Social Protection in the Face of Climate Change: Targeting Principles and Financing Mechanisms

Michael R. Carter and Sarah A. Janzen

January 2015

Abstract

It has long been recognized that climatic risk is an important driver of long-term poverty dynamics, especially in rural regions. We build a dynamic household model of consumption, accumulation and risk management that allows us to draw out the full consequences of exposure to this risk (or vulnerability) by incorporating the long-term impacts of consumption shortfalls (induced by the optimal “asset smoothing” coping behavior of the vulnerable) on the human capital and long-term well-being of families. We show that the long-term level and depth of poverty can be improved by incorporating elements of “Vulnerability-targeted Contingent Social Protection” into a national system of social protection. Such a novel element, if publicly funded, implies less budget for other elements of social protection. In an effort to mediate this implied tradeoff, we then explore the degree to which vulnerable, but not destitute beneficiaries may be able to at least partially foot the bill for Vulnerability-targeted Contingent Social Protection. We find that such individuals face severe liquidity constraints and hence are unlikely to pay the full cost of such protection. However a partial subsidy scheme appears quite promising, and would relax the tradeoffs between the competing elements of a social protection system. Finally, in work still to be completed, we will explore how the relative desirability of Vulnerability-targeted and conventional social protection change as the severity of risk increases.

Michael Carter is Professor, Department of Agricultural and Resource Economics at the University of California, Davis. Sarah Janzen is Assistant Professor, Department of Economics, Montana State University.
1 Introduction

This work builds on previous theoretical and empirical work that analyzes poverty traps and social protection in the face of shocks. We develop a poverty trap model in the face of shocks. In this model, we will account for a critical threshold, around which both equilibrium outcomes and optimal behavior bifurcate. Using stochastic dynamic programming techniques, we analyze the following:

1. Intergenerational tradeoffs between consumption and asset smoothing in the face of shocks
   Several recent empirical analyses of droughts show that it is not only the destitute that severely restrict consumption (and undercut investments in child health and nutrition), but also a group of households who hold modest asset stocks. These households, whom we might label the vulnerable, (because they are not destitute, but face the risk of becoming so) face an unpleasant choice. They can sell scarce assets in order to sustain consumption in the face of drought-induced income declines. Or, they can hold on to their productive assets in the hope of a better future after the drought. While their logic of holding on to remaining assets (often called asset smoothing) is unassailable, it induces the kinds of consumption declines that compromise the human capital of the next generation.
   In this paper, we explicitly model this tradeoff and consider the implications for optimal behavior as well as the design of social protection policies. In contrast to this prior theoretical work, we explicitly consider the implications of shocks and coping (reduced consumption) on the human capital, or capabilities, of the next generation. Empirical work has indicated that stochastic insults to human capital play an important part in the intergenerational transmission of poverty. By explicitly incorporating this mechanism into a coherent theoretical framework, we gain new insights on poverty dynamics, especially in the face of climate change-induced changes in risk.

2. Social protection targeting principles and transfer mechanisms
   Contingent social protection measures—which release transfers in the wake of a shock—may improve resilience amongst the poorest, but it is not only the poorest who may merit inclusion in contingent social protections schemes. In an earlier analysis, Barrett, Carter, and Ikegami (2013) compare purely needs-based social protection with a budget-neutral policy that prioritizes non-destitute, but vulnerable, asset smoothing households. The analysis shows that while a purely needs-based distribution of aid is initially more favorable to the
poorest, over time they must compete with the vulnerable but initially non-poor for transfers. If the aid budget remains constant, then individual transfers will shrink as more people collapse into poverty, unable to graduate from poverty without larger transfers.

Building on this previous work, we explicitly control for the tradeoff discussed in (1) above and

(a) Analyze whether non-destitute, but vulnerable households should also be targeted with state-contingent social transfers; and,

(b) Evaluate how these transfers should be implemented and financed (whether through insurance, cash transfers, etc.). One of the intuitions we will pursue is the degree a mix of public and private provisioning of social protection (through insurance mechanisms) can be used to expand the effectiveness of a social protection scheme for a given public budget.

3. Social protection in the face of climate change

Recent climate-related natural disasters, including droughts, floods and wild-fires, have revealed widespread vulnerability of poor populations. The inability of poor households to sustain critical investments in child health and nutrition during and after such shocks unfortunately means climate-related hazards are likely to result in permanent deleterious consequences for the next generation (as discussed and modeled in (1) above). In this paper, we will consider multiple scenarios of increasing likelihood and severity of shocks and consider the implications of climate change on poverty dynamics under the assumption of non-convex asset dynamics.

Section 2 presents a first dynamic model, which treats human capital and capabilities as exogenously fixed. This first model allows us to develop key concepts and explore dynamically optimal coping strategies for households with different asset endowments. Section 3 then generalizes the model by allowing human capital to evolve inter-generationally, driven by both a tendency to regress to the mean, but also influenced by consumption shortfalls that might occur during the “first 1000 days” of life of the next generation. We show that incorporating this mechanism into the model worsens long-term poverty dynamics

Section 4 then explores whether what we term Vulnerability-targeted Contingent Social Protection can ameliorate these long-term poverty dynamics. While the answer is yes, they come at a cost of reduction of other forms of social if they are publicly funded. We thus explore a co-financing model in which the vulnerable pay some or all of the cost of VT-CSP. We find that a mixed financing model is, in theory,
promising resolution of these tradeoffs. Section 5, still to be written, explores how these tradeoffs change with climate change-induced shifts if risk. Section 6 concludes.

2 Risk, Vulnerability to Chronic Poverty and Asset Smoothing

We begin with our core theoretical model of household intertemporal decisionmaking and analyze it first under the simplifying assumption that human capital is a fixed endowment that is not influenced by consumption choices. While this assumption is patently unrealistic over the longer term, it allows us fix key concepts and ideas concerning risk, vulnerability and asset smoothing. We then review empirical literature which provides evidence on some of the key implications of this (and related) theoretical models. Among other things, this empirical literature points us in the direction of taking more seriously the long-term or inter-generational linkages between consumption choices and human capital, a task which we undertake in Section 3.

2.1 Theoretical Framework

Consider the following dynamic household model. Each household \( i \) has an initial endowment of assets, \( A_{it0} \), where the second subscript denotes time. Households maximize intertemporal utility by choosing consumption \( c_{it} \) in every period. The problem can be written as follows:

\[
\max_{c_{it}} \quad \mathbb{E}_\theta \sum_{t=0}^{\infty} u(c_{it}) \\
\text{subject to:} \\
c_{it} \leq A_{it} + f(A_{it}, H_{it}) \\
f(A_{it}) = H_{it} \max[F^h(A_{it}), F^l(A_{it})] \\
A_{it+1} = f(A_{it}) - c_{it} + (1 - \theta_{it+1})A_{it} \\
H_{it+1} = H_{it} = \bar{H} \forall i, t \\
A_{it} \geq 0
\]

The first constraint restricts current consumption to cash on hand (current assets plus income). As shown in the second constraint, the model assumes that assets are productive \( f(A_{it}) \) and that the households have access to both a high and low
productivity technology, $F^h(A_t)$ and $F^l(A_t)$, respectively. Fixed costs associated with the high technology make it the preferred technology only for households above a minimal asset threshold, denoted $\bar{A}$. Thus, households with assets greater than $\bar{A}$ choose the high technology, and households below $\bar{A}$ choose the low productivity technology.

The third constraint is the equation of motion for asset dynamics: period $t$ cash on hand that is not consumed by the household or destroyed by nature is carried forward as period $t+1$ assets. It can also be thought of as an intertemporal budget constraint, with liquidity expressed in asset units. Assets are subject to stochastic shocks (or depreciation), $\theta_{t+1} \geq 0$. The shock is exogenous, and realized for the households after decision-making in the current period ($t$), and before decision-making in the next period ($t+1$) occurs.

The household’s endowment of human capital, $H_{it}$, augments the total factor productivity of both production processes. As shown by the fourth constraint, we for now we assume that $H_{it}$ is the same for all people and does not evolve over time. Later we will relax this assumption and allow $H_{it}$ to evolve over time based on household consumption choices which of course serve as investments in future human capital.

Finally, the non-negativity restriction on assets reflects the model’s assumption that households cannot borrow. This assumption implies that consumption cannot be greater than current production and assets, but it does not preclude saving for the future.

It is informative to express the household optimization problem in terms of the corresponding Bellman Equation. We consider the simple case where the shocks are distributed i.i.d., so that the most recent shock does not give any information about the next period’s shock. In this case, there is only one state variable, $A_t$. Under these assumptions, the Bellman Equation is:

$$V(A_t) = \max_{c_t} u(c_t) + \beta \mathbb{E}_\theta[V(A_{t+1}|c_t, A_t)]$$ (2)

To reduce notational clutter, we have dropped the $i$ subscript.

The intertemporal tradeoff between consumption and investment faced by the consumer is captured clearly by the first order condition:

$$u'(c_t) = \beta \mathbb{E}_\theta[V'(A_{t+1})]$$ (3)

\textsuperscript{1}If instead the shocks are serially correlated, the agent would use the most recent shock to forecast future asset levels. The state space would then include current and maybe past realizations of $\theta$ and $\varepsilon$ in addition to $A_t$. This extension is considered in the absence of a poverty trap in Ikegami, Barrett, and Chantarat (2012).
A household will consume until the marginal benefit of consumption today is equal to the discounted expected value of assets carried forward to the future.

As has been analyzed by others in similar models (e.g., Buera (2009)), the non-convexity in the production set can, but need not, generate a bifurcation in optimal consumption and investment strategies (or what Barrett and Carter (2013) call a multiple equilibrium poverty trap). This bifurcation happens if steady states exist both below and above \( \tilde{A} \). If they do, there will exist a critical asset threshold where dynamically optimal behavior bifurcates, with those below the threshold deaccumulating assets and moving towards the low steady state, and those above it investing in an effort to reach the high steady state. The former group are often said to be caught in a poverty trap. Following Zimmerman and Carter (2003), we label the critical asset level where behavior bifurcates as the Micawber threshold, and denote it as \( A^M \).

It is important to stress that if \( A^M \) exists, its location depends on parameters of the model, including the severity of risk (for example, Carter (2009) show how \( A^M \) shifts with risk). Also note that small changes in assets around the threshold will have strategy- and path-altering implications. For example, giving an additional asset unit to a household just below the threshold will incentivize them to invest in an effort to escape the poverty trap. Taking 1 asset unit away from a household just above the threshold will push them below and put them on a path of toward the low equilibrium.

This latter observation suggests that in the neighborhood of \( A^M \), incremental assets carry a strategic value. That is, they not only create an income flow, they also give the option of advancing to the high equilibrium in the long-run. We illustrate this point by numerically analyzing this model using the parameterization described in the next section. The line in Figure 1 graphs the right hand side of 3 as a function of current asset holdings. As can be seen, this term—which represents the future value of an asset—is non-monotonic and swells around approximately 14 asset units. As discussed by Carter and Lybbert (2012), it is this jump in the value of assets that leads households in this asset neighborhood to smooth assets, and destabilize consumption when hit with a shock.

### 2.2 Shocks, Vulnerability and Asset Smoothing

To further explore the implications of this baseline or autarchy model, we numerically analyze it using parameters roughly designed to represent the stochastic structure and the productivity parameters of the livestock economy of the semi-arid regions of northern Kenya and southern Ethiopia. Details regarding the numerical implementa-
Figure 1: Opportunity Cost of Assets
tion and calibration procedures are outlined in the appendix. The chosen numerical admit both a low \((A = xx)\) and high \((A = yy)\) long-term stochastic steady state. For convenience, we will refer to the low equilibrium as a poor standard of living. Any agent who ends up at the low equilibrium will be described as chronically poor, or caught in a poverty trap.

Figure 2 summarizes the results of this dynamic programming analysis. The horizontal axis reports the initial asset holding of the household, while the vertical axis reports the probability that the household becomes mired in chronic poverty. The blue line in the Figure reveals that under this parameterization, the Micawber threshold, \(A_M\) is found at an asset level of about 14 units. Any household with assets below that level has probability one of chronic poverty.\(^2\) As can be seen, even households above this threshold face significant vulnerability to falling into chronic poverty, with that probability slowly falling from 50\% to 10\% over the illustrated domain.

While highly stylized, this model has rich implications concerning the impact of large climate shocks:

1. **Irreversible Consequences**

   A shock that pushes a household below the critical asset level, \(A_M\), has irreversible consequences as the household becomes mired in chronic poverty. Vulnerability, as defined in Figure 2 thus matters as those who fall below \(A_M\) become candidates for conventionally conceived schemes of social protection.

2. **Increasing Risk Moves the Threshold**

   The location of the threshold is itself sensitive to risk. Increasing the probability of bad outcomes moves this threshold further to the right (see for example Carter (2009)). For a given asset distribution, this shift not only increases the number of individuals trapped in chronic poverty, but also increasing vulnerability.

3. **Asset Smoothing by the Vulnerable**

   While households near either steady state will tend to smooth consumption in the spirit of the Deaton (1991) model, highly vulnerable households in the neighborhood of \(A_M\) will asset smooth when hit with a shock. In contrast, those near the threshold drastically cut consumption in an effort to preserve

\(^2\)The probability of one indicates that households at that level and below do not attempt to move to the upper equilibrium given their low chance of reaching it and settle in at the low equilibrium, consistent with the value of future assets shown in Figure 1.
Figure 2: Probability of Collapse to a Low Level Equilibrium
capital and avoid the collapse into chronic poverty. While this coping behavior is understandable, it potentially has deleterious long-term consequences as consumption doubles as investment into future human capital. We will later explore the implications of this behavior for long-term poverty dynamics.

These results are provocative, but are of course purely theoretical. Before considering this model and its implications further, we examine the evidence on the degree to which asset smoothing and other signifiers of vulnerability are empirically relevant.

**May be worth saying something about single equilibrium models having somewhat similar implications to points 3; and also if shocks are AR-1 as in Deaton**

### 2.3 Empirical Evidence on Poverty, Vulnerability and Asset Smoothing

In earlier empirical work on coping strategies, both Townsend (1994) and Jalan and Ravallion (1999) note that poor households less effectively smooth consumption than do wealthier neighbors. In later work, Hoddinott (2006) provides evidence that in the wake of the 1994-1995 drought in Zimbabwe, richer households sold livestock in order to maintain consumption. In contrast, poor households with one or two oxen or cows were much less likely to sell livestock, massively destabilizing consumption instead. In Ethiopia, Carter et al. (2007) also find evidence of asset smoothing by the poor, as households coping with a drought attempted to hold onto their livestock at the cost of consumption. Building on Kazianga and Udry’s (2006) empirical finding that poor and wealthy households manage their savings and assets differently in the face of shocks, Carter and Lybbert (2012) propose a structural approach to this problem. They empirically estimate an asset threshold, and show that households above an estimated dynamic asset threshold almost completely insulate their consumption from weather shocks by drawing down assets, whereas households below the threshold do not, despite having the assets to do so. Specifically, households above that threshold sell 90 cents of assets for every dollar of lost income, whereas households below that threshold—who still have substantial asset holdings—cover only about 30% of stochastic income losses with asset sales.

Further evidence on the empirical relevance of asset smoothing comes from a recent randomized controlled trial of the impacts of insurance in northern Kenya. As reported in Janzen and Carter (2014), better off households above an empirically estimate critical asset threshold primarily deal with shocks by selling assets and consumption smoothing. Moreover, the impact of insurance on these households is in fact to reduce their asset sales. In contrast, insurance has almost no impact on asset sales by households below the asset threshold and instead cuts in half their reliance
on the kind of consumption reduction strategies observed by less well-off households in the Carter and Lybbert (2012) study of Burkina Faso. In both countries, the asset smoothers are the majorities of their respective populations.

While asset smoothing is a logical—dare we say dynamically optimal response—to shocks in the model developed above, we need to dig deeper if we wish to understand its full importance and implications for social protection strategies. As Hoddinott (2006) points out, even though asset smoothing is an attempt to preserve assets, consumption is an input into the formation and maintenance of human capital. Hoddinott pointedly argues that, “The true distinction lies in households’ choices regarding what type of capital - physical, financial, social or human (and which human) - that they should draw down given an income shock.” While asset smoothing strategies may be rational, they likely come at the cost of immediately reduced consumption, with potentially irreversible losses in child health and nutrition (Carter et al., 2007). Jacoby and Skoufias (1997) present evidence that households in rural India indeed cope with shocks by reducing child school attendance, although their estimates of the long-term consequence suggest that the overall effects are modest. Work that examines the impacts of drought on prenatal and young children paints a more dismal picture.

The outcomes of undernutrition and malnutrition are well known. In children, these conditions can lead to muscle wastage, stunting, increased susceptibility to illness, lower motor and cognitive skills, slowed behavioral development, and increased morbidity and mortality (Martorell, 1999). Those that do survive suffer functional disadvantages as adults, including diminished intellectual performance, work capacity and strength. For example, Alderman, Hoddinott, and Kinsey (2006) show persistent effects of drought shocks in Zimbabwe that caused lower height-for-age scores and lower educational outcomes, presumably due to lower consumption. In women, undernourishment during childhood can be the cause of lower adult body mass, which means increased risk of delivery complications and lower birthweights for the next generation (Martorell, 1999). These outcomes set the stage for a pernicious intergenerational cycle of undernutrition and its destructive effects.

3 Consumption as Investment in Future Human Capital

The model in Section 2.1 above makes clear why vulnerable, but not destitute households may sharply diminish consumption in the wake of a severe shock. While that strategy may protect the family from immediate danger of economic collapse, it may also impinge on future capabilities and human capital of the family. This section proposes a way to model this additional feedback into our core dynamic model, opening
the door to a deeper exploration of social protection policies.

3.1 Generalizing the Dynamic Model with Endogenous Human Capital Formation

We here make two changes to the model laid out in 1 above. First, while maintaining the model’s infinite time horizon, we break time up into 25-year, generational sequences. Second, a household’s human capital is fixed at its inherited level only for a generation. Every 25 years, as a generation comes to an end, human capital is updated via stochastic process that is also sensitive to the realized levels of nutrition during the first 5-years of that generation. In a highly stylized way, this specification is meant to capture the idea that undernutrition en utero and in the first 4 years of life can have irreversible damage on the physical and cognitive development of the child. Colloquially, we will refer to this period of nutritional sensitivity as the “first 1000 days.” In the analysis to follow, we assume that households ignore these long-term feedbacks into its long-term human capital. Third, we assume that there is initial heterogeneity in both productive assets ($A_i$) and human capital endowments ($H_i$).

Making these changes, we can rewrite the infinite horizon problem 1 as:

\[ \text{While we make this assumption for now primarily to keep the problem manageable mathematically, the assumption could be justified either based on lack of nutritional knowledge or education. Note also that simple discounting will tend to lead the current decisionmakers to largely, but not completely, ignore impacts that occur in the distant future. We leave it to future work to incorporate nutritional awareness in this model. Note also that for the asset smoothers, choice even with full knowledge of its long-term consequences, may be no different than that which modeled when this human capital feedback is ignored. For these households, failure to consumption smoothing would mean an immediate dissent into chronic poverty as opposed to putting it off for a generation.} \]
\[
\max_{c_t} \quad \mathbb{E}_\theta \sum_{g=1}^{\infty} \sum_{t_g=1}^{25} u(c_t)
\]

subject to:

\[c_t \leq k_t + f(A_{it}, H_{it})\]
\[f(A_{it}, H_{it}) = H_{it} \max\{A_{it}^{\gamma h}, A_{it}^{\gamma l}\}\]
\[A_{it+1} = f(A_{it}, H_{it}) - c_t + (1 - \theta_{t+1})A_{it}\]
\[H_{it+1} = \begin{cases} H_{it} & \forall t_g \neq 25 \\ wH_{it-1} + (1 - w)\bar{H} - \lambda \sum_{t=1}^{5} 1(z > c_{it}) \left(\frac{(z - c_{it})}{z}\right)^2 & \forall t_g = 25 \end{cases}\]
\[A_{it} \geq 0\]

where \(g\) counts the generations and \(t_g\) counts years within a generation.

Compared to problem 1, the only change to the problem is the fourth constraint, the equation of motion for human capital. Within the first generation \(g = 1\), \(H_{it}\) is fixed at the level of the endowment \(H_{i0}\). However, two forces shape the human capital endowment of the next generation. First, the next generation’s human capital is driven by a regression to the mean phenomenon, with its basic level of human capital swinging like a pendulum between the human capital of the prior generation and the population average level \((\bar{H})\).\(^4\) Second, if consumption during the first 5 time periods of generation \(g\) falls below a critical nutritional poverty line level, \(z\), then the human capital of generation \(g + 1\) is penalized, with the penalty increasing quadratically with the aggregate nutrition shortfall.\(^5\) This specification reflects the importance of nutritional investments during the early stages of a child’s growth process.

Before analyzing the impact of endogenous human capital formation on poverty dynamics, we first examine the analogue of Figure 2 when agents have an array of human capital endowments, but when we hold those endowments fixed. The contours in Figure 3 display the probability that a household with the asset and human capital endowment levels will fall into chronic poverty. By way of reference, Figure 2 was drawn for an initial human capital level of 1.35. As can be seen in Figure 3, when assets fall below about 14 units, then the probability of chronic poverty becomes one, whereas higher asset levels translate into reduced probabilities. For a household with

\(^4\)Future versions of this model will have human capital swing between upper and lower bounds.

\(^5\)Numerically, we set \(z\) to be the value of steady state consumption for a household with average human capital when at the low steady state equilibrium.
a higher initial human capital endowment (say 1.45), the critical asset threshold drops from 14 to about 7 asset units. For a lower initial human capital level (say, $H_{i0} = 1.2$), the critical level rises to about 14 asset units. We refer to the frontier traced out by these different human capital-specific thresholds as the Micawber Frontier, $A^M(H_{it})$.

In addition to the inverse pattern between $H_{i0}$ and $A^M(H_{i0})$, two other features of Figure 3 deserve mention. First, the minimum asset threshold disappears for agents with sufficiently high human capital (greater than about 1.46 in the diagram). That happens because for these individuals, returns to investment is always so high that it is always worth trying to reach the upper equilibrium. Indeed, for such highly skilled individuals, the probability of collapse is approximately zero.

The second feature is that for a low enough level of human capital (below approximately 1.1), the threshold also disappears as it becomes infinite. For low enough skilled people, there is no level of capital that suffices to make it worthwhile to run the more productive technology. These low-skill individuals will therefore always be chronically poor (see Carter (2009) for further discussion).
3.2 Shocks and Poverty Dynamics with Nutritionally-sensitive Human Capital

We now examine poverty dynamics when human follows the equation of motion given in problem 4 above. Recall that in this model, each generation of a family inherits a level of human capital. That level of human capital is assumed fixed over that generation’s life-course. However, the consumption choices of that generation during its ‘first 1000 days’ shapes the human capital that will be inherited by the next generation of producers. Note that this way of modeling captures some elements of an overlapping generations model in a true dynamic framework.

Figure 4 displays the modified frontier that evolves across the generations when human capital is nutritionally sensitive. The color contours again mark the probability of chronic poverty as a function of the dynasty’s initial human capital and asset endowments. These results are obtained by simulating the dynamic programming for multiple generations, multiple times.

The results are quite striking. Comparing Figures 3 and 4, we see that the Micaw-
ber Frontier has moved to the right and that the band of intermediate probabilities has narrowed. For any given initial distribution of population across the asset-human capital space, these shifts imply higher long-term rates of chronic poverty.

While we are in the early stages of analyzing these results, there appear to be two forces at work that explain this result:

1. Asset Smoothing
When hit by shocks households in the neighborhood of the Micawber Frontier, they tend to let consumption fall in an effort to protect or even reaccumulate assets as quickly as possible. While this strategy can work in the short-term of one generation, it ultimately dooms the family dynasty over the longer term as the consumption shortfalls in years 1-5 sends the next generation’s human capital downwards and past the critical level, $A^M(H_{it})$.

2. Rapid Capital Accumulation
The same logic that diminishes prospects for households in the neighborhood of the frontier also applies to high human capital households that face strong accumulation incentives (that is, akin to the vulnerable, these households also attach an extremely high value of to additional assets (i.e., $V'(A_{t+1})$ is large). In their hurry to reach the steady state, these households inadvertently damage their long-term economic prospects.

While the latter force seems foolish (and an artifact of our assumption of nutritional naïveté), the latter is not. The key point is that these nutritional feedback loops make the poverty consequences of shocks worse.

4 Targeting and Financing Contingent Social Protection
The modeling above draws out the full cost of vulnerability and its costs in terms of long-term, chronic poverty. We now turn to consider the design of social protection strategies in a world such as that modeled above. We focus on two issues that merit policy attention:

1. Targeting of Contingent Social Protection
While social protection schemes conventionally target the destitute, the mechanisms modeled in the preceding section suggest that in some instances, it may...
be cost-effective to target the vulnerable in the wake of shocks lest their assets (physical and human capital) collapse and they become destitute. However, for a given social protection budget, deviation of funds to “vulnerability-targeted, contingent social protection” (VT-CSP) will imply important tradeoffs. The overall desirability of VT-CSP likely depends on the severity of risk, an issue that Section 5 explores.

2. Self- versus Public-financed Contingent Social Protection

The tradeoffs potentially induced by a system of VT-CSP motivate the search for alternative financing mechanisms that might reduce those tradeoffs by allowing a given public budget to stretch further. Specifically, is it feasible to use an insurance model to implement a VT-CSP that is both contingent on shocks and at least partially financed by the beneficiary? If this mixed financial strategy is feasible, then it holds out the prospect of allowing a given public budget to extend further.

In the remainder of this section, we summarize what we have learned so far on both of these issues. Additional work is underway to extend this analysis and will augment the final version of this paper.

4.1 Vulnerability-targeted Contingent Social Protection

Contingent on our own further analysis, we draw on insights drawn from earlier work by Barrett, Carter, and Ikegami (2013) to explore the impacts and tradeoffs of a publicly funded VT-CSP. Those authors explore a model similar to 4 above, except that human capital is fixed and never changes. To explore the implications of different social protection schemes, Barrett, Carter, and Ikegami (2013) contrast poverty dynamics under a conventional needs-based social protection schemes (in which fixed public resources are directed to the destitute) with what they call a “triage” policy, which is essentially a scheme that prioritizes funding a VT-CSP and only residually transfers money to the destitute.

Figure 5 illustrates the results of their dynamic programming analysis. The top panel illustrates the evolution of the headcount poverty measure under autarchy (no social protection), conventional social protection (targeted to the neediest) and a VT-CSP which prioritizes the non-poor vulnerable over the destitute. Both social protection schemes assume the same, fixed public budget. As can be seen, the VT-CSP dominates the conventional program in terms of lower long-term poverty rate. This of course happens because the VT-CSP brakes shock-driven collapse into chronic
poverty of the vulnerable. Surplus resources (after paying for the VT-CSP transfers) are also used to boost the asset levels of those below the Micawber frontier.

While these results are striking, they also come at a cost. The lower panel Figure 5 illustrates the evolution of a poverty gap measure under the alternative social protection scenarios. As can be seen, the VT-CSP scheme makes the poor worse off for the first 15 years of the simulation than they would under a budget neutral, conventional social protection scheme. After year 15, that tradeoff disappears as the poverty gap falls further under the VT-CSP scheme as the ranks of the poor have been thinned out sufficiently that the residual budget available for transfer to the destitute increases.

While we need to explore these insights further in our model with endogenous human capital, this first analysis is telling of both the strengths and the weaknesses of VT-CSP.

4.2 Mixed Financing Models for Vulnerability-targeted Contingent Social Protection

The VT-CSP scheme analyzed in section 4.1 essentially operates like a publicly funded insurance scheme: those suffering shocks receive payments in the wake of a shock that drives them below the Micawber Frontier, $A^M(H_u)$. This observation motivates the question as to whether this kind of social protection could be offered in the form of an insurance contract that is funded in part by beneficiary contributions. There are at least several questions that confront this kind of proposal:

1. Can a feasible insurance contract be devised that offers adequate protection while circumventing problems of moral hazard and adverse selection?

2. Would vulnerable individuals be willing to voluntarily purchase such a contract?

Regarding the first question, it is well known that an earlier generation of efforts to employ individual indemnity-based insurance in rural areas of the developing world collapsed under the weight of asymmetric information and transaction costs (Hazell (1992); Barnett, Barrett, and Skees (2008)). Recent technological innovations in remote sensing, as well as the rediscovery of old ideas like area yield insurance (see

---

7 Conventional insurance relies on loss verification to control moral hazard. Unfortunately, for a small, remote farmer, a single loss verification will consume multiple years of premium payments, rendering this kind of insurance economically infeasible. Similarly, individual-specific loss rating is non-economic for small-scale, exposing conventional insurance schemes to adverse selection.
Figure 5: Vulnerability-targeted Contingent Social Protection

Source: Barrett, Carter, and Ikegami (2013)
Halcrow (1949)), have reignited efforts to use insurance in this area, but this time relying on “index insurance” that makes payments based on an easy-to-measure index, which cannot be influenced by the individual, but which is correlated with (but not identical to) individual outcomes.\(^8\) While the outpouring of new index insurance schemes (see Chantarat et al. (2012) International Fund for Agricultural Development and World Food Program (2010), Miranda, Farrin, and Romero-Aguilar (2012) and Carter et al. (2014) for listings of new programs) seems to indicate that these contracts solve the moral hazard and adverse selection problems, their costliness and the fact that they by definition offer incomplete coverage for losses raise the issue as to whether individuals—especially the vulnerable—would be willing to purchase these contracts.

In ongoing work (Janzen, Carter, and Ikegami (2015)) we explore these issues using a variant of model 1 in which the household can also use its cash on hand to purchase units of index insurance. Intuitively, we might expect the vulnerable to voluntarily purchase insurance as they have the most to gain. However, as shown in the top panel of Figure 6, this intuition is not correct as demand for insurance at market prices drops almost to zero for households in the neighborhood of the Micawber threshold. As Janzen, Carter, and Ikegami (2015) detail, while it is correct that insurance is highly valuable to vulnerable households, it is also the case that these households are the most liquidity-constrained because incremental assets are also highly valuable (as a form of protection) for these households. Note that these vulnerable households do begin to purchase insurance as soon as they build up their asset stocks. In the end, the long-run prospects of vulnerable households are substantially changed by the availability of insurance. It does not, however, completely eliminate their vulnerability.

Because the unwillingness of the vulnerable to purchase insurance is primarily driven by liquidity constraints, it may be suspected that their demand would be highly price elastic and sensitive to partial subsidization of insurance. The lower panel in Figure 6 confirms this intuition. When subsidies cut the cost of insurance in half, demand by the vulnerable responds rapidly, with implied gains in reduced vulnerability.

\(^8\)Index insurance indemnifies insured farmers based on an external index such as directly measured average yields in a region or average yields as predicted by rainfall, remotely sensed measures of plant growth such as evapotranspiration. Because these area measures are beyond the influence of any individual producer, index insurance is largely immune to the moral hazard and adverse selection problems that sank earlier efforts to use conventional insurance for small-scale agriculture. \(^?\) discusses technical design issues and options, while Miranda, Farrin, and Romero-Aguilar (2012) and Carter et al. (2014) review experience with index insurance to date.
Figure 6: Demand for Insurance as a Form of VT-CSP

Actuarially Fair Premium
Plus 20% Loading

Zero Loading
Plus 40% Discount

Proportion of Assets Insured vs. Assets

Source: Janzen, Carter, and Ikegami (2015)
While we still need to push this analysis further, there are grounds to explore whether a mixed financing model for VT-CSP—in which insurance premiums are shared by both beneficiaries and the public social protection budget—can be effective according to the poverty criteria explored in section 5 above.

5 Social Protection in the Face of Climate Change

This section is still to under construction.

6 Conclusion

While still incomplete, our analysis has drawn out the full consequences of vulnerability by incorporating the long-term impacts of consumption shortfalls (induced by the optimal “asset smoothing” coping behavior of the vulnerable) on the human capital and long-term well-being of families. We show that long-term level and depth of poverty can be improved by incorporating elements of “Vulnerability-targeted Contingent Social Protection” into a national system of social protection. Such a novel element, if publicly funded, implies less budget for other elements of social protection. In an effort to mediate this implied tradeoff, we then explore the degree to which vulnerable, but not destitute beneficiaries may be able to at least partially foot the bill for Vulnerability-targeted Contingent Social Protection. We find that such individuals face severe liquidity constraints and hence are unlikely to pay the full cost of such protection. However a partial subsidy scheme appears quite promising, and would relax the tradeoffs between the competing elements of a social protection system.

Finally, in work still to be completed, we will explore how the relative desirability of Vulnerability-targeted and conventional social protection change as the severity of risk increases.
References


