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Poverty Traps and the Social Protection Paradox

Munenobu Ikegami, Michael R. Carter, Christopher B. Barrett, and Sarah Janzen

Cash transfer programs, progressively targeted at the poorest, have become a predominant policy for addressing chronic poverty in developing countries. While pioneered by middle-income developing countries (notably Mexico, South Africa, and Brazil), cash transfer programs have spread across the developing world, including the risk-prone pastoral regions of northern Kenya whose economic reality underwrites the analysis in this chapter.[1]

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1. With the region receiving "emergency" food aid year after year, the Kenyan government in 2009 created a social protection scheme, the Hunger Safety Net Programme (HSNP), built around bimonthly cash transfers targeted at the region's chronically poor and indigent. By regularizing progressively targeted assistance, HSNP had hoped to put households on a pathway out of poverty by enabling asset accumulation and sustained investment in child health and education so as to avert future chronic poverty arising due to economic disability (see the discussion in Hurrell and Sabates-Wheeler [2013]).

There is ample evidence that cash transfers break the liquidity constraints that Loury (1981) argues propagate poverty intergenerationally by limiting parents' health and education investments in their children. However, there is much more modest evidence that these programs enhance the earned incomes of recipient households and affect their living standards once the cash transfers come to an end, despite their theoretical potential to do so.[2] Indeed, policymakers in Latin America now confront the conundrum of former cash transfer recipients who revert to their pretransfer living standards once their transfer eligibility ends. In northern Kenya, the Hurrell and Sabates-Wheeler (2013) impact evaluation of the Hunger Safety Net Programme (HSNP) cash transfer scheme found that while transfers allowed recipient households to economically tread water even as their untreated neighbors sunk under the weight of continuing shocks, it did nothing to help recipient households craft a pathway out of poverty. Similar to Latin American countries, Kenya is now looking to augment its HSNP cash transfer program with a "poverty graduation program."[3]

The apparently weak impact of cash transfer programs on the upward mobility of poor households in at least the medium run has particular salience in risky regions. If cash transfers do little to promote upward mobility in general, their effect on poverty dynamics may be further blunted in risky environments because they do not protect the assets of the nonpoor who are vulnerable to falling into poverty. This omission has two potential effects. First, conventional cash transfers do not stem the downflow of the vulnerable nonpoor into poverty that is driven by shocks (Krishna 2006). Second, by not protecting the assets of the poor and the vulnerable nonpoor, cash transfers in turn do little to enhance the investment incentives of the already poor.[4] Given these two effects, the population of future poor may grow, raising the cost of any antipoverty program.

These observations raise the question whether an alternative social protection scheme can more effectively reduce the extent and depth of poverty when compared to the purely progressive targeting rules of standard cash transfer programs. Using a dynamic stochastic programming

2. The Gertler, Martinez, and Rubio-Codina (2012) study of Mexico's PROGRESA program finds notable investment and income effects from a purely cash transfer program. The Bastagli et al. (2016) review study finds more modest evidence of such effects, unless specific efforts were made by implementers to support planning, investment, and business development. In a similar spirit, the six country studies contained in Maldonado et al. (2016) find some evidence that the potential impacts of cash transfers on earned income are when cash transfers are paired with ancillary business development programs targeted at cash transfer recipients.

3. The current generation of graduation programs takes their inspiration from BRAC's ultrapoor program that recognizes that more than liquidity increments may be needed to reduce chronic poverty. Such programs involve a mix of cash transfers, financial education, confidence building and coaching, and culminate with an asset transfer. Banerjee et al. (2015) summarize evaluations of graduation programs that span both middle- and low-income countries.

4. Indeed, if anything, it might be expected that means-tested cash transfers would discourage accumulation, as successful accumulation could lead to loss of benefits.

model meant to capture key features of a risky rural landscape like that of northern Kenya, this chapter explores the poverty-reduction potential of a hybrid social protection system that combines conventional cash transfers targeted at the poorest with state of the world contingent cash transfers (SWCTs) targeted at the vulnerable nonpoor in the wake of negative shocks.

Our findings include what we call the paradox of social protection. Under the assumption that transfers are unanticipated (i.e., that households do not alter their accumulation strategies in anticipation of social protection benefits), we show that when compared to a standard, progressively targeted scheme, a hybrid policy that diverts some the social protection budget to the vulnerable nonpoor results in lower levels of poverty in the medium term, although poverty rates are higher in the short term. Conventional cash transfer programs thus implicitly make an intertemporal trade-off between the well-being of the poor today versus their well-being in the future. The hybrid program creates the mirror intertemporal trade-off.

We then relax the assumption that transfers are unanticipated and explore the impacts of hybrid social protection when the contingent transfers are anticipated. We show first that anticipation crowds in additional accumulation by the poor, who are incentivized by the fact that SWCTs will protect their assets should they invest and advance to the ranks of the vulnerable nonpoor. This ex ante accumulation effect might be termed a positive moral hazard, as it induces investment and risk taking by the poor that lessens the overall rate of poverty. At the same time, when SWCTs are precisely targeted at the vulnerable as in our model, a new equilibrium appears. Specifically, a subset of agents accumulate only to the point where they are eligible for SWCTs, but not beyond. This new equilibrium reflects a more conventional negative moral hazard, as those at this equilibrium make choices that increase the probability of receiving the insurance-like contingent social protection payments.

Given the trade-offs, expense, and complexities associated with SWCTs and hybrid social protection, we then ask whether the impacts of an SWCT can be achieved with an insurance contract that is cofunded by the government and by the vulnerable nonpoor. Rather than holding the social protection budget fixed, we instead ask how much budget is needed over time to fully close the poverty gap for all poor households and to pay for the government insurance subsidy that is offered to all poor and vulnerable nonpoor households under the hybrid scheme. Drawing on companion work that models the dynamically optimal demand for insurance (Janzen, Carter, and Ikegami 2018), we show that the present value of the required government expenditure stream is lower under the hybrid insurance scheme than it would be under a conventional cash transfer scheme targeted only at the poor. This cost saving is realized without any trade-off between the well-being of the poor in the present and the future.

The remainder of the chapter proceeds as follows. Section 6.1 presents a dynamic stochastic model of household consumption and asset accumulation in which households enjoy heterogeneous endowments of assets and productive skill. Section 6.2 then uses this model to analyze a stylized model of a village economy composed of 300 households distributed randomly over the ability-initial asset space that defines the intertemporal choice model. As a baseline for later analysis of alternative policy regimes, we use dynamic programming methods to simulate the stylized economy over a sixty-year time horizon, tracking the evolution of growth, poverty, and a new measure of "unnecessary deprivation."

Section 6.3 then explores the impact of alternative social protection schemes, one that targets transfers in a purely progressive fashion, and another in which the available budget is targeted according to a triage protocol that prioritizes transfers to households that are vulnerable to slipping into chronic poverty over transfers to already poor households. In this section, we assume that households do not anticipate transfers. It is here where the paradox of social protection emerges. By preventing collapse into poverty by agents vulnerable to asset shocks, the triage scheme ultimately reduces the extent of poverty and leads to greater transfers to and higher welfare for poor households in later years.

Section 6.4 then relaxes the assumption that transfers are unanticipated and explores what happens when agents fully anticipate contingent transfers provided to the vulnerable under the triage scheme. We show that anticipation of these transfers has both positive and negative effects. Finally, we show that implementing the contingent transfers as a partially subsidized insurance contract (with copays required of beneficiaries) eliminates the negative while preserving the positive effects of contingent protection. Section 6.5 concludes.

6.1 Assets, Ability, Risk, and the Multiple Dimensions of Chronic Poverty

Azariadis and Stachurski (2005) define a poverty trap as a "self-reinforcing mechanism which causes poverty to persist." A robust theoretical literature has identified a variety of such mechanisms that may operate at either the macro level—meaning that an entire country or region is trapped in poverty—or at the micro level—meaning that a subset of individuals become trapped in chronic poverty even as others escape (Barrett and Carter [2013], Kraay and McKenzie [2014], Ghatak [2015], and Barrett, Garg, and McBride [2016] provide recent review papers). In this chapter, we explore the implications of a micro poverty trap mechanism for the design of social protection programs, employing a variant of what Barrett and Carter (2013) call the "multiple financial market failure" poverty trap model. This model can generate multiple equilibria in the sense that a given individual may end up at the high or the low equilibrium depending on initial conditions and stochastic realizations.

The semiarid pastoral region of northern Kenya, which motivates this work, is an area of widespread chronic poverty. Multiple studies, using different data sets, have found evidence of bifurcated asset dynamics in this region, with households above a critical level tending to a high equilibrium and those below it tending to a low level (Barrett et al. 2006; Lybbert et al. 2004; McPeak and Barrett 2001; Santos and Barrett 2011; Santos and Barrett, chapter 7, this volume).[5] To explore how social protection might work in this environment, we build on the Buera (2009) nonstochastic model of asset accumulation with two production technologies under credit constraints and heterogeneous agent ability.[6] We extend the Buera model by adding asset shocks to allow for the importance of both ex ante awareness of risk and the ex post experience of shocks as key determinants of poverty dynamics (Elbers, Gunning, and Kinsey 2007).

We show that multiple poverty trap mechanisms emerge in this setting. Low-ability households are innately poor, as they never find the high-return technology attractive and thus they endure low incomes indefinitely. Meanwhile, intermediate-ability households can dramatically change their asset accumulation choices in response to ex ante asset risk and ex post realization of asset shocks. This cohort faces a multiple equilibrium poverty trap of the sort on which the literature has long focused. Finally, there is a high-ability group that may start off poor but will inevitably take up the high-return technology and graduate out of poverty and remain nonpoor (in expectation) in the long run.

6.1.1 A Model of Asset Dynamics and Heterogeneous Ability

Consider an economy in which each individual j is endowed with a level of innate ability (α_j) as well as an initial stock of capital (k_{j0}). Preferences are unrelated to the individual's innate ability. In what follows, we treat α_j as fixed. We conceptualize the agents in this economy as adults and α_j as capturing the predetermined physical stature, cognitive development, and educational attainment with which they entered adulthood and the economy. This approach obviously ignores the origins and evolution of such innate ability. Carter and Janzen (2017) generalize the specification here and allow each

5. Note, these findings do not generalize globally. Broad-based empirical evidence of poverty traps has been mixed (Subramanian and Deaton 1996; Kraay and McKenzie 2014), although Kraay and McKenzie (2014) conclude that the evidence for the existence of structural poverty traps is strongest in rural remote regions like the arid and semiarid lands of East Africa. As Barrett and Carter (2013) note, there is a tendency to sometimes conflate the failure to find a multiple equilibrium poverty trap with the nonexistence of poverty traps. Poverty traps can, of course, be single equilibrium, as in Naschold (2013). For a particularly interesting analysis of the emergence of a multiple equilibrium from a single equilibrium structure, see Kwak and Smith (2013).

6. Related previous papers include Becker and Tomes (1979), Loury (1981), Banerjee and Newman (1991, 1993), Galor and Zeira (1993), Ray and Streufert (1993), Aghion and Bolton (1997), Piketty (1997), Carter and Zimmerman (2000), and Ghatak and Jiang (2002).

dynasty's human capital to evolve intergenerationally through a stochastic process in which ability regresses to the mean level unless compromised by nutritional shortfalls. In this chapter, however, we set aside this additional complexity in order to concentrate on exploring social protection policy design in the presence of poverty traps.

Each period the individual has to choose between two alternative technologies for generating income. Both technologies are capital using and skill sensitive (i.e., for both technologies, more able people can produce more than less able people). One technology (the "high" technology) is subject to a fixed cost, E, such that the technology is not worth using at low amounts of capital. Specifically, we assume that income, f, for individual j in period t is given by

$$f\left(\alpha_j, k_{jt}\right) = \alpha_j \max\left[f_H\left(k_{jt}\right), f_L\left(k_{jt}\right)\right]$$

where $f_L\left(k_{jt}\right) = k_{jt}^{\gamma_L}$, $f_H\left(k_{jt}\right) = k_{jt}^{\gamma_H} - E / \alpha_j$, $E > 0$, and $0 < \gamma_L < \gamma_H < 1$.[7] We denote as $\hat{k}(\alpha)$ as the value of capital where it becomes worthwhile to switch to the more productive technology (i.e., $\hat{k}(\alpha_j) = \{k \mid \alpha_j f_L(k) = \alpha_j f_H(k)\}$).[8]

If an individual had access to only one technology, she or he would accumulate capital up to a unique steady-state value $k_L^*(\alpha_j)$ for the low technology or $k_H^*(\alpha_j)$ for the high technology. The key question is then what happens when the individual has access to both technologies. In the spirit of Skiba (1978), we ask whether an individual, whose initial capital stock is below $\hat{k}(\alpha_j)$, will gravitate toward the high or the low technology.[9]

Consider the case of an individual who begins life with $k_L^*(\alpha_j) < k_{j0} < \hat{k}(\alpha_j)$. Note that because this individual is beyond the low-level steady state, but short of the technology switch point, incremental returns to further investment are low relative to the cost of forgone consumption, discouraging further accumulation. Borrowing constraints and limited income make it impossible for the individual to discretely jump over the region of low returns. Will this individual optimally accumulate assets over time and end up at $k_H^*(\alpha_j)$ and a nonpoor standard of living? Alternatively, will the individual settle into a poor standard of living with capital stock $k_L^*(\alpha_j)$? More formally, is there an initial asset threshold, $\tilde{k}(\alpha_j) < \hat{k}(\alpha_j)$, below which individuals slip to the low equilibrium (remaining chronically poor), and above which she or he will move to the high equilibrium (eventually becoming nonpoor)?

7. Note that fixed costs do not vary by ability level as the division of E by α_j is canceled out by the premultiplication of the production function by α_j, which allows us to more generally keep the notation simpler.

8. By construction, this formulation favors adoption of the high technology by assuming away information problems and all other obstacles to adoption other than financing. This simplification eliminates inessential factors that would reinforce the effects that are generated here under full information.

9. As first explored by Skiba (1978), with a nonconvex production technology, a bifurcated accumulation strategy could occur around a critical minimum asset level.

We analyze this question with a dynamic model of consumption and investment choice. We rule out borrowing, and hence consumption in every period can be no more than available wealth, or what Deaton (1991) calls cash on hand:

$$c_{jt} \leq k_{jt} + f(\alpha_j, k_{jt}),$$

The household's stock of accumulated capital evolves over time according to the following rule:

$$k_{jt+1} = (k_{jt} + f(\alpha_j, k_{jt}) - c_t)(\theta_{t+1} - \delta)$$

where δ is the natural asset depreciation rate and $\theta_t \leq 1$ is a random asset shock realized at the beginning of every period t. Note that $\theta = 1$ implies optimal conditions, whereas $\theta < 1$ indicates less favorable conditions or an unfavorable shock that destroys some fraction of wealth. We assume that $(\theta_t - \delta) > 0$. While in principle $\theta > 1$ might be allowed, such events seem unlikely and we will restrict the analysis to the case where only negative shocks are possible.[10] The cumulative density function of θ_t is denoted by $\Omega(\cdot)$ and we assume that every household knows $\Omega(\cdot)$.

In period t households choose their production technology, consumption, and (implicitly) investment based on state variable k_{jt} (asset holdings), α_j (innate ability), and the probability distribution of future asset losses (Ω). Households then observe asset shocks θ_{t+1}, which determine asset losses. The primary timing assumption is that the shocks happen after the household's decision to save or consume, and then once again all the information needed to make the next period's optimal decision is contained in k_{jt}. Assembling these pieces, we can write the decision maker's intertemporal choice problem as

$$\max_{c_{jt}} E_\theta \sum_{t=0} \beta^t u(c_{jt}) \tag{1}$$

subject to:

$$\begin{aligned} c_{jt} &\leq k_{jt} + f(k_{jt}) \\ f(\alpha_j, k_{jt}) &= \alpha_j \max\left[f_H(k_{jt}), f_L(k_{jt})\right] \\ k_{jt+1} &= (k_{jt} + f(k_{jt}) - c_{jt})(\theta_{jt+1} - \delta) \\ k_{jt} &\geq 0 \end{aligned}$$

10. While this assumption mechanically implies lower expected returns relative to the case where some shocks are greater than one (holding f fixed), this assumption does not necessarily imply that returns are low. Instead, in the spirit of frontier production analysis, $k + f(\alpha, k)$ can be thought of as the maximum achievable cash on hand assuming good conditions, and less than optimal conditions simply means that returns are some fraction less than what is maximally obtainable.

where E_θ is expectation taken over the distribution of the random shock θ, β is the time discount factor, and $u(\cdot)$ is the utility function defined over consumption c_{jt} and has the usual properties. Denote the investment rule in the presence of asset shocks as $i^*(k_{jt} \mid \alpha_j, \Omega)$.[11]

6.1.2 The Micawber Frontier and the Two Dimensions of Chronic Poverty

As in Skiba (1978) and Buera (2009), this model identifies a critical asset level, denoted $\tilde{k}(\alpha_j)$, around which dynamic behavior bifurcates. An individual with ability level α_j will attempt to accumulate the assets needed to reach the high-technology equilibrium if she enjoys capital stock $k_{j\tau} > \tilde{k}(\alpha_j)$. Otherwise, she will only pursue the low technology, accumulating the modest stock of capital that it requires. Note that this frontier, a generalization of what Zimmerman and Carter (2003) call the Micawber Threshold, divides those who have the wealth needed to accumulate from those who do not.[12] We label $\tilde{k}(\alpha_j)$ the Micawber Frontier.

The two graphs in figure 6.1, created through numerical analysis of the dynamic programming model 1, present the Micawber Frontier under the parameterization reported in the appendix that we use to implement the model in the remainder of this chapter.[13] Along the horizontal axes are innate ability or skill levels, ranging left to right from least to most able. The vertical axes measure the stock of productive assets. Figure 6.1, panel A graphs the probability that a household occupying each initial endowment position will end up chronically poor, that is, at the low-level equilibrium. Notice that households on the west/southwest side of the figure approach the low-level equilibrium with probability one, indicating that for these endowment positions it is not worthwhile to even attempt the accumulation of the assets required to reach the high equilibrium. As shown in figure 6.1, panel B, we define the Micawber Frontier as the locus of skill and assets where the household, behaving optimally according to model 1, switches to a strictly positive probability of escaping chronic poverty. The solid curve in figure 6.1, panel B graphs this locus. Comparing across the two graphs in figure 6.1, we can see that for endowment positions far enough east and north of the Frontier, the probability of escaping chronic poverty is one. For middle-ability households in the multitoned band just north and east of the Micawber Frontier, the probabilities of escape are modest.

11. More precisely, $i^*(k_t \mid \alpha, \Omega)$ is the policy function of the following Bellman equation:

$$V(k_t) \equiv \max_{i_t} \{u(f(\alpha, k_t) - i_t) + \beta E[V(k_{t+1} \mid k_t, i_t)]\}$$

$$\text{where } E[V(k_{t+1} \mid k_t, i_t)] = \int V(\theta_t[i_t + (1-\delta)k_t])\, d(\theta_t).$$

12. Skiba (1978) less poetically calls the equivalent threshold in his model a critical cut-off point.

13. Buera (2009) provides a formal proof for his nonstochastic model.

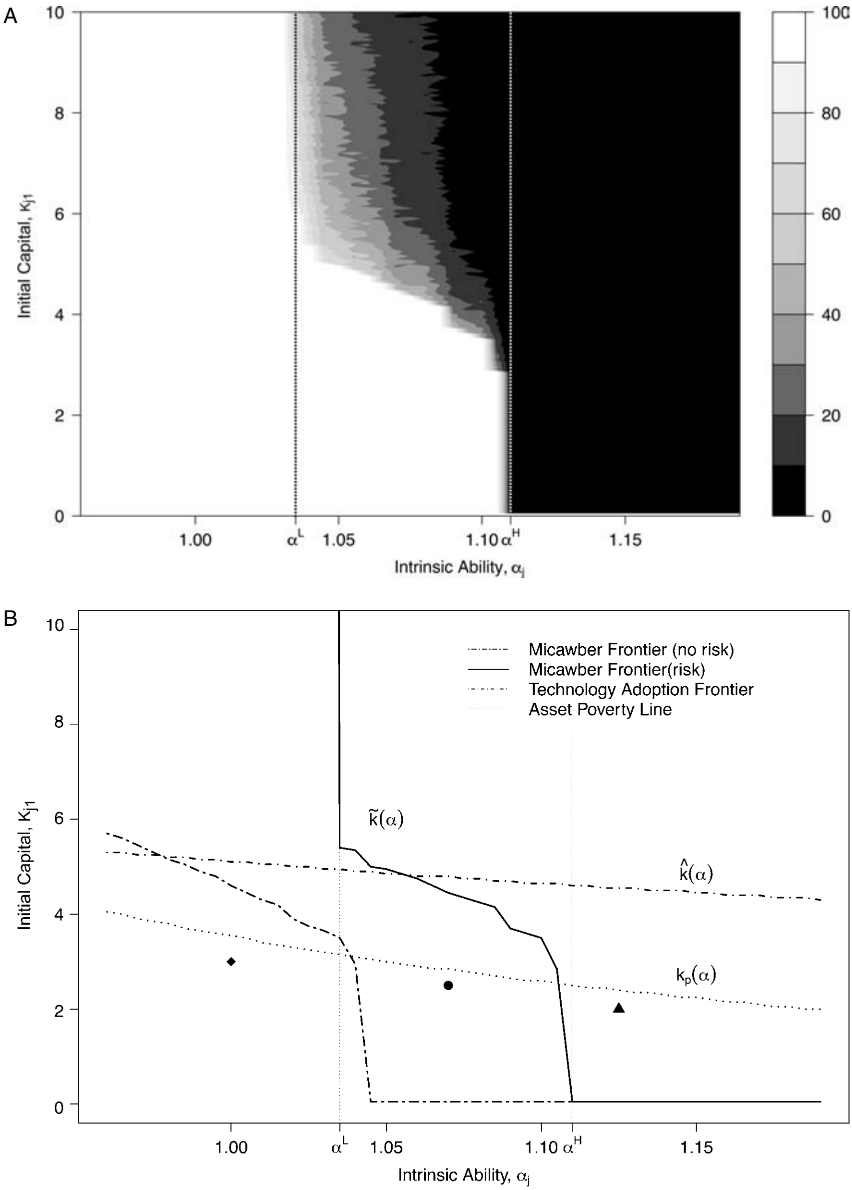

Fig. 6.1 The Micawber Frontier and chronic poverty. *A*, probability of chronic poverty (percent); *B*, risk and the Micawber Frontier.

To ease discussion and link it to more conventional poverty analysis, figure 6.1 also includes an "asset poverty line," the dashed downward-sloping line, denoted $k_p(\alpha_j)$. For each ability level, this asset poverty line indicates the stock of assets the individual must have in order to produce a living standard exactly equal to a money metric poverty line, y_p. We define y_p as the level of income that a reference middle-ability person ($\alpha_m = 1.07$ in the numerical analysis) would produce were she in steady-state equilibrium at the *low* technology ($y_p = f(\alpha_m, k_L^*(\alpha_m))$). This assumption is, of course, arbitrary, but it has the rhetorical advantage of allowing us to label most individuals poor unless they craft a pathway to the high technology. This is desirable in our stylized model as it creates a strong linkage between improved technology adoption, income, and poverty measures.

Note that the Micawber Frontier has a behavioral foundation and thus differs from the asset poverty line, which is based on a standard (and therefore arbitrary) income poverty line.[14] Those agents whose initial ability-asset endowments place them above the Micawber Frontier but beneath the asset poverty line will be initially poor. With the positive probabilities illustrated in figure 6.1, panel A, these individuals will prove to only be transitorily poor as they attempt to accumulate their way out of poverty. By contrast, those whose initial endowments situates them beneath the Micawber Frontier but above the asset poverty line will not be poor initially, but will steadily eat into their asset holdings and will eventually become poor. These movements represent structural transitions across the poverty line.

There can also be stochastic movements around the asset poverty line among the subpopulation that finds itself above the Micawber Frontier. For those individuals, small asset shocks may temporarily leave them beneath the asset poverty line without driving them off their growth path toward the high equilibrium. Such individuals would be seen to be "churning," to use the language employed by some poverty analysts. Individuals could find themselves above both the Micawber Frontier and the asset poverty line, in which case they would always be nonpoor assuming they escaped further shocks. Symmetrically, individuals initially below both the Micawber Frontier and the asset poverty line would always register as being poor. This simple depiction of the Micawber Frontier and the asset poverty line captures the full range of conventional static and dynamic poverty measures.[15]

As illustrated in figure 6.1, the numerical analysis identifies three distinct regions in the space of ability and initial asset holdings. Irrespective of their capital endowment, high-skill individuals with $\alpha_j > \alpha^H$ will always move toward the high equilibrium as $\tilde{k}(\alpha_j) = 0 \; \forall \; \alpha_j > \alpha^H$. When they reach the

14. As discussed by Carter and Ikegami (2009), this characteristic of the Micawber Frontier makes it an interesting candidate as the base for chronic poverty measures.

15. See Carter and Barrett (2006) for a discussion of distinct generations of poverty analysis that encompass these different ideas.

technology-shift asset threshold $\hat{k}(\alpha_j)$ they will optimally switch to the higher technology. Irrespective of their starting position, these *upwardly mobile* agents steadily converge to the steady-state asset value for the high technology. They may be poor over some extended period as they move toward their steady-state value, but eventually they should become nonpoor by virtue of the optimal accumulation behavior induced by their high-ability endowment. Such individuals do not face a poverty trap.

In contrast, those with an innate ability level below the critical level α^L will never move toward the high technology, irrespective of their initial asset endowment. This critical skill level defines a region of intrinsic chronic poverty, made up of individuals who lack the ability to achieve a nonpoor standard of living in their existing economic context.[16] These individuals face a single equilibrium poverty trap.

Those in the intermediate-skill group with $\alpha^L < \alpha_j < \alpha^H$ have positive but finite values $\tilde{k}(\alpha_j)$. If sufficiently well-endowed with assets ($k_{j0} > \tilde{k}(\alpha)$), these intermediate-ability individuals will attempt to accumulate additional assets over time, and will with some strictly positive probability adopt the high technology and eventually reach a nonpoor standard of living. However, if these same intermediate-skill individuals begin with assets below $\tilde{k}(\alpha_j)$—or if a shock pushes them below that level—they will no longer find the high equilibrium attainable and will settle into a low standard of living. Like those in the region of intrinsic chronic poverty, intermediate-ability individuals initially endowed with less than $\tilde{k}(\alpha_j)$ will be chronically poor. Unlike the intrinsically chronically poor, the chronic poverty of the intermediate-skill individuals represents needless or unnecessary deprivation in the sense that they could be helped to lift themselves out of poverty with appropriate social protection policies, as we discuss below. For a given set of production possibilities, the total number of chronically poor in any society will thus depend on the distribution of households across the ability-wealth space.

Finally note that while some authors (e.g., Barrett and Carter 2013; Kraay and McKenzie 2014) often distinguish between single equilibrium poverty trap models, multiple equilibrium poverty trap models, and models without poverty traps, our model shows that all three possibilities can coexist in a single economy with heterogeneously endowed agents.[17]

6.1.3 The Ex Post and Ex Ante Effects of Asset Shocks

The Micawber Frontier is a function of the economic environment in which individuals find themselves. In particular, the distribution of the

16. CPRC (2004, 2008) give examples of individuals who suffer such fundamental disabilities.
17. The econometrics of empirically testing for the existence of poverty traps in the face of this kind of complexity is not fully developed, although Santos and Barrett (chapter 7, this volume) make some important progress in this regard.

stochastic term θ fundamentally shapes investment behavior. We now explore the impact of ex ante risk and ex post shocks on investment and the long-term evolution of poverty.

The ex post effect of realized shocks comes about simply because negative events may destroy assets, knocking people off their expected path of accumulation. For upwardly mobile individuals, such shocks may delay their arrival at the upper-level equilibrium, necessitating a period of additional savings and asset reaccumulation. But it does not set them on a different accumulation path. Similarly, realized shocks have no long-term effect on the equilibrium toward which the low ability, intrinsically chronically poor gravitate.

In contrast, the ex post consequences of shocks can be rather more severe for households of intermediate ability. Consider the case of a household that is initially slightly above the Micawber Frontier. A shock that knocks it below the frontier will banish the household into the ranks of the chronically poor, as in the wake of the shock, the household will alter its strategy and move toward the low equilibrium (divesting itself of assets).

While these ex post effects of shocks are important, the anticipation that they might take place would be expected to generate a "sense of insecurity, of potential harm people must feel wary of—something bad can happen and spell ruin," as Calvo and Dercon (2009) put it. Numerical analysis of the model shows that this sense of impending ruin indeed discourages forward-looking households from making the sacrifices necessary to reach the high equilibrium. The Micawber Frontier shifts to the southwest once asset risk is removed, as shown in figure 6.1, panel B. The dashed curve is the Micawber Frontier in the absence of risk. The boundaries marking the critical skill levels at which households move between the different accumulation regimes also shift out, meaning more intrinsically upwardly mobile households and fewer intrinsically chronically poor households when we eliminate the ex ante effects of risk.

The most dramatic effects of risk are seen by considering a household whose skill and capital endowments place it between the two frontiers. Consider a household whose skill and initial asset endowments are represented by the solid circle in the middle of figure 6.1, panel B. Absent the risk of asset shocks, such a household would strive for the upper equilibrium and eventually escape poverty. In the presence of risk, such a household would abandon this accumulation strategy as futile and settle into a low-level, chronically poor standard of living. In the face of asset risk, the extraordinary sacrifice of consumption[18] required to try to reach the high equilibrium is no longer worthwhile, and the household will optimally pursue the low-level, poverty trap equilibrium. By contrast, the shift has no significant behavioral

18. The consumption sacrifice is extraordinary because the immediate returns from incremental accumulation do not outweigh the cost of forgone consumption.

effect on either intrinsically chronically poor households (represented by the solid diamond on the left side of figure 6.1, panel B) or intrinsically upwardly mobile households (the solid triangle on the right side of figure 6.1, panel B).

To explore the differential effects of risk and shocks on these different subpopulations, Carter and Ikegami (2009) use the dynamic choice model above and simulate the income streams it generates in three distinct settings:

- A nonstochastic economy in which agents repeatedly apply the optimal investment rule, $i_n^*(k_{jt} \mid \alpha_j)$;[19]
- an economy characterized by risk without realized shocks in which agents follow the risk-adjusted optimal accumulation rule, $i^*(k_{jt} \mid \alpha_j, \Omega)$, but never actually experience shocks (a scenario that allows us to isolate the ex ante effects of risk); and,
- a fully stochastic economy, meaning that individuals not only follow the risk-adjusted optimal investment rule but each period they are subject to a random asset shock generated in accordance with the probability structure Ω.

Their simulations show that for the intrinsically chronically poor (low α_j) and the upwardly mobile (high α_j) groups, the impact of risk and shocks on the realized stream of utility is relatively modest and attributable almost entirely to the disruptive, ex post effects of asset shocks. In contrast, for the intermediate-ability group, the ex ante behavioral (i.e., investment disincentive) effects of uninsured risk account for most of the welfare effects of risk and shocks. These effects are also large in magnitude for the intermediate-ability group. While the discounted income streams for the other two groups fall only 5–10 percent in the fully stochastic scenario, the drop is approximately 25 percent for the intermediate-ability group, with roughly 90 percent of the losses due to the ex ante risk effect exclusively.[20] The difference arises because while risk slightly reduces the desired steady-state capital stock for low- and high-ability agents, mainly it forces them to occasionally rebuild assets in order to reattain the desired steady-state capital stock. In sharp contrast, intermediate-ability agents may fundamentally shift their investment strategy in the presence of risk, eschewing any attempt at trying to reach the high-level equilibrium open to them, creating added avoidable chronic poverty.

Among other things, these simulations show that in the presence of critical asset thresholds, risk takes on particular importance for those individuals

19. The subscript n denotes this nonstochastic world and $i_n^*(k_t \mid \alpha)$ is policy function of the following Bellman equation:

$$\begin{aligned} V_{nr}(k_t) &\equiv \max_{i_t} \{u(f(\alpha, k_t) - i_t) + \beta V_{nr}(k_{t+1}|k_t, i_t)\} \\ &= \max_{i_t} \{u(f(\alpha, k_t) - i_t) + \beta V_{nr}(i_t + (1 - \delta) k_t)\}. \end{aligned}$$

20. Details on these simulation results are available from the authors by request.

subject to multiple equilibria. Conversely, removal of risk (through social protection or insurance schemes) could in principle generate large benefits for intermediate-ability individuals, as we now explore.

6.2 Poverty Dynamics Absent Social Protection

The analysis in the prior section showed that both the anticipation and experience of economic shocks have a fundamental effect on behavior and welfare in the presence of poverty traps, expanding the portion of the endowment space from which people do not escape poverty through their own efforts. This observation suggests that social protection policies have a fundamental role to play in stimulating poverty reduction and economic growth. But how will different social protection policies work in a world with multiple sources of poverty traps? As a first step toward answering this question, this section uses the model of individual decision-making developed above as the basis for analyzing accumulation, growth, and poverty in a stylized economy lacking any social protection policies. Sections 6.3 and 6.4 will then take a careful look at the impact of alternative social protection schemes on this economy.

6.2.1 The Stylized Economy and Measures of Performance

Consider now an economy comprising agents whose livelihood choices are described by the intertemporal maximization problem (1). To keep things simple, we will assume that all shocks are idiosyncratic and that prices in the economy are unaffected by shocks and by individuals' decisions. While these assumptions are clearly at odds with the real world, they permit us in the first instance to clarify basic principles and trade-offs in the design of social protection policies.[21]

For purposes of the numerical analysis, we assume that there are 300 agents, each described by a skill and initial capital stock pair. We allocated agents along the skill continuum, with 25 percent each in the intrinsically chronically poor and upwardly mobile ranges, and half of the agents in the intermediate-ability range where endowments matter to their accumulation and welfare trajectories. Each agent was then assigned a random initial capital stock drawn from a uniform distribution over the zero to ten range. While in any existing economy we would expect there to be a correlation between skill and observed capital stock, this random assignment of capital creates an experimental environment in which to study asset dynamics under alternative social protection schemes.

21. When shocks are correlated across households, asset and other prices will begin to covary with household income. The implications of this covariance can be important, as Carter et al. (2007) discuss empirically in the case of Ethiopia. Zimmerman and Carter (2003) theoretically examine the implications of such asset price covariance, showing that it can create another type of poverty trap.

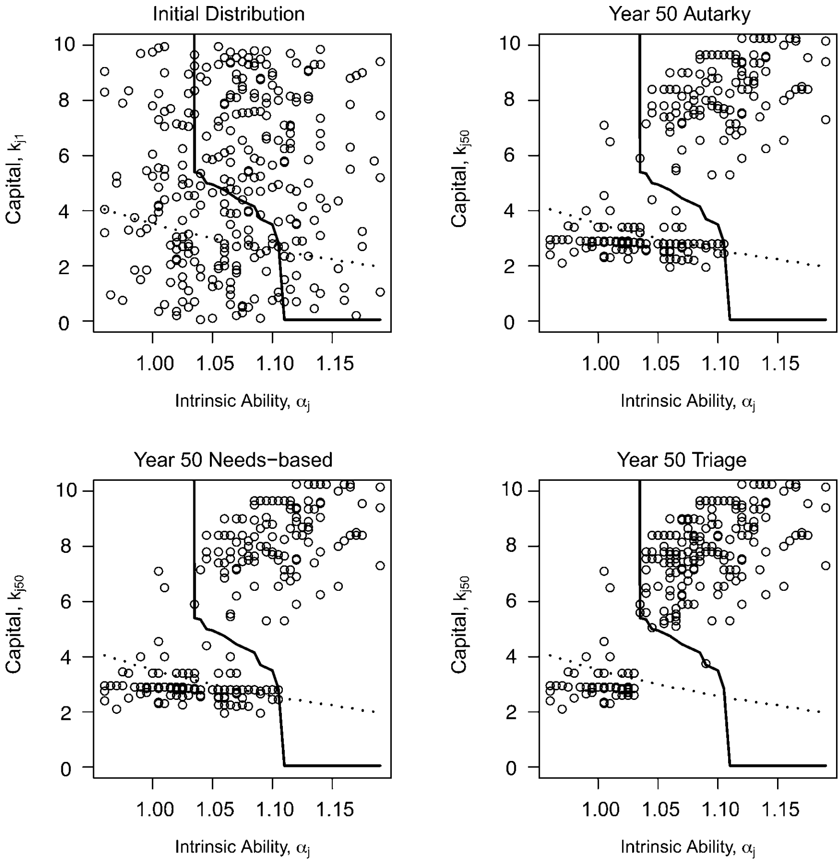

Fig. 6.2 Asset evolution with and without social protection

The diagram in the top left corner of figure 6.2 shows the initial distribution of ability and wealth in this stylized economy. Each symbol on the graph represents the initial position of an individual agent. The solid line is the Micawber Threshold under the stochastic environment, while the dashed line is again the asset poverty line. The other graphs in the figure—to be discussed below—show the evolution of endowment positions under alternative social protection policies.

While we can simply focus on the trajectories of agents given their initial endowment positions, we also employ a set of summary measures to track the performance of the stylized economy under alternative social protection regimes:[22]

22. In work not reported here, we also analyzed the impacts of the different policies using a conventional Benthamite social welfare function as well as the dynamic poverty measures suggested by Calvo and Dercon (2009). The qualitative story told by these measures is similar to that which can be gleaned from the measures discussed here.

1. Gross national income (GNI) defined simply as the sum of the incomes of the 300 agents. Note that this measure will evolve over time based on capital accumulation (or deaccumulation) as well as the shift of households between the low- and high-technology regimes.

2. Standard static poverty measures based on the Foster-Greer-Thorbecke (FGT) family of measures:

$$P_\gamma^y = \frac{1}{n}\sum_{y_j<y_p}\left(\frac{y_p - y_j}{y_p}\right)^\gamma \tag{2}$$

where n is the total number of individuals, y_p is the income poverty line, y_j is individual j's income, and γ is the usual FGT sensitivity parameter. We will specifically focus on the popular head count (P_0^y) and poverty gap (P_1^y) measures. As discussed above, we set the poverty line y_p at the level of income that a medium-skill individual would produce in steady state if she had access only to the low technology.

3. A novel measure of unnecessary deprivation, D_γ^y. This measure resembles the FGT poverty gap measure, in that it focuses only on those beneath the income poverty line. In addition, D_γ^y focuses only on the subset of the poor who have the skill or human capability to reach the high equilibrium, $\alpha_j > \alpha^L$. Denoting the maximum steady-state income available to individuals with $\alpha_j > \alpha^L$ as $\bar{y}_j{}^* = \alpha_j f_H(k_H^*(\alpha_j))$, we define the unnecessary deprivation gap as $\bar{y}_j^* - y_j$, and we define our measure of unnecessary deprivation as

$$D_\gamma^y = \frac{1}{n}\sum_{\substack{y_j<y_p \\ \alpha_j>\alpha^L}}\left(\frac{\bar{y}_j^* - y_j}{\bar{y}_j^*}\right)^\gamma. \tag{3}$$

As with the FGT measure, γ is a sensitivity parameter, with $\gamma = 0$ offering a head count of unnecessary deprivation, $\gamma = 1$ measuring the money metric unnecessary deprivation gap, and $\gamma > 1$ placing greater weight on larger underperformance relative to potential. In our subsequent calculations, we rely on the unnecessary deprivation head count measure.[23]

Together, these economic core measures permit us to track over time both the economic costs (forgone output and unexploited technological opportunities) and the human costs (low standards of living and unnecessary deprivation) of poverty traps.

6.2.2 Baseline Case of No Social Protection

The top right panel of figure 6.2 shows the asset distribution after fifty years of simulated history for our stylized economy. As can be seen, the asset

23. Because it relies on knowledge of steady-state capital holdings conditional on unobservable ability, this measure seems impractical in empirical work. It is nonetheless helpful as a conceptual tool for distinguishing unnecessary poverty from that which is unavoidable given individuals' immutable endowments and the economic environment in which they operate.

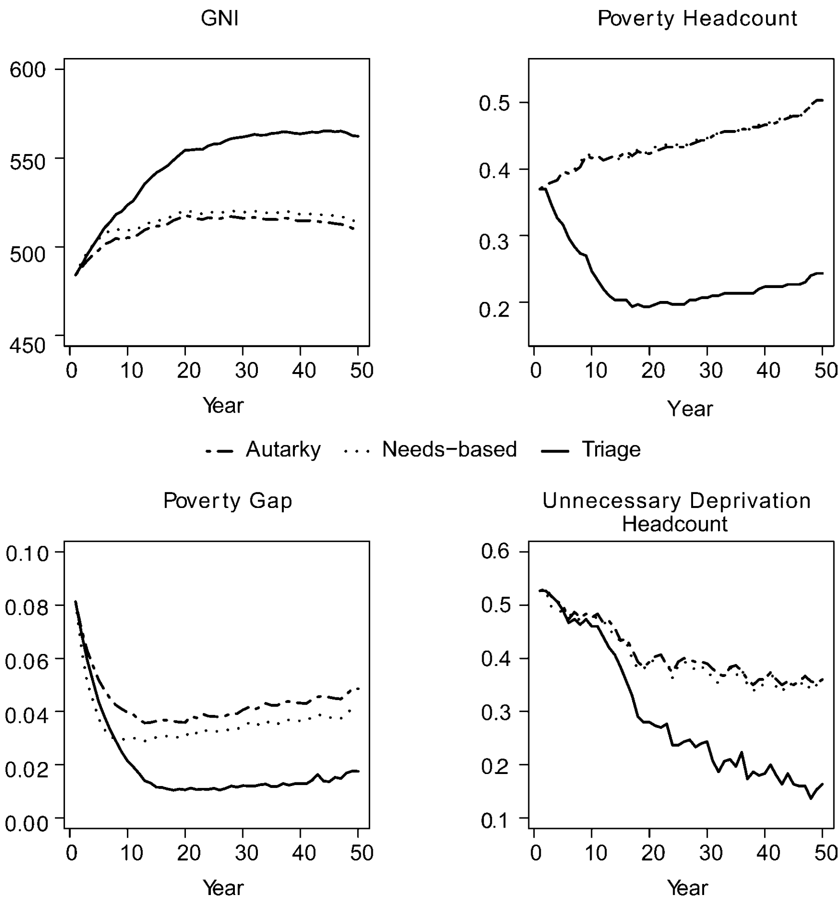

Fig. 6.3 Economic evolution under alternative social protection policies

distribution (which was originally randomly distributed independently of the ability distribution) has bifurcated, with a strong positive correlation between innate ability and wealth. One set of individuals has comfortably settled above the Micawber Frontier at the high-technology steady state. The other group is at the low-level steady state, below the asset poverty line. There are quite a few poor individuals in the middle-ability group whose potential to reach the high equilibrium has been blocked by their low initial asset levels, or realized asset shocks that trapped them below the Micawber Frontier.

With no exogenous technical change or growth in productive inputs to stimulate growth and modest investment incentives for a large portion of the population, GNI in this baseline economy is relatively stagnant over time as reflected in the "autarky" line in the top left quadrant of figure 6.3. This reflects the fact that the positive accumulation and associated productivity gains of those above the Micawber Frontier is offset by the lost potential—and wealth deaccumulation and productivity decline—of many of those trapped below it. The decline among some subpopulations is manifested through the disadoption of the high technology, use of which falls from roughly 60 percent to only 40 percent of the population. Further reflection of this economic bifurcation is found in the increasing levels of poverty, measured both as a poverty head count (top right quadrant) as well as by the poverty gap indicator (bottom left quadrant), and our unnecessary deprivation head count measure (bottom right quadrant). Income inequality (not shown) declines modestly over the first decade of the simulations, then increases above the initial level by year twenty-five as households converge on their α-conditional long-run equilibria. The lackluster performance of the base case poverty trap economy illustrates both the human and aggregate economic costs of poverty traps. The next sections consider alternative policy regimes that might lead to better outcomes.

6.3 Poverty Dynamics with Unanticipated Social Protection

This section examines the impact of reactive food aid or unanticipated cash transfers on the stylized economy studied in the prior section. The label "unanticipated" signals that these policies are implemented ex post of shocks and we assume away agents' anticipation of the resulting transfers and the behavioral response that would follow from such anticipation. This simplification is made to help understand more clearly how poverty dynamics shift in response to different sorts of social protection policies. In particular, we seek to illustrate clearly the value of addressing the purely ex post effects of asset shocks, even if agents do not expect transfers. Section 6.4 below will relax the assumption that households fail to anticipate and respond to social protection policies.

For all alternatives, we assume that the social protection agency[24] has access to an annual budget that amounts to 2.5 percent of initial GNI.[25] This arbitrary amount was chosen because it is insufficient to lift all initially poor individuals above the poverty line, though it is enough to substantially close the poverty gap. We further assume that the social protection agency has access to full information, including household ability and asset holdings, realized shocks, and knowledge of the production technology. While these are implausibly strong assumptions, using them to explore targeting

24. We use the broad term social protection agency to encompass local or national governments as well as nongovernmental organizations (NGOs) that might respond to shocks.

25. We ignore the source of taxation that generates these resources and the associated distortionary effects on the economy. They could be conceptualized as either external resources (brought in by a donor, an NGO, or a relief agency), or as domestic tax resources transferred from another sector of the national economy.

of this limited assistance budget helps further illustrate the workings of the multiple poverty trap economy.

6.3.1 Poverty and Aid Traps under Progressive, Means-Tested Cash Transfers

Under the progressively targeted or needs-based scenario, the agency uses its budget only for progressively targeted, humanitarian/cash transfers. After each production cycle, it calculates the total poverty shortfall for the economy, $S = \Sigma_{y_j < y_p}(y_p - y_j)$. If the available budget B exceeds the shortfall ($B/S > 1$), then all poor individuals are given transfers to increase their income to the level of the poverty line. If $B/S < 1$, then each poor individual is given transfers that move them to an income level equal to $(B/S)y_p$. Note that this targeting method makes the largest transfers to the least well-off, but as the ranks of the poor grow, S increases and thus each individual poor person's transfer receipt shrinks. The transfer simply adds an increment to the first (budget) constraint in optimization problem (1). Once individuals receive the transfer, they make their consumption versus investment decision according to the same logic of problem (1) above and assume that future transfers will never occur. Section 6.4 relaxes this strong assumption, but for now it helps to understand the different effects of alternative social protection policies.

The impact of this needs-based assistance regime on asset distribution can be seen in the bottom left diagram in figure 6.2. The figure is quite similar to that under autarky (the top right panel), except that asset levels are somewhat higher for those below the poverty line, especially among lower-ability persons, reflecting a transfer rule based on realized income levels and the exogenous injection of resources, B, into the economy that manifest as individual transfers to the current poor. Turning to figure 6.3, we see that the poverty head count and unnecessary deprivation measures follow a trajectory nearly identical to that which emerges absent social protection. While standard cash transfers do not fundamentally alter poverty dynamics, they do reduce the poverty gap. As can be seen in the bottom left graph of figure 6.3, the injection of well-targeted external resources cuts the poverty gap relative to the no social protection policy regime. But, the steady creation of newly poor households over time due to adverse asset shocks causes the FGT(1) to steadily rise after year ten of the simulation because the transfer received by any individual poor household shrinks as more poor people compete for a fixed aid budget, leading to an increasing poverty gap. The GNI is higher in the economy with needs-based transfer, but this is largely an artifact of the exogenous aid resources that are transferred into the economy via the cash transfer mechanism.

In a world where budgets for transfers are available exogenously (e.g., via unrequited transfers associated with overseas development assistance), progressively targeted transfers that flow to the chronically poor plainly reduce income and asset poverty, if only because there are added resources in this scenario. However, these transfers do not fundamentally alter the economy's dynamics. Indeed, the troubling irony is that poverty grows in this economy in spite of these transfers as some agents suffer asset shocks that drop them into poverty, but then receive insufficient transfers to enable them to climb back out of poverty on their own. Transfer policies that are designed to respond to one poverty trap mechanism—low innate ability that leads to chronically low income—systematically fail to address the other poverty trap mechanisms in this economy by failing to prevent more people from inadvertently falling into the trap over time.

These results signal what might be termed a relief trap. By failing to stem the flow of intermediate-ability individuals below the Micawber Frontier, the fixed humanitarian assistance budget becomes less and less able to meet the needs of those below the poverty line. If the social protection agency (or the international community) were intent on holding poverty at, say, year ten levels, then increasing fractions of total public expenditures would need to be devoted to aid budgets to accommodate the inflow of the unnecessarily poor who have suffered severe asset shocks and fallen into the basin of attraction of their low-level equilibrium.[26] We abstract here from the standard public finance problems of raising revenues, but clearly the growing demands for transfers would have to be met either through increasingly distortionary taxation or through reducing funds available for developing new technologies, building schools and infrastructure, or other interventions (not modeled here) that are aimed at boosting productivity. Poverty traps can thus, in a very direct way, create relief traps for purely progressively targeted social protection programs.

6.3.2 State of the World Contingent Cash Transfers

As the prior simulations make clear, asset risk in our model creates an ever increasing amount of unnecessary deprivation that eventually overwhelms the capacity of needs-based cash transfers to provide relief, as seen in the rising poverty gap and head count measures in figure 6.2. This observation suggests that a social protection scheme targeted at the vulnerable in the vicinity of the Micawber Frontier—that is, a safety net designed to stem the increase in unnecessary poverty—can potentially generate a win-win-

26. There is a complex set of changes occurring in these simulations, which begin from an arbitrary distribution of assets across the ability distribution. The decline (but not the elimination) of unnecessary deprivation shows that some individuals are adjusting to a new steady state in which they are not poor. Similarly, some low-ability individuals who were arbitrarily assigned large initial stocks of assets also dissave and eventually become poor over time. Finally, some number of households get pushed below the households when large shocks are realized. This latter group is reflected in the slow but steady increase in the poverty and deprivation measures in the out-years of the simulation suggesting that the pressure for an increasing aid budget moderates, but is not completely eliminated over time as households settle into their new steady states.

win scenario, with higher rates of improved technology adoption and GNI growth, reduced poverty (especially for intermediate-ability groups), and less stress on the social protection budget.

To explore this idea, we initially analyze a harsh "triage" policy regime in which the social protection agency provides transfers to households according to the following rules:

1. Each time period, the available budget, B, is allocated with first priority to individuals pushed below the Micawber Frontier by negative shocks. Denote these threshold-based transfers as SWCTs. An individual j is eligible for a SWCT of amount $\text{SWCT}_j = \tilde{k}(\alpha_j) - \theta_t[i_{jt} + (1 - \delta)k_{jt}]$ if $i_{jt} + (1 - \delta)k_{jt} > \tilde{k}(\alpha_j)$ and $\theta_{jt}[i_{jt} + (1 - \delta)k_{jt}] < \tilde{k}(\alpha_j)$. In words, if an individual was above the Micawber Frontier prior to the most recent asset shock but below it afterward, the agency provides a transfer to move the household back to the Micawber Frontier. If the total budget is no less than the total eligible contingent transfers ($B \geq \Sigma_{j=1}^{J}\text{SWCT}_j$), then all individuals pushed below the threshold are given an asset transfer to lift them exactly back to it. If the budget is insufficient to cover all SWCTs, then it is allocated first to those closest to the Micawber Frontier so as to minimize the increase in the head count of unnecessary deprivation.

2. If there is any remaining budget after step 1 (i.e., if $B > \Sigma_{j=1}^{J}\text{SWCT}_j$), then those middle-ability individuals already below the Micawber Frontier (due to low initial inheritance or prior bad luck not remedied by an SWCT) are given priority for asset transfers that lift them over the Micawber Frontier.[27] Analogous to stage (1), total potential spending on asset transfers is calculated (denote this total amount as CN). If $CN > B - \Sigma_{j=1}^{J}\text{SWCT}_j$, then the budget is again prioritized in order to minimize unnecessary deprivation by first helping the most vulnerable, defined as those closest to the Micawber Frontier.

3. If $B >$ SWCT + CN, then the residual budget is allocated according to the progressive or needs-based formulation discussed in the previous subsection.

This triage policy would be difficult to implement in most places due to the daunting information requirements it imposes—knowing the Micawber Frontier, individual ability, individual-specific shocks, and so forth. We develop this as a thought experiment because it captures clearly the intertemporal trade-offs inherent to a system characterized by multiple poverty mechanisms. Figures 6.2 and 6.3 illustrate the results of this assistance

27. Barrett (2005) refers to this kind of asset transfer as a cargo net transfer, as it is intended to lift people above—or help people climb over—thresholds at which accumulation dynamics bifurcate. Note that asset transfers are distinct from SWCT safety net transfers that keep people at or above those same thresholds. Graduation programs centered on asset transfers to the capable poor, like those described in Banerjee et al. (2015) and Gobin, Santos, and Toth (2017), are the real-world analogue to these asset or cargo net transfers.

regime for our stylized poverty trap economy. The results stand in strong contrast to autarky and needs-based assistance simulations. As shown in the bottom right panel of figure 6.3, by year fifty, all most unnecessary deprivation is eliminated and the head count of total poverty levels off at 25 percent, the share of the population that is intrinsically chronically poor by construction. Compared to the standard cash transfer policy, technology adoption is higher, as is GNI. In the longer run, this triage approach to development assistance plainly outperforms needs-based assistance by any of these metrics.

However, the bottom left diagram in figure 6.3 illustrates a core ethical challenge associated with vulnerability-targeted social protection. The FGT(1) poverty gap measure is lower under progressively targeted cash transfers for the first eight to ten years of the simulation because needs-based assistance flows primarily to the least well-off, while the stylized vulnerability-targeted policies are aimed at the vulnerable nonpoor nearest the Micawber Frontier. But, paradoxically, after eight to ten years, those who are poor are better off under the triage design because it reduces the number of people needing assistance, allowing the fixed social protection budget to provide more generous support to those who inevitably need it due to irreversibly low ability. But, prior to that time, individuals who are poor, and especially the poorest, are better off under needs-based targeting. The results for (asset or income) inequality (not shown) are qualitatively similar, with needs-based transfers generating lower inequality in the economy over the first eight to ten years, but threshold-based transfers generating lower inequality over longer horizons. These results underscore the difficult trade-offs inherent to the design of social protection policy, both over time and across subpopulations of the poor. In the presence of multiple poverty trap mechanisms, these trade-offs become especially sharp.[28]

6.4 Moral Hazard and the Design of Anticipated Social Protection

The analysis in section 6.3 revealed the paradoxes and challenges of social protection in an economy characterized by poverty traps that take several forms. That analysis, however, unrealistically assumed that individuals do not anticipate social protection benefits. This lacuna is especially important for SWCTs that are targeted at the vulnerable. Such transfers operate as a form of insurance, and as discussed above, this insurance might alter ex ante

28. In additional simulations not reported here, we considered whether these trade-offs could be mitigated by mixing different kinds of transfers and/or by reallocating budgets intertemporally through borrowing. While these alternatives can reduce the magnitude of the trade-offs reported here somewhat, they cannot be eliminated entirely. This underscores the unavoidable nature of the targeting trade-offs in both cross section (between different subpopulations of the poor and vulnerable) and over time in a multiple poverty trap economy.

investment incentives for households both above and below the Micawber Frontier itself.

In this section, we therefore relax the assumption that contingent transfers are unanticipated and consider households' rational response to them. While we could, in principle, analyze endogenous response to anticipated, progressively targeted cash transfers, we limit our attention here to anticipated vulnerability-targeted social protection schemes.[29]

6.4.1 Positive and Negative Moral Hazard

We expect two kinds of household response to safety net transfers. First, since safety net transfers mitigate asset risk, households are willing to accumulate more assets ceteris paribus. This is canonical moral hazard, in that the provision of some insurance induces increased risk taking.[30] In this model, accumulation of assets subject to stochastic shocks is the only risk-taking behavior available to agents. But asset accumulation is socially desirable in this setting, as it increases productivity and adoption of improved production technologies, increases GNI, and reduces poverty. We therefore call this incentive effect "positive moral hazard."

Second, because the safety net transfers are conditional (on pre- and postshock asset holdings) and given the standard intertemporal trade-off between current consumption and saving for future consumption, ceteris paribus households have an incentive to satisfy the transfer condition as often as possible so as to receive extra resources. If some external agency or government will insure them against falling into a poverty trap, households do not need to self-insure through asset accumulation to the same degree, thereby creating a disincentive to invest beyond the Micawber Frontier that defines eligibility—equivalently, reducing the need for precautionary savings—that runs counter to social objectives. We therefore label this effect "negative moral hazard."

For a middle-ability person with $\tilde{k}(\alpha_j) = 5$, figure 6.4, panel A, shows expected asset losses as a function of level of capital stock held with (the dashed line) and without (the solid line) the SWCT policy. As can be seen, there is zero chance of asset losses exactly at this threshold, and expected asset losses above the threshold will always keep the individual at or above $\tilde{k}$. When these contingent transfers of the vulnerability-targeted social pro-

29. This choice is primarily made for analytical convenience. Under the triage policy developed in section 6.3, the magnitude of cash transfer payments is itself uncertain, depending on the vagaries of the weather that dictate the residual budget left for such transfers. Clearly, we would expect cash transfers to discourage private accumulation (Hubbard, Skinner, and Zeldes [1995] give an empirical example showing how means-tested social insurance programs discourage precautionary savings in the United States). By ignoring these disincentive effects, we are thus overstating the possible effectiveness of cash transfers, which only reinforces our broader point.

30. Recognize that risk is increasing in asset holdings because θ is a multiplicative shock and independent of k. Therefore, stochastic losses are greater when k is larger.

tection are anticipated, the individual's optimization problem (1) can be rewritten as follows:

$$\max_{c_{jt}} E_\theta \sum_{t=0}^{\infty} \beta^t u(c_{jt}) \tag{4}$$

subject to:

$$c_{jt} \le k_{jt} + f(k_{jt})$$

$$f(\alpha_j, k_{jt}) = \alpha_j \max[f_H(k_{jt}), f_L(k_{jt})]$$

$$k_{jt+1} = \begin{cases} \tilde{k}(\alpha_j) \text{ if } \begin{cases} (f(k_{jt}) - c_{jt}) + (1-\delta)k_t > \tilde{k}(\alpha_j) \text{ and} \\ (\mathrm{k}_{jt} + (f(k_{jt}) - c_{jt})(\theta_{jt+1} - \delta) < \tilde{k}(\alpha_j) \end{cases} \\ (k_{jt} + f(k_{jt}) - c_{jt})(\theta_{jt+1} - \delta) \text{ otherwise} \end{cases}$$

$$k_{jt} \ge 0.$$

This is the same as the problem specified in section 6.2, except for the important change in the law of motion governing k_{jt+1} now that households are aware of and respond to the contingent transfers.[31]

Figure 6.5 illustrates the impact of the anticipation of contingent transfers on the probability of chronic poverty. For ease of comparison, figure 6.5, panel A, repeats the probabilities when these transfers are not anticipated (from figure 6.1, panel A). Comparing figure 6.5, panels A and B, we see that substantially fewer endowment positions are likely to end up chronically poor. This additional accumulation induced by the presence of contingent transfers at the (autarky) Micawber Frontier precisely represents positive moral hazard.

While the vulnerability-targeted contingent transfers incentivize upward mobility, they also have a discouraging effect on further accumulation that would take households beyond the safety of $\tilde{k}(\alpha_j)$ where assets are fully protected. A large swath of middle-ability agents end up in long-term equilibrium at exactly $\tilde{k}(\alpha_j)$. This behavior represents classic negative moral hazard as the presence of the implicit insurance provided by the contingent transfer leads individuals to undertake behaviors that make contingent payments more likely.

31. The household problem at period t can be represented in Bellman Equation form as

$$V(k_t) \equiv \max_{i_t} \{u(f(\alpha, k_t) - i_t) + \beta E[V(k_{t+1}|k_t, i_t)]\}$$

$$\text{where } E[V(k_{t+1}|k_t, i_t)] = \int V(k_{t+1}(k_t, i_t, \theta_t, k_g, \delta))d\Omega(\theta_t)$$

$$k_{t+1}(k_t, i_t, \theta_t, k_g, \delta) = \begin{cases} k_g \text{ if } i_t + (1-\delta)k_t > k_g \text{ and } \theta_t[i_t + (1-\delta)k_t] < k_g \\ \theta_t[i_t + (1-\delta)k_t] \text{ otherwise.} \end{cases}$$

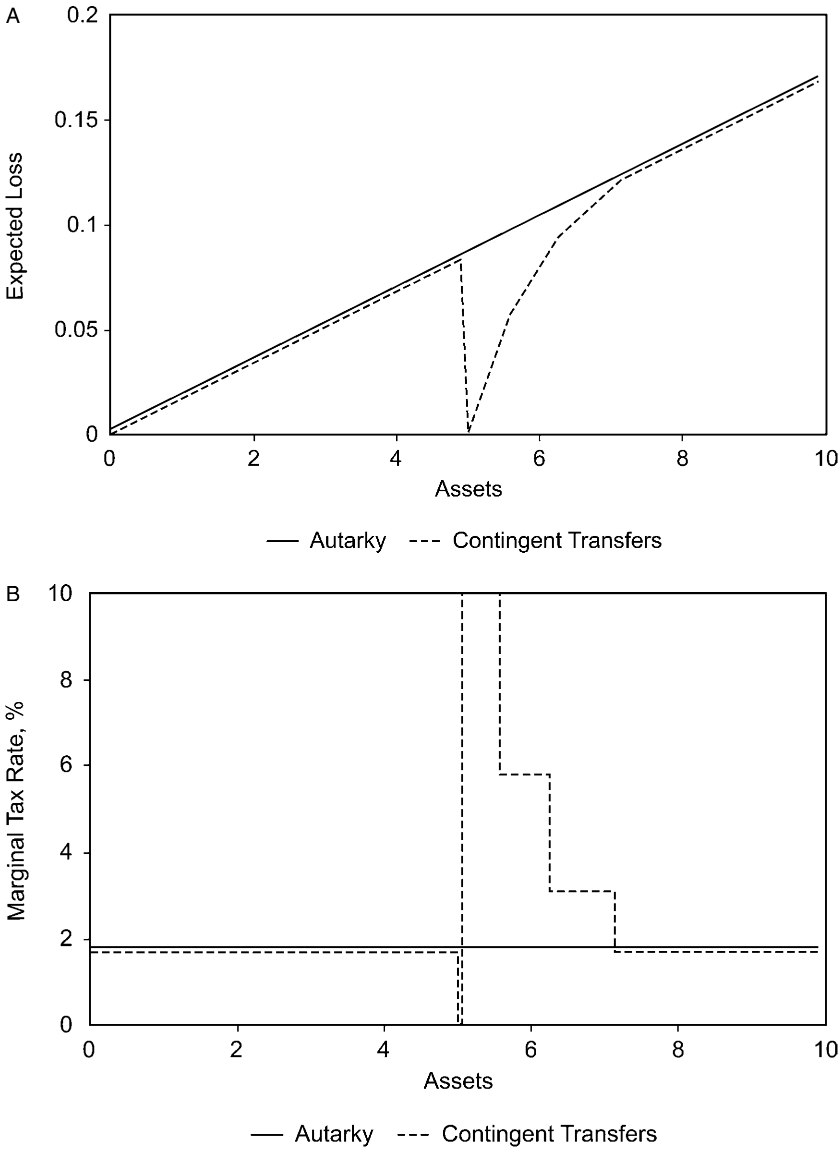

Fig. 6.4 Nature's tax rates under contingent social protection. *A*, expected asset losses; *B*, marginal tax rates.

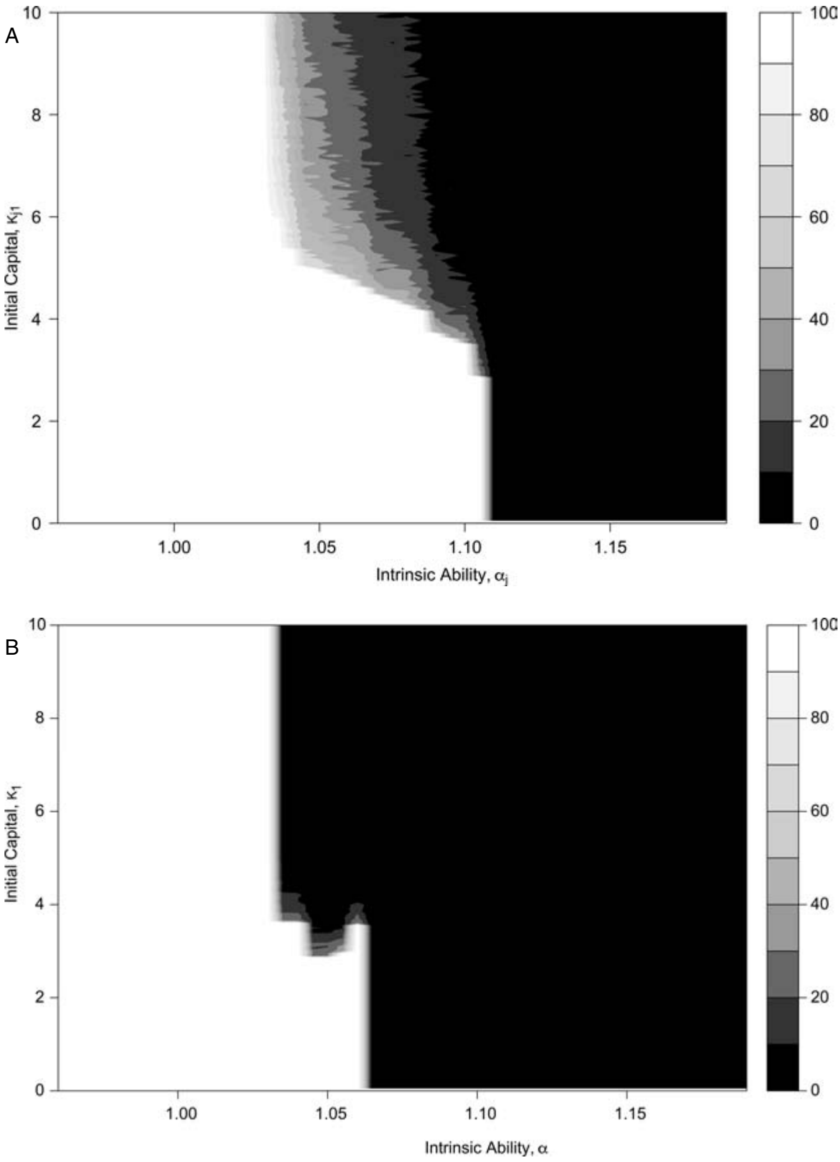

Fig. 6.5 Ex ante impacts of anticipated social protection. *A*, prob. low equilibrium under autarky (percent); *B*, prob. low equilibrium under social protection (percent).

Figure 6.4 allows further insight into the emergence of this new insured outcome. Note that nature essentially acts as an unreliable tax collector in this model, probabilistically taking away some fraction of assets every period. Figure 6.4, panel A, shows expected asset losses as a function of the level of capital stock held. The solid line shows these expected losses absent the contingent social protection scheme. Under the multiplicative risk specification, this is linear with a constant expected marginal tax rate of 1.7 percent (under the numerical assumptions used to analyze our model). This marginal tax rate is shown by the corresponding horizontal line in figure 6.4, panel B.

Under the precisely targeted SWCT scheme, expected losses drop to exactly zero at $\tilde{k}(\alpha_j)$, as shown by the dashed line in figure 6.4, panel A. Beyond that asset level expected losses begin to increase, eventually becoming identical to expected losses absent this form of social protection.[32] Figure 6.4, panel B, shows the implied marginal tax rates under this scheme. As can be seen, under the discrete probability structure used to analyze the model, the marginal tax rate abruptly jumps from 0 to 10 percent, and then slowly decreases to the natural tax rate of 1.7 percent as capital stocks accumulate beyond the indemnity payment threshold. This sharp and discontinuous elimination of social protection as the individual moves away from the insured point $\tilde{k}(\alpha_j)$ discourages accumulation and leads to a class of agents who settle in at the new $\tilde{k}(\alpha_j)$ equilibrium.

6.4.2 Using Index Insurance and Copays to Implement State of the World Contingent Social Protection

Negative moral hazard and the attraction of $\tilde{k}(\alpha_j)$ as a new equilibrium reflect in part the extremely precise targeting of the contingent transfers (and sharp jump in marginal tax rates) that define the vulnerability-targeted social protection scheme. However, this kind of precise targeting is of dubious relevance in the real world where neither realized shocks, asset levels, the Micawber Frontier, nor individual skills are easy to observe. Together, these observations raise the question as to whether something akin to SWCTs can be implemented using a market-based microinsurance scheme. Index insurance, which delivers payouts to policyholders on the basis of a predetermined index unaffected by the behavior or skill of the insured, could be particularly useful. Index insurance offers four potential advantages:

1. Payments can be triggered by a relatively cheap-to-observe index that signals shocks;[33]

32. With bounded shocks, there will be a capital stock such that even the largest shocks cannot reduce assets to $\tilde{k}(\alpha)$, the level where contingent payments kick in.

33. For the specific case of northern Kenya, see the discussion of an index insurance design in Chantarat et al. (2013).

2. it can rely on self-selection through the purchase of insurance, obviating the need to observe skill;

3. it can require a copayment, which reduces costs, allows the available public budget to stretch further, and enhances individual investment incentives relative to the SWCT case; and,

4. if cost reductions are sufficiently strong, reliance on insurance may eliminate the need for a precisely targeted subsidy that creates the behaviorally perverse sharp discontinuities in the effective marginal tax rate, as explored in section 6.4.1.

Janzen, Carter, and Ikegami (2018) employ a dynamic model similar to that developed here, while ignoring skill heterogeneity. The analysis compares an autarky scenario in which insurance is unavailable, and a targeted insurance subsidy scenario in which the government pays half of the commercial insurance premium (assuming a 20 percent markup) for all households that hold assets less than the level required to generate an average income equal to 150 percent of the poverty line. In all cases, the simulation assumes that households behave optimally based on the price of insurance and the dynamic choice problem displayed above.

The Janzen, Carter, and Ikegami (2018) analysis shows a 50 percent insurance subsidy (offered across the board to all but the wealthiest agents) can induce investment and upward mobility (positive moral hazard), but without the negative moral hazard seen in section 6.4.1. Importantly, they show that under the assumptions of their model,[34] the total social protection budget (defined as funds for the insurance subsidy plus funds for cash transfers needed to close the poverty gap for all poor households) quickly becomes lower under a combined insurance/cash transfer scheme than under a pure cash transfer scheme. As shown in figure 6.6, total costs are in fact higher in the short run under the hybrid scheme, but they become lower as the induced upward mobility eventually reduces the cost of cash transfers. Under their numerical assumptions, the present value of total social protection expenditures is 16 percent lower under the hybrid scheme.

The feasibility of using index insurance to offer contingent protection has been extensively studied in the semiarid regions of northern Kenya. Chantarat et al. (2013) and Mude et al. (2009) describe an initial contract design used in this region, and Jensen, Barrett, and Mude (2017) and Janzen and Carter (2016) report empirical impact evaluation results that are

34. The parameters of the model deviate from those used in the other simulations in this chapter. While the results are not directly comparable, the findings are still insightful. Notably, the Janzen, Carter, and Ikegami (2018) model must assume some level of basis risk (the difference between realized losses and the index). The model assumes relatively low basis risk. In practice, this is likely to overestimate the benefits of index insurance if basis risk is high.

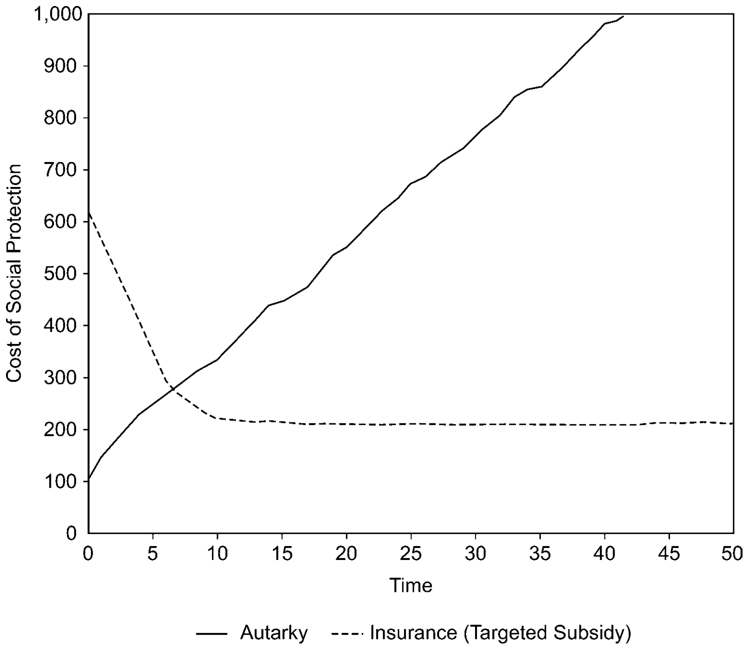

Fig. 6.6 Costs of alternative social protection schemes

consistent with the expected ex ante and ex post effects of contingent social protection that have been explored theoretically in this chapter. Despite these empirical findings, demand for the available insurance in northern Kenya has remained modest. At least partially in response to this puzzle, the government of Kenya has recently launched multiple programs that offer state of the world contingent social protection, including distribution of free livestock insurance through its KLIP (Kenya Livestock Insurance Program). The government also offers a scalable version of its core social protection scheme (the HSNP program), which extends benefits to vulnerable (but not abjectly poor) households when objective indicators signal drought conditions. The impacts of these new programs, and their ability to fundamentally alter poverty dynamics, as this chapter's theoretical analysis suggests, remain to be seen.

6.5 Conclusions

This chapter has put forward a dynamic stochastic model of a stylized poverty trap economy in which asset risk plays a major role and heterogeneity of individual ability creates two types of chronic poverty. Some people are chronically poor because their innate ability condemns them to a low standard of living. Others suffer unnecessary deprivation simply because they inherit insufficient productive capital to reach the critical asset or Micawber Frontier at which it becomes optimal to make the short-term sacrifices necessary to accumulate assets and (probabilistically) escape chronic poverty. Each of these two poverty trap mechanisms invites a different policy response. When both types of chronic poverty coexist, therefore, trade-offs inevitably arise in developing cost-effective poverty-reduction strategies.

Using this framework, we have shown that purely progressively targeted social relief—such as cash transfers—can fall prey to an aid trap because it does nothing to address the root causes of poverty. In particular, it does not protect the assets of those of intermediate ability and wealth who are vulnerable to asset shocks and to becoming poor over time. Members of this latter group steadily fall into avoidable chronic poverty, adding to the pool of individuals suffering unnecessary deprivation and needing income support. As a result, while purely progressively targeted social protection initially reduces the depth of poverty, the lot of the poor deteriorates over time due to increasing competition for limited social protection resources. Moreover, an unadorned, purely progressively targeted system of social protection does not appreciably change the number of poor, nor does it enhance wealth accumulation, economic output, or adoption rates of improved technologies.

We have then shown that a hybrid policy, which issues state of the world contingent cash transfers (SWCTs) to vulnerable-but-not-indigent households, eliminates unnecessary deprivation, empowers upward mobility, and boosts growth through endogenous asset accumulation and adoption of improved technologies. While this hybrid policy still confronts important trade-offs among different poor people and over time, this theoretical exercise establishes the potential gains to social protection that targets vulnerability (not just abject poverty) and thereby creates economic multipliers. However, despite these gains, household anticipation of SWCTs discourages some from accumulating assets beyond the range where they remain eligible for social protection transfers.

A key question then becomes whether the balance between positive and negative moral hazard can be altered by changing the mode of delivering contingent transfers. Drawing on the work of Janzen, Carter, and Ikegami (2018), we have argued that imprecisely targeted partial subsidies for index insurance can achieve the benefits of SWCTs and strike a better balance between positive and negative moral hazard, encouraging upward mobility but not artificially braking it with means-tested cutoffs. While there are challenges to implementing SWCTs via an insurance mechanism in practice, a hybrid social protection system that mixes insurance subsidies and cash transfers in theory appears to be more cost-effective than standard cash transfers as a way to address chronic poverty in risk-prone regions like northern Kenya.

Ultimately, the key finding of this chapter is that poverty traps characterized by multiple equilibria can have a pronounced effect on the performance and design of policies intended to stimulate poverty reduction, economic growth, and uptake of improved production technologies. There are potentially large returns to developing and using knowledge about critical asset thresholds to target assistance to the vulnerable nonpoor. The coexistence of populations facing different sorts of poverty traps, however, also raises unavoidable, thorny trade-offs among distinct cohorts of the poor, as well as difficult intertemporal trade-offs between current and future poverty reduction.

Appendix

Parameters and Other Details for Numerical Simulation

This section provides additional detail on the formal model used to generate the results discussed in the main body of the chapter.

The functional specification for the utility function $u(\cdot)$ is

$$u(c_t) = \frac{c_t^{1-\sigma} - 1}{1 - \sigma}.$$

The probability density of θ_t is assumed to be

$$\text{density of } \theta_t = \begin{cases} 0.90 \; \mathit{if} \; \theta_t = 1.0 \\ 0.05 \; \mathit{if} \; \theta_t = 0.9 \\ 0.03 \; \mathit{if} \; \theta_t = 0.8 \\ 0.02 \; \mathit{if} \; \theta_t = 0.7. \end{cases}$$

The other structural parameter values are assumed as follows: $\sigma = 1.5$, $\delta = 0.08$, $\beta = 0.95$, $\gamma_L = 0.3$, $\gamma_H = 0.45$, and $E = 0.45$.

We discretize continuous variables k and α as follows: $k = \{0.05, 0.10, \ldots, 15.00\}$ and $\alpha = \{0.960, 0.965, \ldots, 1.190\}$.

For the simulation of the stylized economy of 300 individuals, we draw α from $N(1.070, 0.055^2)$, with the mean and variance chosen so that ex ante proportion of low-, middle-, and high-type individuals (defined relative to the stochastic Micawber Frontier) would be 25 percent, 50 percent, and 25 percent, respectively. We draw k_1 from Uniform[0.1, 10.0] and assume that k_1 and α are statistically independent from each other.

We specify poverty line as follows. The asset level that generates income exactly equal to the poverty line satisfies the following equation:

$$y_p = f(\alpha, k_p),$$

where y_p is income-based poverty line. That asset level obviously depends on α and we denote it by $k_p(\alpha)$. We assume that an intermediate-ability individual would fall below the income poverty line if he used the low technology and thus set poverty line by $k_p(\alpha = 1.070) = 2.8$ and thus $y_p = 1.46$.

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