Definition 1 it follows that for $N > \hat{N}(\eta, \delta)$ uneducated workers invest with zero probability when the educated population invests with probability one. Following the steps in part (a), investing with probability one is strictly dominating strategy for all educated. Thus, here uneducated never invest and remain uneducated, which is a behavioral poverty trap. For $\delta \geq \hat{\delta}(\eta, 1)$, it is immediate from Definition 1 that all workers invest with probability 1, hence there does not exist any poverty trap.

2. In the presence of behavioral biases, as the mass of skilled workers is weakly lower, and their incomes are weakly higher, the result follows. □

Proof of Proposition 2 *1.(a)* As the mass of educated remains constant at any steady state, in an economy without behavioral biases, there could be only three types of steady states – (i) all parents invest with probability one, (ii) no parents invest, (iii) all skilled invest with probability one and all unskilled invest with a certain probability such the mass of educated remains the same. Now, by the definition of $\underline{\delta}$ and $\bar{\delta}$, when $\delta \in (\underline{\delta}, \bar{\delta})$ neither (i) nor (ii) is possible. For any $\delta \in (\underline{\delta}, \bar{\delta})$ and $\eta = 1$, there exists a unique probability with which unskilled workers invest such that the mass of educated remains constant over time. From the definition of steady state and eq. (2) or (3):

$$\begin{array}{c}\text{prob. of investment for unskilled } \lambda_u^*(\delta) \\ \text{and steady state mass of educated } N^*(\delta)\end{array} : \begin{cases} \lambda_u^* \cdot (1-\beta N^*) + \beta \cdot N^* = N^* \\ \frac{(1-\bar{s})^{\sigma}}{\sigma} + \delta\frac{[\beta A(\beta N^*)^{-(1-\phi)} + (1-\beta)]^{\sigma}}{\sigma} = \frac{1}{\sigma} + \frac{\delta}{\sigma}. \end{cases}$$

1. (b) First, we find out the necessary and sufficient conditions for the existence of the equilibrium where all educated invest with probability 1 and no uneducated invest, $\langle \mu_u, \mu_n, \mu_s \forall \equiv \langle 0, 1, 1\rangle$,

which is also a steady state. In this steady state, indeed, there is a poverty trap, as the families who are uneducated remain poor forever with certainty.
Then, we show that at any $\eta \in [0,1)$, for moderate warm glow, those conditions are satisfied.

Recall, the decision of uneducated and educated unskilled workers differ only because of the difference in their beliefs about the probabilities of their children getting skilled jobs. As, $\eta\beta < \beta$, the investment condition of the educated-unskilled workers, eq. (2), would give us the maximum and that of the uneducated workers, eq. (3), would give us the minimum of the mass of the educated workers, such that $\langle 0,1,1\rangle$ is an equilibrium.[4]

$$N_{\max} \equiv \tilde{N}(\delta) : \frac{(1-\bar{s})^\sigma}{\sigma} + \delta \frac{[\beta A(\beta\tilde{N})^{-(1-\phi)} + (1-\beta)]^\sigma}{\sigma} = \frac{1}{\sigma} + \frac{\delta}{\sigma}$$
$$N_{\min} \equiv \hat{N}(\eta,\delta) : \text{ as defined in Definition 1.}$$

Now observe, $0 < \hat{N}(\eta,\delta) < \tilde{N}(\delta) < 1 \ \forall \delta \in (\underline{\delta}, \bar{\delta})$ and $\forall \eta \in [0,1)$. Therefore, the equilibrium $\langle 0,1,1\rangle$ exists for $N \in [\hat{N}(\eta,\delta), \tilde{N}(\delta)]$.

2. Suppose not. There exists a steady state, with behavioral bias, where the educated-unskilled workers invest with a positive probability, and the steady-state skilled income without bias (m_s say) is strictly higher than that with bias (m_s^b say).

Consider the decisions of an educated-unskilled worker from each of the scenarios. As both of them are investing with a positive probability,[5] we must have

$$\delta\Big[\frac{[\beta\cdot m_s^b + 1-\beta]^\sigma}{\sigma} - \frac{1}{\sigma}\Big] \geq \frac{1}{\sigma} - \frac{(1-\bar{s})^\sigma}{\sigma} = \delta\Big[\frac{[\beta\cdot m_s + 1-\beta]^\sigma}{\sigma} - \frac{1}{\sigma}\Big] \quad \Rightarrow \quad m_s^b \geq m_s.$$

This is a contradiction. □

[4]At $\tilde{N}$, an educated-unskilled worker would just be indifferent between investing and not investing when all other educated workers invest and no uneducated invest. Similarly, at $\hat{N}$, an uneducated worker is indifferent between investing and not investing when all educated workers invest and no other uneducated invest.

[5]Recall, in an economy without any bias, at the steady state the unskilled workers invest with probability $\lambda_u^*(\delta)$ which is a strict fraction. Hence, eq. (2) holds with equality.