The Impact of Loss Aversion in Poverty Traps

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1 Introduction

Understanding why 659 million people live in extreme poverty — less than two dollars a day — is a complicated but urgent global issue [The World Bank, 2022]. If economists fail to understand the determinants of poverty, helpful intervention strategies will fail to alleviate the underlying problems in the economies that are crushing the impoverished. Economic models based in standard economic theory have been an essential tool in the progress made so far, however, there is a lot of evidence psychology impacts people's decision making, especially when it comes to handling money [Haushofer and Fehr, 2014]. By incorporating the ideas of nonstandard decision making in behavioral economics, a better understanding of the dynamics of poverty might emerge.

This paper explores how a person's psychology can affect the poverty dynamics not predicted in standard models. Specifically, I modify a classic yet simple economic model from Banerjee and Newman [1994] of a poverty trap to incorporate the psychological feeling of loss aversion. This paper combines two important areas of research: poverty traps and behavioral economics.

The theory of a poverty trap argues that within an economy, there can exist a self-reinforcing mechanism where someone's poverty keeps them in poverty. This is different from the standard view of poverty, where if one works hard enough they can climb the economic ladder, though maybe slowly, into a higher wealth level. In a poverty that, the condition of the economy means that even when someone works their hardest, saves, and does everything right, they will never leave poverty. The mechanisms arise from issues like nutrition [Dasgupta and Ray, 1987], borrowing and lending [Banerjee and Duflo, 2011, Chapter 7], and psychological behaviors like temptation [Banerjee and Mullainathan, 2010] and inattention [Banerjee and Mullainathan, 2008]. All mechanism contain the same fundamental ideas that below a certain wealth level someone can never gain wealth, and that the only way to bring people out of this trap is for an external source, often a government, to push them into a higher wealth level just over the trap.

In Figure 1 [Banerjee and Duflo, 2011], the qualities of a poverty trap take on a "S-Shaped Curve". This S-Shaped function visualizes a theoretical prediction of someone's future earnings as a function of their current earnings, and how below a certain point a person's earnings will only decrease. Individuals that start with wealth just below the unstable steady state, P, converge a lower wealth at point N, the "poor" stable steady state. Individuals above the poverty trap line P earn more every subsequent period, converging to a higher wealth at point Q, the "rich" steady state. This also means the small difference in wealth between starting points A1 and B1 result in a massive difference over time. A powerful insight then about poverty traps is that small changes in wealth can have significant, long-run effects for both the individual and the economy.

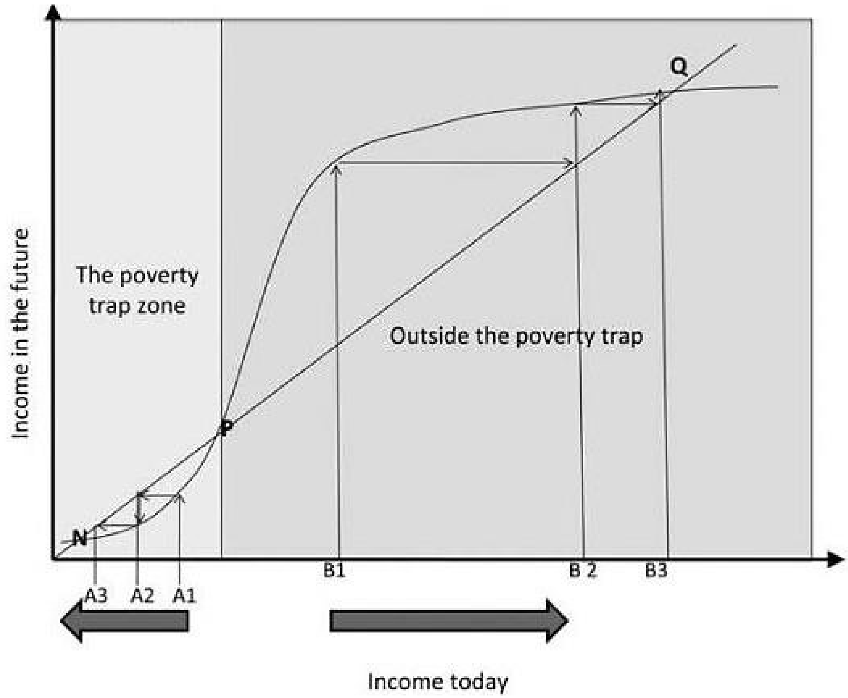

Figure 1: The S-Shaped Curve of a Poverty Trap

In an economy where a poverty trap exists, there's a stronger role for policy intervention than in a world where poverty is a matter of hard work. Again, if poverty is not a trap — graphically, this would look like Figure 1 but from P onward, where P is 0 — then through hard work, anyone in poverty can slowly climb out of poverty. Here, a small financial push is not a useful policy intervention as it won't change the long-run equilibrium for that individual or economy. It's like pushing someone from B1 to B2. But when a poverty trap exists, interventions can have change the trajectory of an individual and the entire economy for the better. Most policy interventions take the role of a cash injection, but depending on the source of the trap, other types of policy can alleviate its effects. There's been notable success in interventions such as developing Microfinance Institutions (MFIs) [Banerjee and Duflo, 2011, Chapter 7], free education [Banerjee and Duflo, 2011, Chapter 4], and nutritional supplements and food price ceilings [Banerjee and Duflo, 2011, Chapter 2]. By identifying where a poverty trap exists, policy makers can implement specific and targeted interventions to make sure all individuals can climb the economic ladder and engender the growth of the economy.

The second topic I focus on is behavioral economic theory, specifically the theory of loss aversion. Behavioral economics reconciles observed behavior with standard economics, involving the psychology of nonstandard decision making in economic models. Loss aversion is the idea that people feel losses more intensely than gains. This idea was famously introduced in Kahneman and Tversky [1979], but has since blossomed. Research in recent decades has found people exhibit loss aversion in many different environments, like in the equity premium puzzle [Benartzi and Thaler, 1995], regarding the endowment effect [Kahneman et al., 1991], and a number of puzzles in labor economics [Fehr and Goette, 2007]. As more evidence emerges that people are very loss averse, it's worth exploring how loss aversion might affect poverty.

The results of my model shows that loss aversion significantly disrupts the dynamics of an existing poverty trap. My model was adapted from Banerjee and Newman [1994], which explores a moral hazard issue within a capital market and the intergnerational poverty trap model that emerges. When I introduce loss aversion, parents dislike giving less to their child than what they started out with in life. To avoid this, poor parents consume less for themselves and spend a greater share of their income on their child. This admits notable changes to the baseline poverty trap model. First, I find the model adopts "sticky" ranges of wealth — a collection of unstable steady states — near both the original unstable steady state and the rich stable steady state. This means for some people who would have converged to abject poverty, they instead stay at a slightly higher wealth; and, some very wealthy people who would've converged down to the rich equilibrium actually stay wealthier. This has the effect of reducing the total number of people who converge to poverty but increasing wealth inequality. Second, those who still converge to abject poverty do so slower than in the baseline model. It takes more generations for family lines to completely cluster at 0 wealth than previously predicted. My findings could offer insight on why some intervention strategies that offer small financial pushes don't see much change in long-term outcome, and reconcile observed poverty dynamics with those predicted in the baseline model.

My model supports previous research from Blumberg and Kremer [2014], which show a similar range of sticky wealth levels. In this paper, the authors apply loss aversion to risky borrowing, which creates a behavioral poverty trap. Loss aversion in my model does not create the poverty trap, it simply changes an existing poverty trap's dynamics. The result of both models, however, differ the same way from the classic two stable steady state equilibria, and introduce a range of possible unstable or semi- steady state wealth levels that disrupt the classic S-Shaped function.

In Section 2, I analyze the baseline model of a poverty trap from moral hazard in a capital market. Then in Section 3, I build off the baseline model and incorporate loss averse preferences using the reference-dependent framework in behavioral economics. Finally, I offer concluding remarks in Section 4.

2 Baseline Model

In this section, I analyze and highlight key features of the Banerjee and Newman [1994] paper which I modify into my own model in Section III.

In Banerjee and Newman [1994], the authors analyze a specific case from a poverty trap model based on their previous research that has since become foundational. This paper was adapted from the authors' earlier work Banerjee and Newman [1993], which has since become foundational to the study of poverty trap models. The basic premise of their model is that all individuals use what wealth they start out with in life as collateral to borrow and invest in a capital market. Because of a moral hazard issue where an individual with low enough wealth might chose to run away with the loan they borrowed, banks lend lower amounts of capital to those who with lower amounts of collateral, wealth. Despite a convex production set — whereas previous models had to assume a nonconvex function to generate a poverty trap [Galor and Zeira, 1993] — those with low wealth will earn a substantial amount less than those with higher wealth. A parent who has participated in this capital market, splits their income between present consumption and a bequest for their child. This generates an inter-generational poverty trap when the bequest is lower for their child than the parent's initial wealth; a cycle begins where every subsequent generation is poorer than the last until they converge to 0 wealth, abject poverty. This paper considers a special case of the model that is both tractable and preserves useful insights about poverty traps within a capital market.

Consider an economy with people who differ in starting wealth but have access to borrowing in capital market. A person lives for only one period, t, and has one child that lives in the next period, $t+1$. They start out with some initial wealth, w_t, and over their period they earn money to spend it all at the end. A person has a Cobb-Douglass utility function over their own consumption, c_t, and bequests for their child, b_t where their propensity to bequeath is denoted as σ:

$$U(c_t, b_t) = (1-\sigma)\ln(c_t) + \sigma \ln(b_t) \tag{1}$$

People earn money by putting their initial wealth up as collateral to borrow capital, k, to invest in production. The market's production function is: $f(k) = R\min\{k, \underline{k}\}$. This linear function has a marginal return rate of R for every unit of capital invested between 0 and $\underline{k}$. However, for every unit of capital invested after $\underline{k}$, the marginal return is 0. At the end of their period, their total income is $f(k) - kr + wr$. Here, $-kr$ is the loan the borrower pays back, weighted by the gross rate interest, r; and $+wr$ is the borrower's returned collateral, also weighted by r. Any individual in this economy would maximize their payoff by borrowing exactly $\underline{k}$, since borrowing anymore would yield no return but garner the cost of r for every additional k borrowed. We denote $\underline{k}$ as the *first-best* level of capital since this is the optimal amount to borrow.

Due to a moral hazard problem within the capital market, banks administer loans based on a person's collateral, their initial wealth. Because a lender cannot completely monitor every person, there is some non-zero probability someone might run away — renege — with the capital they borrowed. When a person reneges, they sacrifice their collateral but keep the loan and the returns of production. A person will only renege if they believe the expected value of running away exceeds paying back the loan and getting their collateral back. Let the probability of being caught depend on the size of the loan: $\pi(k) = \pi\min\{k, \overline{k}\}$. Where $\overline{k} > \underline{k}$, and $R, r, \underline{k}, \overline{k}, \pi$ are all exogenously determined.

A bank must balance lending out as much as they can, but no enough someone would want to run away with the loan. By lending more, both the borrower and the bank are better off. But moral hazard means some people might renege if lent too much. These constraints means banks will only lend an amount of capital such that borrowers are indifferent to or prefer paying back the loan instead of reneging:

$$f(k) - kr + wr \geq [1 - \pi(k)]f(k) \tag{2}$$

This can be further simplified as

$$\pi(k)f(k) - kr + wr \geq 0$$

$$\pi Rk^2 - kr + wr \geq 0$$

Some people with high enough initial wealth simply wouldn't want to renege and can borrow the first-best level of capital. Those who are rich have a lot to lose by sacrificing their collateral, whereas those who are poor might be sacrificing very little. So for those who are rich enough, they will never renege. This creates a wealth cut-off point for those who can borrow the first-best amount of capital and those under this wealth level who cannot. This wealth cut off, w^*, is be found by plugging $\underline{k}$ into the above Inequality 2, and solving for wealth. This admits a wealth cut off of $w^* = \underline{k} - \frac{\pi R\underline{k}^2}{r}$ where those above this wealth, $w > w^*$, borrow the first-best level of capital, $\underline{k}$.

Below w^*, individuals will only be lent $k < \underline{k}$ — the *second-best* level of capital — which is a function of the initial wealth. To determine how much capital is lent depending on one's wealth, I solve for the smallest root in the simplified Inequality 2. (The larger of the two roots breaks the assumption $\overline{k} > \underline{k}$.) This will admit capital as a function of wealth:

$$k(w_t) = \frac{r - \sqrt{r^2 - 4\pi Rrw_t}}{2\pi R} \tag{3}$$

After an individual borrows either the first-best or their second-best level of capital, the total income be be written exclusively as a function of their initial wealth:

$$V(w_t) = \begin{cases} \underline{k}(R-r) + w_t r, & \text{if } w_t \geq w^* \\ k(w_t)(R-r) + w_t r, & \text{if } w_t < w^* \end{cases} \tag{4}$$

such that $k(w_t)$ is be expressed as Equation 3.

Banerjee and Newman assume the constraints $R > r > 2\overline{k}\pi R$ and that $\sigma R < 1$. Using their utility function in Equation 1, I then derive the share of an individual's income which they will bequeath to their child.

$$w_{t+1} \equiv b_t = \sigma V(w_t) \tag{5}$$

By plugging Equation 4 into Equation 5, we get Equation 6.

$$b_t \equiv b_t(w_t) = \begin{cases} \sigma\left(\underline{k}(R-r) + w_t r\right), & \text{if } w_t \geq w^* \\ \sigma\left((R-r)\frac{r-\sqrt{r^2-4\pi R r w_t}}{2\pi R} + w_t r\right), & \text{if } w_t < w^* \end{cases} \tag{6}$$

In this bequest function, an intergenerational poverty trap emerges for those below a certain wealth level who give a bequest less than what their own initial wealth, $b_t < w_t$. This wealth level is the unstable steady state point, where those below it are in the poverty trap and those above enter a state of upward mobility where each generation earns more than the last. For children below the poverty trap line, the wealth they start out with will be less than their parent's initial wealth. This means the child will borrow less, have lower future earnings, and give even less as a bequest to their own child. Note that within this economy, everyone is borrowing as much as they can for the largest returns, everyone tries their best. Yet, due to the poverty trap, some lineages will helplessly converge to poverty. I graphically visually the recursive nature of bequests:

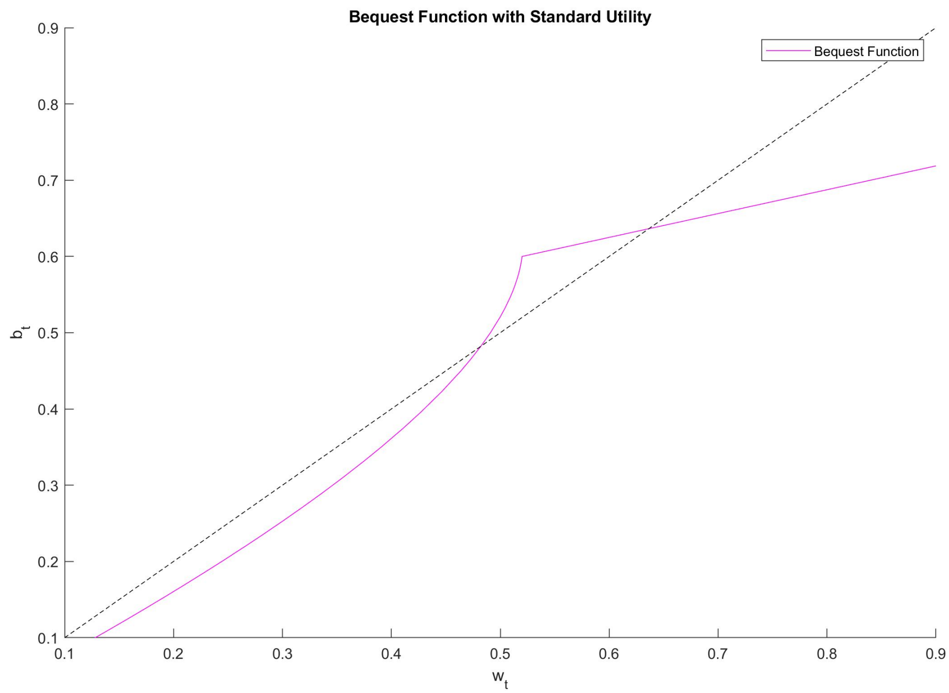

Figure 2: Recursion Diagram for Bequests (Equation 5)

In Figure 2, I fix the exogenous variables to give a clear example of a poverty trap. For wealth levels below .475, the poverty trap line, an individual's lineage will be stuck in the poverty trap converging to 0, the "poor" stable steady state. Between .475 to .65, individuals are in a state of mobility: they gain wealth every generation converging to the "rich" stable steady state around .65. Those above that wealth level converge down to that rich equilibrium point. This clearly adopts the same S-shaped features as in Figure 1. For further analysis, the dynamics of this poverty trap can be seen when applied to each individual in a population

2.1 Wealth Distribution

In this section, I create various population distributions to visualize the long-term and aggregate affects of this baseline poverty trap.

2.1.1 Uniform Distribution

First, I employ a uniform distribution between wealth levels from 0 to 1 and I set the population size at 1000 individuals. The following figure shows the long-term effects of this poverty trap over 20 periods (generations). I display both the views from the initial period (left) and the end period (right).

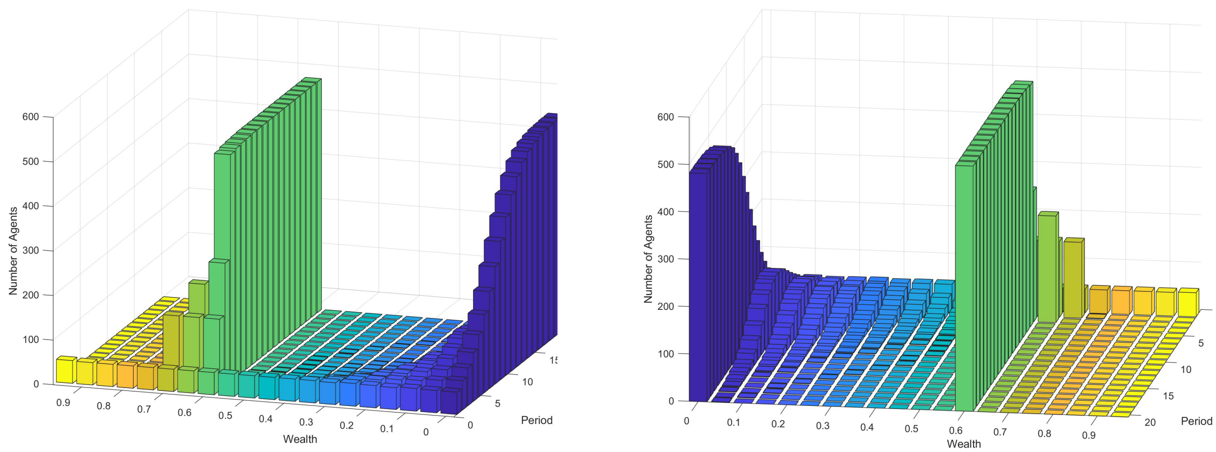

Figure 3: Standard Utility Histogram with Uniform Population Distribution

Since my example admits an unstable steady state point, the poverty trap line, near .475, it follows that with a uniform distribution of wealth about 47.5% of the population will converge to poverty. Qualitatively, those below that poverty trap line converge to poverty fairly quickly, where most individuals converging to poverty do so by period 10. This is slow, however, when compared to those converging to the rich equilibrium point, which only takes 3 periods.

2.1.2 Gaussian Distribution

When I employ a Gaussian distribution, the dynamics change only slightly where slightly fewer people converge to poverty. I fix the Gaussian curve parameters with a standard deviation of .15, and a mean of .5.

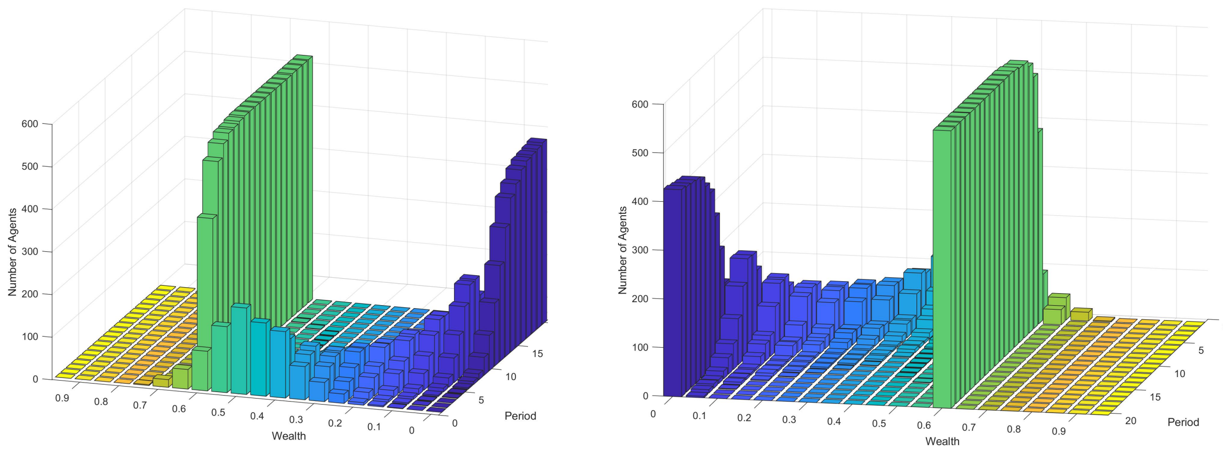

Figure 4: Standard Utility Histogram with Gaussian Population Distribution

With a Gaussian wealth distribution, we see less people converge to poverty, around 42% instead of 47.5% with the Uniform wealth distribution. While this is slightly fewer people get caught in the poverty trap, the fundamental severity of the trap doesn't change much. Similarly, those who converge to the rich equilibrium point do so fairly quickly, while those who converge to poverty take more period to fully clump at this point.

The resulting economy, in both distributions, leave many poor and a great divide between the poorest and the wealthiest in the economy. The only way more people would converge to the rich steady state is if the wealth distribution was significantly skewed above the poverty trap line. This corroborates the intuition behind policy intervention for poverty traps: in order to see long-term, broad economic growth, a government must push people past the poverty trap point.

3 Reference-Dependent Model

I combine the reference-dependent framework introduced by Kőszegi and Rabin [2006] with the baseline model from Banerjee and Newman [1994] to analyze the effects of loss aversion on a poverty trap. I consider when individual are loss averse to bequeathing less to their child than their own initial wealth. This does not create its own poverty trap, but rather changes the dynamics of the baseline poverty trap by modifying the individual's utility function. Specifically, loss aversion over bequests creates sticky regions of wealth where some families that would have converged to poverty now stay at a higher, stagnant income level. In aggregate, this means few income levels fall in the poverty trap zone. Additionally, individuals converge to poverty much slower since parents are still giving more to their child than before. I find these results by incorporating the reference dependent framework, where I derive the new utility function as:

$$U(c_t, b_t) = (1-\sigma)\ln c_t + \sigma \ln b_t + \eta v(\sigma \ln b_t | \sigma \ln w_t) + \eta v(\sigma \ln c_t | -\infty) \tag{7}$$

The difference between the reference-dependent utility in Equation 7 and the baseline model's utility in Equation 1, is the addition of the "gain-loss" function, $v(x|r)$. This function was introduced by Kőszegi and Rabin [2006] to capture loss aversion which they write generally as Equation 8.

$$v(x|r) = \begin{cases} x - r, & \text{if } x \geq r \\ \lambda\left(x - r\right), & \text{if } x < r \end{cases} \tag{8}$$

$$\eta \geq 0, \lambda \geq 1$$

Equation 8 captures loss aversion by comparing one's utility "x" to some reference point, "r". When an utility input "x" is above a person's internal reference point "r" for what their utility should be, they code their utility as a gain; if the utility is less than the reference point, it is coded as a loss. The loss aversion coefficient, λ, captures the severity of this felt loss and in turn, how much individuals will change their behavior to avoid experiencing it. In Equation 7, the term η describes how much someone cares about the gain-loss utility. Note that if $\lambda = 1$, then a person feels no loss aversion and weights relative gains and losses the same. If $\eta = 0$, then they place no weight on the relative gains or losses. At either those values, this model admits the same results as the baseline case in Equation 1.

I created specific reference points for both consumption and bequests in my model to isolate loss aversion for bequests. For consumption, the relevant reference point is $-\infty$.

Meaning, consumption is always coded as a gain since $(1-\sigma)\ln c_t > -\infty$ for all c_t. For bequests, the reference point is a person's initial wealth, w_t. If a parent gives their child more than what they got, $w_t \geq b_t$, they code that as a gain. But if a parent bequests a child less than what they themselves started with, $w_t < b_t$, they code that as a loss. While $\lambda > 1$, this creates loss aversion from bequeathing less than what they their initial wealth.

Depending on how much a person believes they'll bequeath to their child and what they'll actually bequeath, I find the share of their income bequeathed will change in various ways. When $b_t \geq w_t$, a parent experiences no losses and gives their child the same share of their income as in the original mode: $\sigma V(w_t)$. When $b_t < w_t$, this means a parent initially believed they were going to give $b_t \geq w_t$, but now experiences the loss and disappointment from realizing they might not. This feeling induces a parent to change their behavior in order to mitigate the loss. For all parents experiencing a loss, they cut back their personal consumption in order to bequeath more. How much more they bequeath to their child depends on their wealth level. Parents that are sufficiently close to a stable steady state find it best to give exactly $b_t = w_t$, which is to give their child exactly how much they started out with. Otherwise, I find parents give their child $\alpha V(w_t)$, such that $\alpha = \frac{\sigma(1+\lambda\eta)}{1+\eta-\eta\sigma(1-\lambda)}$ where $\alpha > \sigma$ when $\lambda > 1$. I find α by using Equation This simply means parents will consume less and bequeath a bit more when they are experiencing this loss.

This loss aversion to bequests doesn't change the production function, it complicates how people give at different wealth levels and the resulting S-Shaped curve. It's important I note that the aspects of the baseline capital market do not change. Recall Equations 4 and 3 which state people below a certain wealth level w^* face constraints, those above this wealth level do not. These equations help create Figure 2, which shows the poverty trap area and the rich steady state. Clearly, those below a certain wealth lvel trapped in poverty bequest $b_t < w_t$ and feel loss aversion. Similarily, despite being able to borrow the first-best amount of capital, some individuals start with an initial wealth higher than the rich steady state and converge down to it. Some rich individuals are bequeathing $b_t < w_t$ and experience loss aversion. The only individuals who won't be experiencing loss aversion are those in the range of mobility, which encompasses those who can borrow the first-best amount of capital, and some who borrow the second-best but still enough to grow every generation. To synthesize the ranges of bequest behavior, I create four cases for an individual for an individual to fall into:

1. $b_t < w_t, w_t < w^*$ (Poor and shrinking)

2. $b_t > w_t, w_t < w^*$ (Poor and growing)

3. $b_t > w_t, w_t \geq w^*$ (Wealthy and growing)

4. $b_t < w_t, w_t \geq w^*$ (Wealthy and shrinking)

Individuals who are poor and below the poverty trap will change their bequest preferences due to loss aversion (Category 1). Similarly, those who are rich enough and converging down to a lower wealth level also experience loss aversion (Category 4). For Categories 2 and 3, they do not change their bequest behavior due to loss aversion.

I derive a bequest curve for each case and create a new bequest function in terms of initial wealth. The bequest behavior from categories 1 to 2 and 3 to 4 are discontinuous, which means they cross the 45-degree line at different places. These two areas of discontinuity creates a range of wealth for which a person gives neither $b_t < w_t$ nor $b_t > w_t$; I find that for two different ranges of wealth, people bequeath *exactly* their initial wealth, $b_t = w_t$. I denote these as "sticky" ranges of wealth, a region of unstable steady states. I show all these collective bequest behaviors in Equation 9:

$$b_t \equiv b_t(w_t) = \begin{cases} \alpha\left(\underline{k}(R-r) + w_t r\right), & w_4 < w_t \\ w_t, & w_3 \leq w_t \leq w_4 \\ \sigma\left(\underline{k}(R-r) + w_t r\right), & w^* \leq w_t \leq w_3 \\ \sigma\left(k(w_t)(R-r) + w_t r\right), & w_2 < w_t < w^* \\ w_t, & w_1 \leq w_t \leq w_2 \\ \alpha\left(k(w_t)(R-r) + w_t r\right), & 0 \leq w_t < w_1 \end{cases} \tag{9}$$

Where

$$\alpha = \frac{\sigma\,(1+\lambda\eta)}{1+\eta-\eta\sigma(1-\lambda)}$$

$$w_4 = \frac{\alpha\underline{k}(R-r)}{1-\alpha r} \qquad w_3 = \frac{\sigma\underline{k}(R-r)}{1-\sigma r}$$

$$w_2 = \frac{\sigma r(1-\sigma R)(R-r)}{\pi R(1-\sigma r)^2} \qquad w_1 = \frac{\alpha r(1-\alpha R)(R-r)}{\pi R(1-\alpha r)^2}$$

I visualize this new loss averse bequest function below in Figure 5

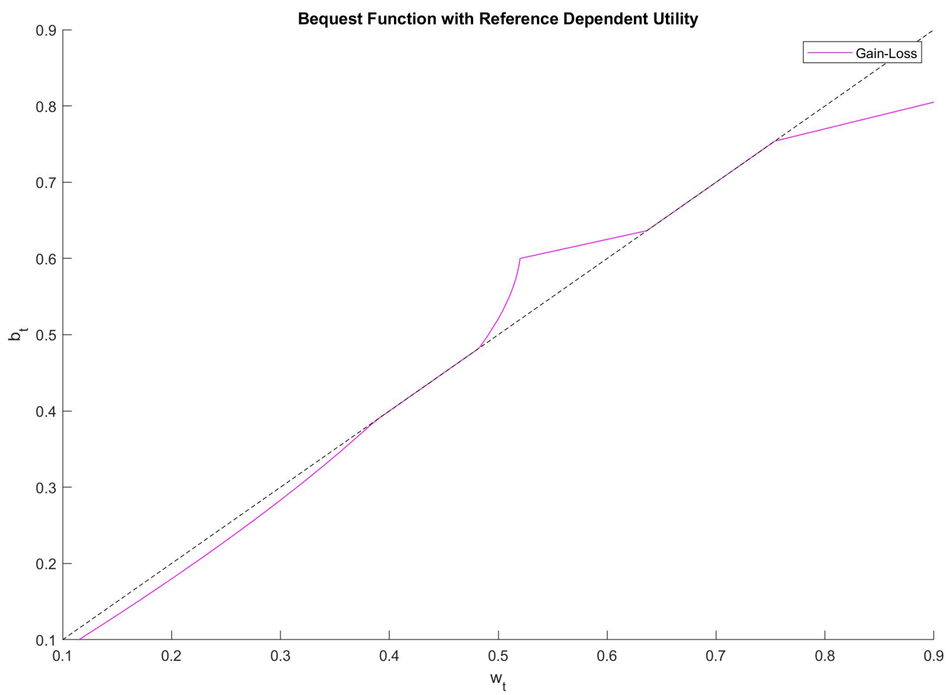

Figure 5: Generational Wealth with reference-dependent utility

For ease of reference, I define the various steady state equilibria. First, I refer to the stable steady state at 0 and the region of wealth that individuals converge to 0 simply as "Poverty" or the "Poverty Trap Zone". From w_1 to w_2, there are a range of unstable steady state points that I designate to be "Low-Income"; a range where people give $b_t = w_t$ instead of converging to poverty. The "Region of Mobility" encompasses those between w_2 and w_3

converging to w_3. For those with wealth between w_3 and w_4, which is another range of unstable steady states, is called the "Middle Class", including those converged to the semi-steady state point w_3. Finally, for those above w_4 who converge down to the Middle Class semi-steady state exactly at w_4 are the "Upper-Middle Class". This is important as the difference between those converging up to the Middle Class versus those converging down to it can be notable. These "class regions" can be seen graphically as the segments of the bequest function that directly follow the 45-degree line.

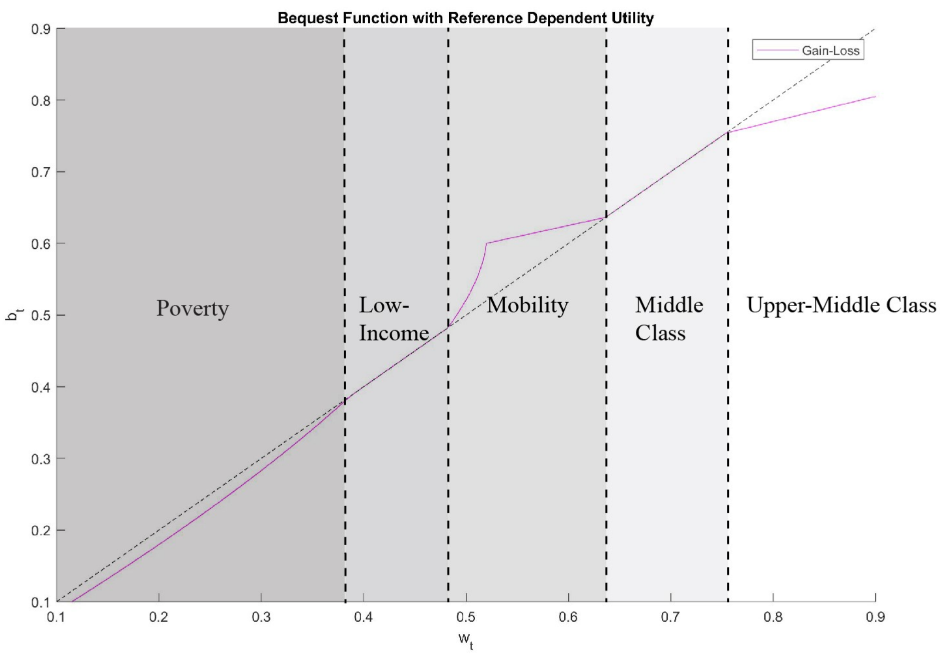

Figure 6: Class Zones for New Bequest Function

I visually compare the resulting bequest functions between the Gain-Loss utility and the baseline utility in Figure 7. The Mobility region in both models does not change, between .475 and .65. In the loss averse model, they do not feel a loss thus they do not change the share of their income they put towards bequests. Immediately looking outside this region of mobility, the starkest difference between the models are the sticky regions in Low-Income and the Middle Class. How far these regions stretch depends on the exogenous variables. I find they are most sensitive to σ and λ since loss aversion is what is creating these regions in the first place. Looking at the Poverty and Upper-Middle Class zones, it's important to note these individuals universally give more than their respective wealth levels in the standard model. By experiencing a loss, they mitigate this feeling by increasing their bequest. In the long-run, individuals in the poverty trap zone will converge to poverty slower than in the baseline model. Visually, this means the bequest function is steeper for those experiencing loss aversion.

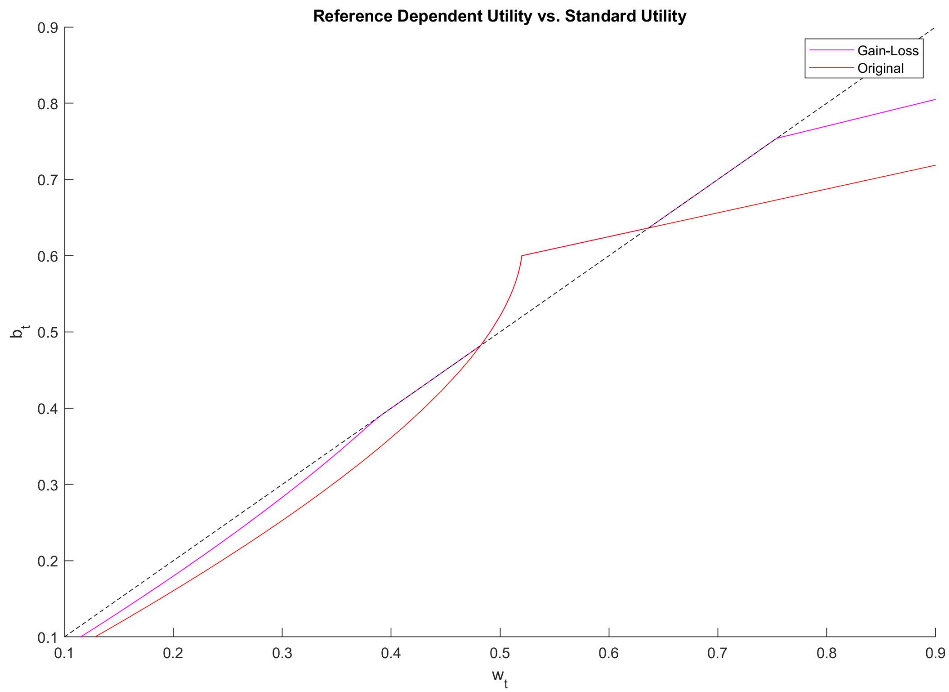

Figure 7: Generational Wealth comparison between reference dependent utility and the standard model

The difference in the baseline poverty trap and the loss averse affected poverty trap can change intervention policy. Poverty traps inform policy makers that a small change in wealth can have huge effects. In my new model though, the effect of a small change in wealth is dampened. I'll first identify the point .375 as the poverty trap line. If we go off up our standard assumption of policy trap dynamics, we'd expect a small financial push just above that point would lead a family into a cycle of growth. Instead, we'd observe a family line stagnate at that wealth level. If small changes in wealth do not seem to help many families out of poverty, this might explain why some interventions like MFIs don't always have a significant affect reducing poverty [Kraay and McKenzie, 2014]. Policy makers that fails to recognize how loss aversion changes poverty trap dynamics might then fail to employ helpful intervention.

3.1 Wealth Distribution

Continuing my analysis from Section 2.1, I create various wealth distribution to visualize the polarization of wealth within this economy. I create wealth distributions between 0 and 1, and use 1000 individuals at different wealth levels.

3.1.1 Uniform Distribution

I begin by assuming a uniform distribution as before, and I find a consistent story plays out: most people polarize to Poverty or Middle-Class, with smaller populations converging to Low-Income and Upper-Middle-Class. We see this in the histogram plots in Figure 8 which include views with the initial period foremost (left) and the end period foremost (right).

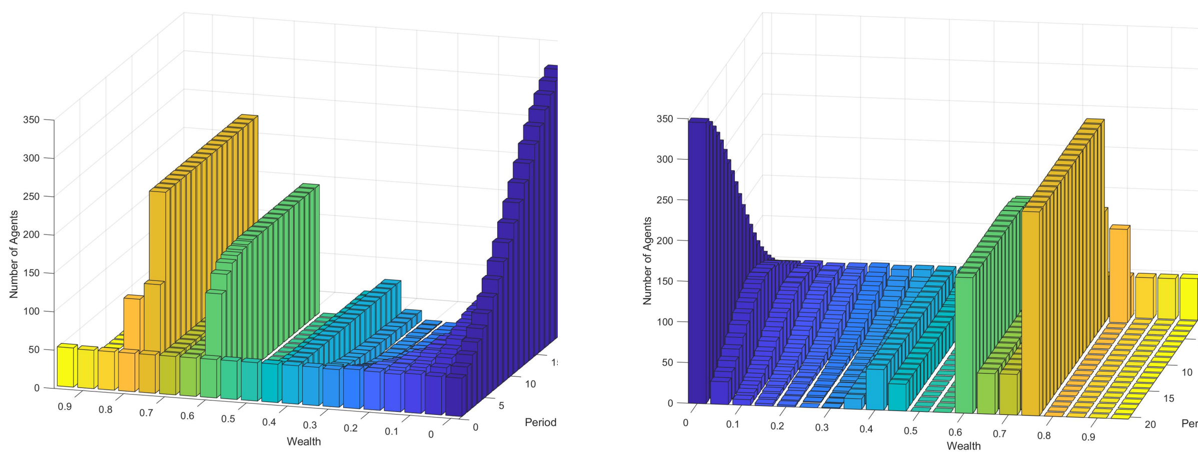

Figure 8: Gain-Loss Utility Histogram for Uniform Distribution

In Figure 8, we see that the individuals quickly converge to different wealth levels. Comparing my new model's results to the baseline in Figure 5, only about 35% converge to the poverty steady state, a 12.5% drop. The remaining 12.5% that didn't converge to 0 wealth stay at a slightly higher wealth in the Low-Income region. Also in Figure 5, 52.5% converged to the "rich" steady state around point .65. In the new Figure 8, the aforementioned "rich" steady state is no longer the highest level of wealth. Now, over 37.5% individuals are at a higher wealth level. Put simply, less people converge to poverty, many stay at higher wealth levels.

To better illustrate the comparative polarization of wealth, we can compare the histogram in the first period to the last period for both the baseline and the new gain-loss models.

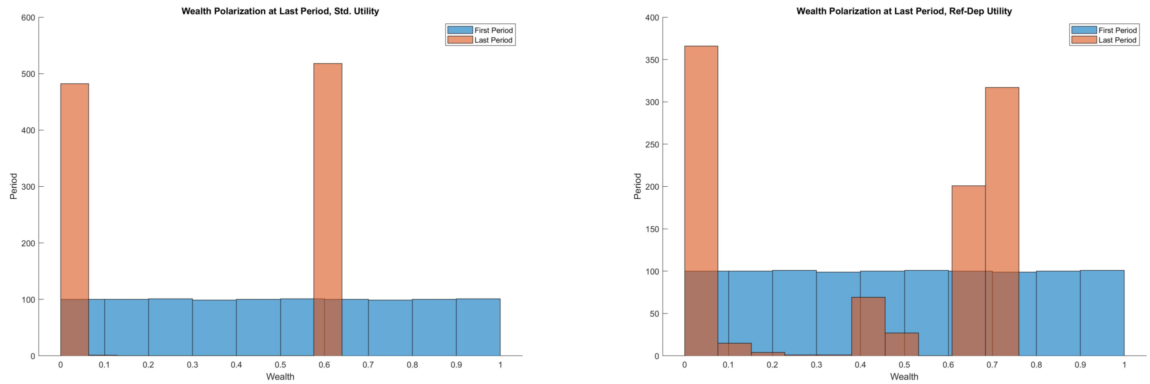

Figure 9: 2-D Histograms for Reference Dependence and Standard Utility

While many converge to poverty in both models, in my new model less people converge to actual poverty and many more end up in the sticky regions.

3.1.2 Gaussian Distribution

I fix the Gaussian curve parameters with a standard deviation of .15, and a mean of .5.

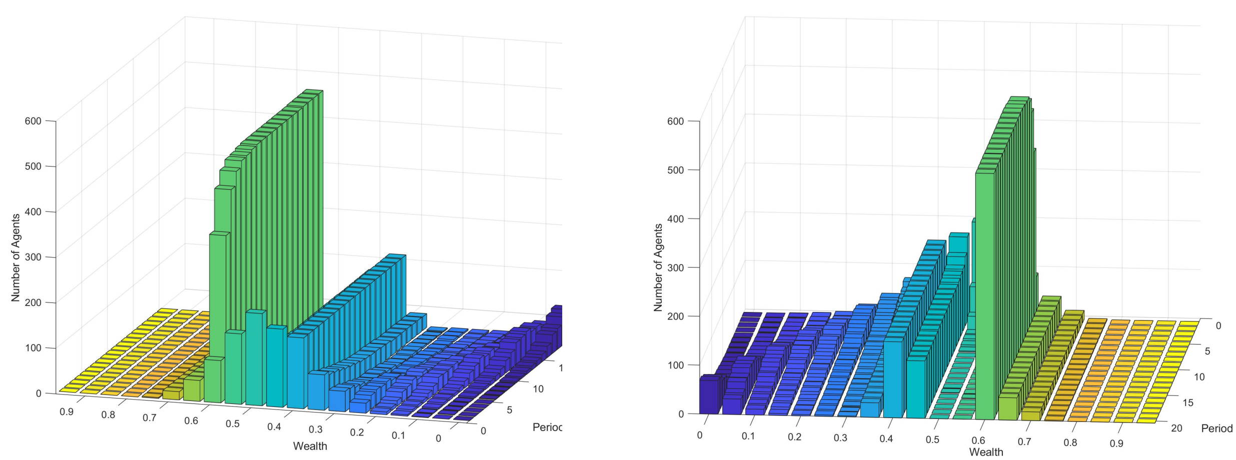

Figure 10: Gain-Loss Utility Histogram for Gaussian Distribution

As we can see, given a normal distribution, very few people end up in Poverty and are instead stuck in Low-Income. This contrasts greatly to the standard model, Figure 4, where nearly 5 times the number of people end up in poverty: 8% in my model versus 42% in the baseline. For a close up of the resulting polarity difference between the baseline (left) and reference-dependence (right) utilities, we can again compare the first/last time steps for both the models.

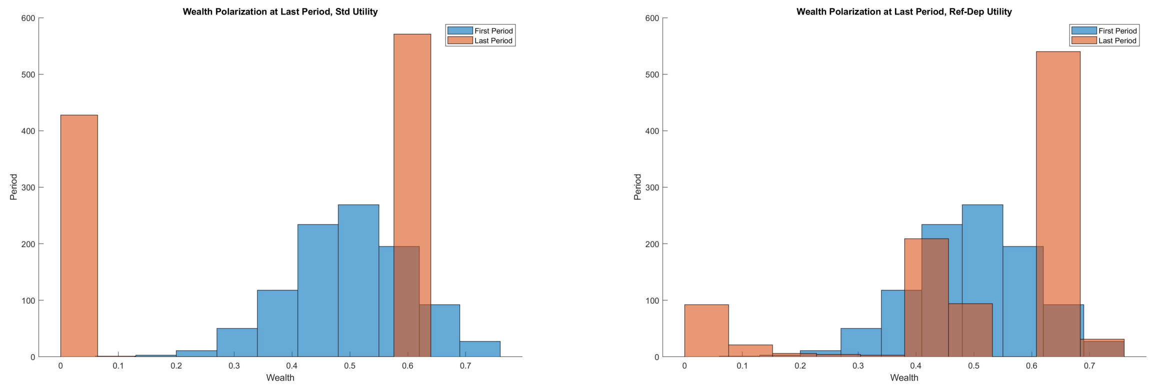

Figure 11: 2-D Histograms Comparisons for Gaussian Dist.

It becomes even more evident that with a Gaussian distribution, the population with reference-dependent preferences becomes much better off. The effect of loss aversion mitigates the number of people who converge to poverty, which in turn keeps many at higher income levels. The average wealth level in 20 generations in the reference-dependent population, regardless of distribution, is higher than that in the baseline model.

4 Conclusion

The results of my model shows that loss aversion can create two ranges of unstable steady states, sticky regions, for wealth in a poverty trap model. These individuals whose family lines would have converged to the poverty stable steady state instead stay at a higher income level, saving more wealth levels from the poverty trap though these individuals also never become better off with time. It also causes those affected by a loss to bequeath at higher rates overall, slowing convergence to the poverty steady state. These are significant changes from the baseline poverty trap model originally explored in Banerjee and Newman [1994]. For policy, this means a small financial push might not have the large, long-run effect the baseline model predicts because of the large sticky wealth regions. If policy makers fail to recognize how large a push individuals needs to not only escape poverty but escape the Low-Income zone, interventions might fails to substantially change the long-run trajectory of the economy and the wealth of individuals.

5 References

References

The World Bank. Poverty overview. Technical report, The World Bank, 2022. data retrieved from World Bank Group, `https://www.worldbank.org/en/topic/poverty/overview`.

Johannes Haushofer and Ernst Fehr. On the psychology of poverty. *Science*, 344(6186): 862–867, 2014. doi: 10.1126/science.1232491.

Abhijit V Banerjee and Andrew F Newman. Poverty, incentives, and development. *The American Economic Review*, 84(2):211–215, 1994.

Partha Dasgupta and Debraj Ray. Inequality as a determinant of malnutrition and unemployment: policy. *The Economic Journal*, 97(385):177–188, 1987.

Abhijit Banerjee and Esther Duflo. *Poor Economics*. PublicAffairs, 2011.

Abhijit Banerjee and Sendhil Mullainathan. The shape of temptation: Implications for the economic lives of the poor. Technical report, National Bureau of Economic Research, 2010.

Abhijit V Banerjee and Sendhil Mullainathan. Limited attention and income distribution. *American Economic Review*, 98(2):489–93, 2008.

Daniel Kahneman and Amos Tversky. Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2):263–291, 1979. URL `http://www.jstor.org/stable/1914185`.

Shlomo Benartzi and Richard H Thaler. Myopic loss aversion and the equity premium puzzle. *The quarterly journal of Economics*, 110(1):73–92, 1995.

Daniel Kahneman, Jack L Knetsch, and Richard H Thaler. Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic perspectives*, 5(1):193–206, 1991.

Ernst Fehr and Lorenz Goette. Do workers work more if wages are high? evidence from a randomized field experiment. *American Economic Review*, 97(1):298–317, 2007.

Seth Blumberg and Michael Kremer. Dynamic loss aversion, growth, and development. *Unpublished manuscript*, 2014.

Abhijit V Banerjee and Andrew F Newman. Occupational choice and the process of development. *Journal of political economy*, 101(2):274–298, 1993.

Oded Galor and Joseph Zeira. Income distribution and macroeconomics. *The review of economic studies*, 60(1):35–52, 1993.

Botond Kőszegi and Matthew Rabin. A model of reference-dependent preferences. *The Quarterly Journal of Economics*, 121(4):1133–1165, 2006.

Aart Kraay and David McKenzie. Do poverty traps exist? assessing the evidence. *Journal of Economic Perspectives*, 28(3):127–48, 2014.