INITIATIVE ON Fragility, Conflict, and Migration

Anticipatory versus Post-Shock Transfers: Conceptual Analysis

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Contents

Introduction

Climate shocks are becoming increasingly prevalent because of climate change (IPCC, 2023). Moreover, these climate shocks have more potential to negatively affect populations of low- and middle-income countries, as these populations are more likely to be employed in or around agriculture for income generation, which is particularly vulnerable to climate change (Gitz et al., 2016; Clarke et al., 2022). As a result, mechanisms to help these populations build resilience to climate shocks are increasingly needed to mitigate increases in food insecurity as negative shocks occur.

One such mechanism, that has become more prevalent in recent years, is anticipatory action. Anticipatory action occurs when governments, donors, humanitarian agencies, or a combination thereof can effectively anticipate a climate shock and act beforehand to provide aid (often in the form of cash transfers) and advice to those who they believe will be affected, rather than waiting until the onset of the climate shock and providing affected households with post-emergency aid. Anticipatory action takes advantage of recent improvements in weather prediction (e.g., Alley, Emanuel, and Zhang, 2019) and can be designed in several different ways to assist potentially affected households and communities maintain assets, shift production patterns, or smooth consumption through a negative climate shock. These methods can include information, which can help households plan for the shock, and cash transfers, to help households implement those plans particularly if they would otherwise be liquidity constrained. Transfers could take place once or, for vulnerable households in longer onset shocks such as drought, they could take place repeatedly over time.

Though anticipatory action is increasingly implemented, the theory about how they should work, relative to emergency transfers, is relatively underdeveloped. Therefore, in this paper we fill this gap in the literature by developing a conceptual model that is linked to an underlying theoretical model related to farm household behavior. The theoretical model can account for multiple types of shocks—both longer term shocks, such as droughts that can be predicted, and floods, which in some special cases come with some warning (e.g. Belana et al., 2023), but in others occur with only a few days advance warning, at best.[1] We use the conceptual model to expand upon more narrow definitions used in the theoretical model, and build some analysis around tradeoffs of interest between anticipatory action and post emergency transfers.

The paper proceeds as follows. The next section reviews the literature on anticipatory transfers, and the following section builds out a conceptual model, which is backed by a theoretical model in the appendix. The fourth section uses data to parameterize the model and presents simulation results, and the final section concludes with recommendations about when to use anticipatory action versus post-emergency transfers.

Literature

The existing literature studying the effect of anticipatory cash transfers, relative to the status quo of post-emergency cash transfers is small and limited. There are only a small number of articles that describe the possible benefits of anticipatory action—in the form of cash transfers or information (Costella et al. 2017; Funk et al. 2019; Bhowmik, Irfanullah, and Selim 2021). The possible benefits include providing households the ability to choose less costly coping strategies that allow households to change agricultural practices and diversify livelihood activities while also limiting the need to sell off productive assets or take on debt upon the onset of an extreme

[1] It is unlikely that, for example, cash transfers can occur in advance of a cyclone, but information about cyclones provided in advance can help households prepare.

weather crisis (i.e., a flood or a drought). In general, and as discussed by Pople et al. (2021), there are three theoretical mechanisms that explain how anticipatory transfers might be more beneficial for recipient households, relative to traditional cash transfers dispersed after the onset of a crisis. First, anticipatory cash transfers widen the choice set of coping strategies for recipient households. Second, anticipatory cash transfers allow recipient households to avoid market disruptions driven by the crisis (i.e., limited ability to trade and inflated prices). Third, anticipatory cash transfers allow recipient households the time and space to make choices before the psycho-social trauma of a crisis materializes and potentially hampers cognitive capacity to make informed choices.

This literature also discusses constraints on the effectiveness of anticipatory action. Costella et al. (2017) note that the success of anticipatory action depends on the ability to accurately forecast extreme weather events, the ability to identify and pre-register beneficiaries, and the capacity of the service provider in implementing cash transfers in a short period of time. However, Nobre et al. (2023) note that our ability to accurately forecast extreme weather events is improving and these technological improvements enable the ability of anticipatory action to help humanitarian organizations more effectively support vulnerable households in the time of a crisis.

The few studies in this literature that do use quantitative data on households receiving anticipatory cash transfers rarely are able to focus their comparisons to similar households who received the same cash transfer amount but after the onset of the crisis. For example, Pople et al. (2021) study the effect of a one-off transfer (of $53, provided by the WFP) in the context of a 2020 flood in Bangladesh. Relative to households that did not receive the cash transfer (i.e., due to plausibly exogenous implementation constraints), recipient households were less likely to go a day without eating during the flood and spent most of the transfer on water and food. After the flood, recipient households report higher child and adult food consumption, well-being, less asset loss, engaged in less costly borrowing, and reported higher earning potential. Importantly, this paper does not test the relative effects of anticipatory transfers compared to cash transfers disbursed after crisis onset, however, the authors do find that receiving the cash transfer a day earlier increases welfare.

In a similar type of study, Gros et al. (2019) estimate the effects of a one-off transfer (of $60, provided by the Red Cross) in the context of a 2017 flood in Bangladesh. Relative to households that did not receive a cash transfer, households receiving forecast-based cash improved access to food, reduced high-interest debt, and reduced psycho-social stress during and after the flood. The forecast-based cash also prevented households from selling off valuable assets during the flood, however, it should be noted that this paper does not test whether anticipatory transfers are better than traditional cash transfers after the onset of a crisis. In another example, analysis by WFP (2022) compares outcomes between households that receive both anticipatory cash transfers and information vs. households that receive only anticipatory cash transfers and finds that the information, in addition to the anticipatory transfer, leads to better outcomes among participating households.

The only study that we are aware of that compares outcomes between households receiving anticipatory cash transfers and other comparable households receiving the same cash transfer amount distributed after the onset of the crisis is Balana et al. (2023). The authors study the effect of a one-time cash transfer (of about $400, provided by the International Rescue Committee) in the context of a flood in Nigeria. The authors find that, relative to households receiving the same transfer amount after the onset of the flood, households receiving anticipatory cash transfers increase the number of pre-emptive climate-adaptive actions and have more productive assets, in value terms, at endline. The authors find no effects on short-term food and non-food consumption, possibly because the endline survey took place soon after the post-emergency transfers were distributed.

Given this small and limited literature, we build a theoretical model and conduct simulation analysis to develop a set of guidelines around when and where anticipatory cash transfers might an effective strategy for humanitarian organizations aiming to provide support to vulnerable households exposed to extreme weather events.

Conceptual Model

In this section, we develop a conceptual model linked to a theoretical model in the Appendix that explores the trade-offs between providing anticipatory cash transfers and post-emergency transfers to a population potentially affected by a severe weather event. We can classify weather events into two types—one would be a fast onset event, such as a typhoon, that is difficult to predict and for which only a short time is available before the shock occurs, and the second type is more of a slow onset event, such as flooding from excess rains that build up over a period of weeks, or drought, which takes place over a longer period of time (such as a rainy season). We begin the model by focusing on a one-time transfer occurring before the event occurs; we then consider how the results would differ if there were multiple, regular payments during the event. We largely focus here on slow onset events but discuss anticipatory actions that can help households in the context of rapid events below.

Before laying out the contours of the model, we first lay out some assumptions about the type of population and geography that is being studied. First, we assume the population of a specific geographic area could be affected by a severe weather event occurring soon (e.g. the next seven years). Second, we further assume that the population generally lives in rural areas, and their primary income source is agricultural production.[2] Additionally, we assume that a large proportion of that population is either food insecure or vulnerable to food insecurity. Therefore, there is a humanitarian rationale for intervening in the face of a shock; the goal is therefore to intervene to help reduce the humanitarian crisis of reduced food security caused by the shock. Finally, we assume that each household within the population has assets; these assets could include agricultural implements, livestock, or assets that help them conduct non-agricultural self-employment activities, as well as consumption assets, including housing and other consumer durable goods. Any household landholdings are assumed fixed in the short term.[3]

We consider how this set up applies largely in two different scenarios. We primarily consider how longer-term events—such as droughts—might affect households. We also consider anticipatory transfers in the context of a well-known event, such as flooding due to the release of excess water from a dam, that can be anticipated. For a drought, anticipatory transfers could begin at any time after the agricultural season begins and could be either one-time or provided as multiple transfers. In either case, post-emergency transfers might not occur until either well after the agricultural season is completed or after flood waters recede, and it has become clear in either case that food insecurity increased substantially because of the event. With cyclones or more rapid onset shocks, anticipatory transfers are not typically possible though anticipatory action can be improved, in the context of early warning systems.

We consider how anticipatory action transfers would affect household behavior against two alternative scenarios—one in which households do not receive any assistance, and a second in which households receive assistance only after the shock is being realized. We use a stylized mathematical model in the appendix to illustrate household decision-making about productive activities in this risky environment. In the "no assistance scenario," the household must rely only on its own coping mechanisms to deal with the negative event. We assume for now that there are two components to household income—income from agricultural production and income derived from household assets. The shock can have two implications—first, the agricultural production process can be negatively affected, and second, some portion of assets could be lost because of the shock.[4]

We begin by considering how household responses to the potential of a shock might affect household income, from a theoretical perspective. Households may adjust their activities as follows in absence of information. Because of the possibility of a shock, they may expend a bit less effort than they would otherwise in agricultural production, because of the possibility that it would not be remunerative. From the perspective of a typical agricultural household model, the rationale is that the expected return to labor from agriculture is reduced relative to leisure.[5] This effect can be mitigated if the onset of a shock is particularly slow or can be realized over time; households might, for example, adjust labor in the middle of the season to try to salvage some of their crops, or might replant if rains fail quite early. Moreover, there might be high returns after the shock occurs to expending labor in the recovery period; for example, in rebuilding structures that increase returns to agriculture. Nonetheless,

[2] Pastoralist or semi-pastoralist populations are sometimes targeted for anticipatory action or post-emergency transfers as well; the theoretical model would need some adjustment to cover these populations, so instead we consider how the conceptual model should change when dealing with pastoralists later in the discussion.
3 We note here that these assumptions lay out households that have at least somewhat diversified income sources. Mathematically, in an income generation model the parameter on non-agricultural income can be set to zero for purely agricultural households, making them specialized in agriculture.
4 Note that the fact that the model includes two potential income sources does not preclude households from having only one source. We abstract away from transfer income, which is also relatively common among rural households in low- and middle-income countries. Further, we abstract for now away from the potential for migration; we return to the possibility of migration as a coping mechanism after setting up the basic model.
5 Here, we can consider the optimum a situation in which the household can fully insure negative agricultural shocks.

we can assume that income from agricultural production will decrease relative to either a no risk optimum or a fully insured optimum.

Household asset holdings are also affected by the shock. In the theoretical model in the Appendix, we assume some amount of assets is lost by each household. This effect is particularly problematic, because it implies that household income in the following period(s) will also be negatively affected. As a result, household income is lower until the asset base can be rebuilt to the pre-shock level. These findings can have two implications for food security. First, households become inherently more vulnerable to food insecurity, as their income at present is reduced. Second, depending upon the household's reliance on income from those assets, income could be reduced in the future as households have lower non-agricultural income until its asset base can be built back up, and households could also reduce consumption while building up their asset base.

Continuing to take the household perspective, we next consider how three different scenarios would affect households: 1) a scenario in which anticipatory information is provided to the household only, but no transfers; 2) a scenario in which post-emergency transfers are provided to households; and 3) a scenario in which anticipatory information and transfers are provided to households. From the household perspective, we are initially interested in effects of any type of action on household income, household food security, and household asset holdings.[6] After considering the household perspective on anticipatory versus emergency transfers, we consider trade-offs between the two faced by those making decisions about transfers (WFP, WFP partners, and governments).

Anticipatory Action, no Transfers

We first consider how anticipatory action, in the context of warnings and information, might affect household level outcomes. In the context of a predicted drought, earlier warnings can help households shift from more water intensive to less water intensive crops or varieties, it can help them decide to act to protect their asset bases, or it can lead them to choose other options that can help them potentially mitigate losses to potential income (e.g., sending out migrants to urban areas). However, it should be noted that most of these options require up-front investments. It is costly to protect assets or send migrants to urban areas; in particularly poor areas, seeds could be challenging to obtain for households who typically save seed.

With a flood, whether slower or more rapid onset, predictions can again help households attempt to protect any assets they have. In slower onset events (e.g., flooding beyond a dam), early warning systems can help households plan to protect their asset bases and potentially work to mitigate losses to potential income, as with droughts, by sending away migrants if money is available to do so. For more rapid onset events, early warnings are less likely to help with maintaining assets but can help reduce the loss of life if enough warning can be given.

Assuming a lack of credit availability, in either case, household food insecurity may increase since household production and therefore income is likely to decline. Asset holdings that cannot be protected may also decline. As a result, we would expect to observe an increase in food insecurity. However, in either case, we would expect to observe less people becoming food insecure than in the context of a lack of any anticipatory action. Furthermore, with warnings there should be less loss of life than in a no information context.

Post-Emergency Transfers—Household Responses

The theoretical model in the Appendix first examines how behavior would change in a stylized model when households receive post-emergency transfers relative to no transfer receipt after a negative, persistent shock occurs. In the case of a drought, it is worthwhile to think of the transfer as taking place as the hunger season starts well after a drought reduces production. In this case, it is easy to see that production decisions would not be affected; household production decisions are made long before they would know that a transfer would take place. So, household incomes and therefore food security status would decline prior to the transfer and would increase again with the transfer. Depending upon the timing of the transfer, households may remain food insecure with cash transfers, as they might invest part of transfers received either in the next season's inputs or in replacing

[6] Here, we define household income as the sum of the value of all agricultural production plus residuals earned from household assets, including potential asset sales. We add any transfers received for emergencies (e.g. from the government or international organizations). We do not include wage income or income from remittances; we explore the latter in the additional section on migration.

assets (e.g., livestock) that might have suffered because of the drought. With a slow onset flood, transfers would presumably occur soon after flood waters receive. A similar decision-making process would likely occur, with households not changing anything about their income generation strategy, but potentially making decisions about consumption versus investments in assets that could lead those choosing to invest in assets after transfer receipt.

Anticipatory Action Transfers—Household Response

If households instead receive anticipatory transfers, a key result in the model is that they may adjust their labor input into agricultural production downward, to instead invest it in protecting their asset base. As a result, household income might decrease relative to the no transfer scenario. The amount of decline depends upon the labor investment in protecting assets. Expanding thoughts beyond the strict theoretical model, we could imagine transfers either occurring once prior to the drought, or several times during the typical agricultural season. In the latter case, households might adjust their agricultural activity and could find periods in which additional labor can be used alongside the transfer to boost production.

These conceptual results assume that the overall transfer amount is constant—whether a one-time anticipatory transfer, regular anticipatory transfers, or a one-time emergency transfer. The magnitude of the decline in income depends upon several factors. For example, we have assumed non-transfer income comes from agriculture and residuals from assets; the share of each will affect the overall loss in income. To the extent households have assets, the income loss will also depend on the return to household assets. Beyond the model, if there are opportunities for household members to emigrate to urban areas or less affected rural areas and make higher wages, income losses can be mitigated.

From a food security perspective, recall the theoretical model tightly links income with food security. As a result, the model would suggest that food security could slightly decline with anticipatory transfers relative to post-emergency transfers, as income could slightly decline when households protect assets. In other words, with anticipatory cash transfers, households may make choices that trade off caloric consumption in the short term for income in the longer term. Since incomes are likely to be slightly lower with anticipatory transfers, households receiving anticipatory transfers could make choices that leave them slightly more vulnerable to food insecurity in the near term. However, this difference is likely to be small and, as noted, we expect asset holdings to be higher among households receiving anticipatory transfers.

Moreover, the difference could be mitigated entirely if households make different choices as they receive transfers over time. As discussed above, households might allocate their labor differently as transfers are distributed; if they are distributed at times at which the transfer and additional labor could help boost production, then it could be that agricultural income increases and therefore food security also increases. These potential effects would depend upon the frequency of transfers, the timing of transfers, and previous decisions made by households during the agricultural season, making predictions about whether they would occur difficult. Nonetheless, they are possible.

Choices Faced by Governments and International Organizations

We next use the theoretical framework to explore choices faced by governments, international organizations, and donors in determining whether to provide anticipatory or post-emergency transfers.[7] We assume that the primary goal of governments and international organizations in providing transfers is to minimize the level of food insecurity subject to the budget constraint. A second goal could be to minimize the need for future transfers to the area population. We study this question considering three key parameters—the probability of a negative shock, the transfer amount, and methods of geographic targeting. We extend the discussion here to consider a drought relative to a quick onset shock, such as flooding or cyclone damage.

We first note that a feature of anticipatory versus post-emergency transfers is that there is a chance that the shock is not realized. First, let's consider a one-time transfer. If anticipatory transfers are the policy of choice, there is a risk that the negative shock does not occur, and transfers could have been used in another way. As a result, there is some probability of a shock occurring at which post-emergency transfers are clearly preferred to anticipatory

[7] We note that the model implies one-time transfers, but in general the results should extend to regular transfers given over a short period of time (e.g. 6 months).

transfers. In other words, if we think about that probability as increasing from zero to one, at some point between zero and one, the preferred choice switches from post-emergency to anticipatory transfers.

Reality it is not that simple—anticipatory transfers can be broken up into regular transfers during a longer-term emergency, such as a drought. If the drought does not materialize or is less severe than initially anticipated, transfers can be stopped or adjusted, saving the government, international organization, or donor money. The same principle works geographically—with good monitoring information, transfers could be scaled back in areas that are not as exposed to drought or could be increased in particularly severely affected areas.

The challenge of determining what type of transfers are appropriate for a specific situation increases as the uncertainty increases around the probability of a negative shock. If there is more uncertainty around weather forecasts, there could be a couple of potential effects. In the context of the theoretical model in the Appendix, the additional uncertainty should push the equilibrium towards more use of post-emergency transfers rather than anticipatory transfers, as the additional uncertainty increases would lead the agency providing transfers to make more risk averse decisions. Investments in weather prediction can lower the uncertainty of shocks, which would both reduce uncertainty and help predict rapid onset events. Moreover, these investments could be used to provide information to farmers, a potentially cost-effective way to increase farm profits (e.g. Innovation Commission, 2023).

Before discussing extensions to the model, it is worth briefly considering transfer targeting.[8] Targeting is typically done both by geographic area and by vulnerability. The area that could be affected by either a long- or short-term shock would then begin to affect targeting performance. First, the population of vulnerable people in the entire area might exceed available resources for transfers, in which case an allocation mechanism would be necessary to prioritize areas. One could imagine refining geographic targeting, which would leave out some places that could be affected by the shock; one could refine targeting in this manner by either leaving out places likely to be less affected, or places where fewer residents are vulnerable to food insecurity. One can imagine ranking areas by either of the criteria listed above, and establishing a cutoff reflecting resources available for transfers below which areas did not receive transfers. Alternatively, one could imagine reducing the transfer size, though that might lead more households to be food insecure after transfers were distributed.

Finally, it is worth considering how the conceptual model differs if we consider a shock realized over a longer period, such as a drought. With a drought, there are a couple of differences, here assuming the discussion centers around rain-fed agriculture. First, the probability that rainfall will fail updates over time. Before the season begins, uncertainty around the probability in the model is relatively high, but the rainfall failure becomes clearer, with shrinking uncertainty over time. So, it is important to define that anticipatory transfers would take place before the drought is declared. Second, transfers might take place over time in the context of a drought, rather than being more likely as a one-time transfer.

Migration and Anticipatory Action

Negative weather events may lead to pressure on households to send away migrants. Voluntary migration from rural areas to urban areas or international destinations tends to be positive, as it typically helps households increase total income and improve the distribution of risk within their income generating portfolio (e.g.de Brauw, 2019; Ambler et al., 2023).[9] In fact, cash transfers of any type often lead to increased voluntary migration, since households can overcome liquidity constraints that might otherwise constrain migration.

It is important, then, to differentiate between voluntary and distress migration. Distress migration occurs when households or residents of a rural area feel compelled to leave their homes because they are uninhabitable for a specific reason or set of reasons. Floods and droughts are a documented catalyst of some distress migration, so it is worthwhile measuring potential effects of anticipatory action on distress migration. However, the causality

[8] Targeting transfers based on proxy means tests—even those using new techniques like machine learning—are both relatively expensive to implement and are prone to both inclusion and exclusion errors (Coady, Grosh and Hoddinott, 2004).
[9] A common concern is that voluntary migration from rural areas leads to increased international migration. However, existing research on international migration suggests that in most of the world, voluntary migrants tend to come from wealthier, urban households (e.g. find reference). For example, a recent survey among African migrants in Europe suggests that around two-thirds of them lived in African cities before migrating (UNDP, 2019).

between these negative events and distress migration is not entirely clear and will depend quite a bit on individual circumstances. In some cases, households or potential distress migrants might make it through severe negative shocks without distress migrating, while in other cases, what would not seem such a severe shock might lead households to migrate to seek improved circumstances.

Theoretically, we can imagine the following mechanism by which transfers associated with anticipatory action might reduce distress migration. First, considering information about impending shocks, households receiving such information can plan for those shocks within the context of their own resources. Since distress migration is, by definition, unplanned, such information should help reduce distress migration. Second, if households receive a one-time transfer or regular transfers through a longer-term shock, their income will become at least partially more secure, implying they would have less need to migrate in distress. Further, transfers might help households realize any plans that they might make using information about coming negative shocks. All these factors will lead to reduced propensity to migrate in distress. However, none are completely definitive, as noted above—while anticipatory action and transfers could help reduce or mitigate reasons for distress migration, neither may be sufficient for some households in particularly challenging circumstances.

This question is not necessarily empirical, either. As noted, cash transfers may make it easier for households to voluntarily migrate, so simply measuring migration out of affected areas that, for example, receive and do not receive anticipatory transfers may confuse voluntary and distress migration.

Simulation

In this section, we take the model in the Appendix and develop a simulation to better understand the magnitude of the potential benefits of anticipatory action aid versus post-emergency transfers. To conduct the simulation, we need to parameterize the model. To come up with parameters, we needed a data set that includes information on: 1) households' operating land, 2) income, 3) asset data and 4) whether agricultural activities have been seriously affected by weather-related events, within a specific country. We use the 2015 World Bank CGAP smallholder household survey. This survey includes all the above information, implying that it could be used on its own, rather than pulling in parameters from different data sources.

The CGAP data are nationally representative, covering 2,574 households, and include detailed data on income generation activities and household asset holdings. The assets do not have a value placed on them in the survey, so we use the 2015 Mozambique producer price index data from Food and Agriculture Organization of the United Nations (FAO) to monetize household productive assets. The income measurement is a drawback, as it is based on a single question related to average monthly income. Nonetheless, that income measure can be used in the model, and we interpret results on a percentage change basis.

Table 1. Parameters for Simulation

Name	Value	Definition
$\boldsymbol{b}$	0.2	Budget: percentage of average yearly income for transfers
$\boldsymbol{\delta}$	0.95	Discount rate for income
$\boldsymbol{p}$	0.25	Weather shock probability
$\boldsymbol{\lambda}$	0.64	Income loss ratio = Income after shock / income before shock
$\tilde{\boldsymbol{p}}$	0.98	Prediction accuracy
$\boldsymbol{L}$	50	Total labor
$\boldsymbol{\eta}$	0.9	Discount rate for assets
$\boldsymbol{r}$	0.05	Asset yearly return rate
$\boldsymbol{\alpha}$	0.4	Asset kept ratio = Asset after shock / asset before shock

Source: Authors' calculations.

We use the parameters in Table 1 in the simulations as follows. In the first simulation, we vary the parameter b; the parameter measures the relative size of transfers provided to households. The parameter δ is a fixed discount rate (implying that future income is less valuable in decision making than current income). We use the data to find that about 25 percent of households reported facing a weather shock in 2015. The data also inform the income loss ratio; we assume that about 36 percent of income is lost to the shock, based on averages found in the data. The next parameter, $\tilde{p}$, is based on an assumption; we assume that predictions about where shocks occur is not completely accurate, so there are potentially households receiving anticipatory action that do not experience the negative shock. The next three assumptions are not based on data; we assume 50 units of labor, a discount rate for assets that is higher than for income (since assets depreciate), and a return on assets of 5 percent. Finally, we assume 60 percent of assets are lost in a shock, but we vary this amount in the second simulation.

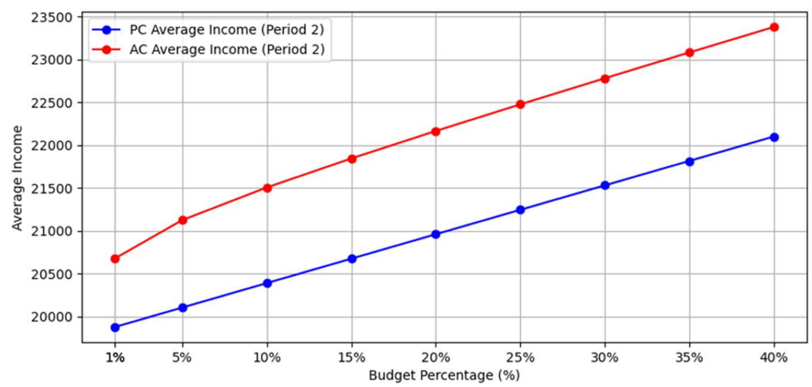
Based on the parameters and the data set above, we perform simulations on both post-emergency and anticipatory cash transfer policies. We find that for the parameters listed above, with a transfer worth 20 percent of overall household income, the simulation suggests an increase of about 6 percent over post-emergency transfers. In the model, the reason that we observe this increase is largely due to the ability of households to better maintain their asset base. As a result, income is not only higher in the initial period (immediately after the shock) but would be higher on a longer-term basis as well, since households were able to maintain a higher asset base for future periods.

We next vary the transfer amount relative to the household income we generate from the CGAP data. Instead of just setting the transfer amount at 20 percent of the sample average household income, we vary the budget percentage from 1 percent to 40 percent and simulate how income levels differ between anticipatory action aid and post-emergency transfers.

We present these results graphically in Figure 1. We find that anticipatory cash transfers (red dots and lines) lead to higher income levels, and lower rates of poverty, for all transfer amounts we considered relative to post-emergency transfers (blue dots and lines) of the same transfer amount. The simulation shows a nearly consistent difference between anticipatory cash transfers and post-emergency transfers for all transfer amounts. This finding might seem trivial, given that the transfer amounts are the same in both cases, the only difference being the timing of the transfer relative to the shock.

Figure 1: Simulation Results Varying Transfer Levels

Panel (a): Household Income

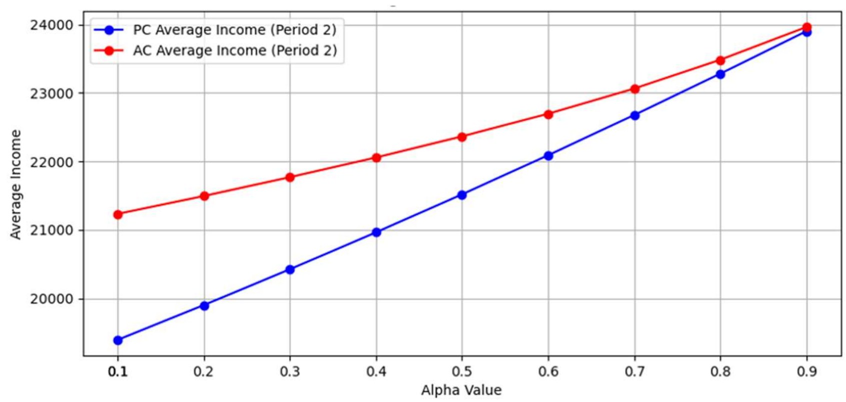


However, there are two points of interest. First, we observe a slight reduction in the difference between anticipatory cash transfers and post-emergency transfers at the lowest transfer values. There may be transfer amounts that are so small that they do not practically facilitate the saving of assets, and thus according to the model, they do not provide meaningful benefits when distributed prior to a shock. Second, we observe that beyond that point, according to the model it is valuable to spread transfers as widely as possible, since more people can benefit in those cases, and the relative benefits to anticipatory action do not appear to vary based on the transfer size. In other words, more people could be helped by an anticipatory aid package that reached 10% of average incomes than one that reached 20% of average incomes, since those packages could be distributed to almost double the number of people (assuming transaction costs increase with larger numbers of people receiving transfers).

We next turn to varying the share of assets that households retain after the shock in the absence of anticipatory action. This parameter is α in the simulation. An intuitive way to think about the α parameter is the extent to which the shock destroys a household's productive assets in the scenario in which they would receive post-emergency transfers. At low values of α, the modeled household is only able to keep very little of their productive assets and at high values of α they can keep most of their productive assets. In the simulation results discussed above, we assumed an α of 0.4, meaning that households would only be able to retain 40 percent of their assets after the shock.

We present these results graphically in Figure 2. We find that our results change meaningfully when we allow the α value to vary. At $\alpha = 0.1$, where households lose almost all their assets to the shock (90 percent of them), we find the largest benefits of anticipatory cash transfers (red dots and lines) relative to post-emergency transfers (blue dots and lines). At the other end of the spectrum, with $\alpha = 0.9$, in which households only lose 10 percent of their assets, the benefits associated with anticipatory cash transfers vanish. This result suggests that anticipatory cash transfers are the most beneficial when the shock in question damages a large share of affected households' assets or force them to sell a large share of their assets.

Figure 2: Simulation Results Varying Post-Shock Assets



Costs of Anticipatory Action

In the model, we assume that the amount spent on anticipatory action aid, in whatever form (seeds, transfers, water infrastructure investments, or other) is equivalent to spending that could occur among the same population with post-emergency transfers. Hence, the monetary cost of anticipatory action—under this assumption—is the same as the monetary cost of post-emergency transfers.

One of the main costs of anticipatory action relative to post-emergency action is the cost of providing aid to individuals or communities that do not end up being affected by the expected negative shock. In the cash transfer literature, this phenomenon is often called "leakage" (e.g. Coady, Grosh and Hoddinott, 2004). There are two important problems that could be caused by leakage: first, deserving beneficiaries who would have been provided with a transfer or services post-emergency can no longer receive them, and second, with more prominent leakage there could be donor pressure to either improve targeting or to reduce the amount of anticipatory action aid provided.[10]

We observe that there is almost always a resource constraint before transfers and services can be delivered. This observation leads to the first parameter that is important to consider in determining this cost—the proportion of the affected population that can be reached (i.e., the targeting proportion). While the proportion is certainly an estimate, it is still a valuable parameter. Consider the El Nino drought in southern Africa in 2023-4; an estimated 20 million people were affected, and approximately 2 million people were reached with anticipatory aid. In this context, 10 percent of the population was reached.

The proportion of the population that can be reached will correlate with the amount of leakage that takes place, which can be defined as the proportion of beneficiaries that were not actually exposed to the shock (i.e., the leakage rate). There is again a clear parallel to the targeting literature for cash transfers; in the first decade of the 2000's, China tested a cash transfer program for its poorest rural residents; because such a small proportion of the poor population was served by the *di bao* program, measures of its targeting performance were some of the best in the world, relative to other programs (Chen, Ravallion, and Wang, 2006).

We expect the relationship between the proportion of the population to be reached and the leakage to be positive and convex, meaning that as a larger proportion of the population can be reached, the amount of leakage will increase at an increasing rate. The logic behind the shape of this hypothesized relationship is as follows: at low targeting proportions the number of people that we can provide anticipatory transfers to is dwarfed by the overall number of affected people. In this scenario, the leakage rate will be low because of the scale of the disaster relative to available resources to provide anticipatory transfers. As the targeting proportion increases, however, so does the potential to mistakenly distribute anticipatory transfers to households that ultimately are not affected by the shock. This function is convex because available technology that allows us to predict if and where a shock will

[10] There is an implicit assumption that targeting post-emergency transfers is well done, e.g. all post-emergency transfers would go to deserving individuals. While targeting post-emergency transfers to deserving individuals is non-trivial, relative to anticipatory transfers, it is categorically easier to mitigate leakage once we already know if and where a disaster has occurred.

take place allow us to predict which households will need assistance and at low targeting proportions, we can be reasonably sure that we can identify these households. As we approach the limit where we are targeting all (or nearly all) of the households that will need assistance, the potential we mistakenly distribute anticipatory transfers increases quickly because the number of needy households that will not be targeted declines and approaches zero.

Without data on actual leakage rates across a variety of anticipatory transfer programs with a targeting proportion (i.e., the proportion of the affected population that can be targeted), the structure of this relationship is not possible to directly measure; however, we can speculate using stylized functions that assume different parameters defining the relationship between the targeting proportion and the leakage rate.

Figure 3: Stylized Leakage Rate Functions

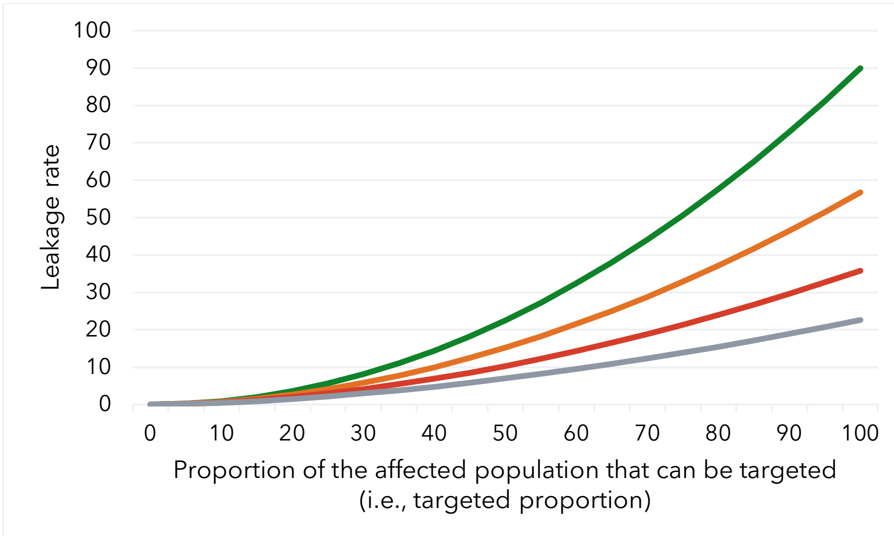


Figure 3 illustrates four stylized functions, which each show a positive and convex relationship between the targeted proportion and the leakage rate at varying degrees. A key point is that under some innocuous assumptions, there is no reason to be concerned about leakage until at least 25-30 percent of the households in need can be reached by anticipatory action. Under current funding levels for anticipatory action, the costs are negligible.

Recommendations

This paper describes conceptual issues related to anticipatory action aid in a novel framework, considering it directly against post-emergency aid. Our stylized model, that appears in the Appendix, suggests that anticipatory action allows households to reallocate their labor so that they can preserve assets in the context of an impending shock. There is a potential short-term benefit, as in a more protracted shock such as a drought households may be able to use anticipatory action to maintain their income levels through the shock, and there is a longer-term benefit as well, in that households are able to better maintain their asset base for the following year(s), increasing long-term income.

In the simulation we run, we find that once aid amounts are large enough to help them maintain those assets, there is no additional benefit to incomes relative to post-shock aid. The simulation, however, treats time in a somewhat crude manner, and likely understates any gains to aid in a protracted shock. So, the income gains that we state do not account for short-term income gains. Nonetheless, a key lesson is that once need is met to raise food security levels, it makes sense to spread anticipatory action aid as widely as possible.

This point is particularly true when we consider the relative costs of anticipatory action. We suggest that so long as the population receiving anticipatory action is below 25 percent of the overall population affected by a shock, the costs are likely to be negligible. If anticipatory action grows to a point at which more than a quarter of a projected affected population can be reached, it is worthwhile considering the potential costs of mistargeting more seriously, from both a humanitarian and a political perspective.

Appendix: Theoretical Model

Here are some basic preliminary assumptions about rural households used to build the theoretical model, which include households' homogeneity, no initial saving, and risk neutrality.

A1. **Households' homogeneity**: All households are small-scale, with a few productive assets. In this case, the productive assets work the same for all the households in the analysis.

A2. **No initial saving**: Households have no initial savings and households can only rely on anticipatory transfer to save productive assets.

A3. **Households are risk neutral**.

Finally, we note the following functional form assumptions:

A4. **Well-behaved functions**: We assume production functions $f(\cdot)$ and $\theta(\cdot)$ are continuous and first and second-order differentiable. In addition, we assume $f_L > 0$, $f_M > 0$, $f_{LL} < 0$, $f_{MM} < 0$ (diminishing marginal returns for labor and land endowment), and $\theta_A > 0$, and $\theta_{AA} < 0$ (diminishing marginal returns for productive assets).

A5. **Cost function**: We assume there is a cost to preserving assets $c(L_p)$, that increases in the amount of labor allocated to it ($c_L > 0$, $c_{LL} > 0$). By allocating some labor to asset preservation, some share of assets $\gamma(L_h)$ is preserved, where $\gamma(0) = 0$, $\gamma_L > 0$, $\gamma_{LL} < 0$.

Consider a village made up of N agricultural households who have a fixed endowment of land (M) and own productive assets (A). They produce an agricultural product by the production function f(L; M) where L is labor input. We assume they must choose the amount of labor to use in period 0 (L^0), and the income from that labor is realized in period 1, reflecting the fact that crops take time to grow.

The household chooses an amount of labor L_a to allocate to farming activities, with the remainder to leisure activities (which are part of the household utility function). In period 1, if we normalize the price of the farm good to 1, then the monetary income Y of household h in a period with no shock exposure would be:

$$Y_h = f(L_{ah}; M_h) + r\theta(A_h) \tag{1}$$

where θ(.) is the function by which household assets yield income, and r is the rate of return relative to the agricultural price level. We assume the function is the same for each household for simplicity. Within the village, there is heterogeneity in income realizations based on different land and labor endowments, and asset holdings. Let's now consider that the village is susceptible to shocks occurring with probability p between the labor allocation period (period 0) and the income realization period (period 1). There is also some level of income $\bar{Y}$ below which a household becomes food insecure. From the perspective of the model, if a shock occurs, productivity can decrease, or assets can be lost. We assume the loss in either case can be represented by λ (with $0 < \lambda < 1$), and if the loss occurs, then the household will have income of:

$$Y_h = \lambda f(L_{ah}; M) + r\theta(\lambda A_h) \tag{2}$$

Note that due to the asset loss, an income that is below $\bar{Y}$ in the present period suggests lower income in the future as well (e.g., beyond period 1), due to the lower asset level. So, households become susceptible to permanently lower income.

We finally assume that households derive utility from leisure (S), expected income, and their asset holdings at the end of period 1 (K), so the utility function is $U(S_h, E(Y_h), K_{h1})$.[11] The household will then maximize utility conditional on expected income; without intervention they will choose an amount of agricultural labor yielding expected income:

$$E(Y_h) = (1-p)[f(L_{ah}; M_h) + r\theta(A_h)] + p[\lambda f(L_{ah}; M_h) + r\theta(\lambda A_h)] \tag{3}$$

[11] Note that K=A with probability 1-p and K=lA with probability p.

There are two things to note about the expected household income. First, the labor allocation to agriculture is affected by the probability of a shock. It is trivial to show that the labor allocation to agriculture is decreasing in p (e.g., $\frac{\delta L_a}{\delta p} < 0$), so labor allocation is lower than it would be if households could insure themselves against shocks. Second, within the model there is no way, at present, for households to change their asset holdings, so although they enter the utility function, they do not change household behavior. Finally, it is worth noting that the expected asset holdings at the end of period 1 is given as:

$$K_1 = (1-p)A_h + p\lambda A_h \tag{4}$$

Post-Emergency Transfers

Let's next consider that some proportion ρ of the N households in the village would fall under the food security threshold $\bar{Y}$ in the context of a specific shock. If $\rho > \rho^*$, where ρ^* is some threshold proportion of households, then in ideal circumstances either the government or international community will make transfers T to households in the village. Therefore, the total transfers are NT, and household income after the shock and the transfer is:

$$Y_{hT} = \lambda f(L_{ah}; M_h) + r\theta(\lambda A_h) + T \tag{5}$$

The size of the transfers will affect how many households become food secure because of the transfers but suffice to say that for any (reasonable) level of transfers T, the remaining number of households that remain food insecure is $\rho' < \rho$. Moreover, note that households with incomes above $\bar{Y}$ post transfers can potentially invest in additional assets, so they are less likely to fall below $\bar{Y}$ in future periods. While we do not model this possible choice here, we note that future incomes in the aggregate could be higher due to the reinvestment of some portion of the transfer.

It is important to note that this transfer could not be anticipated by resident households. Consequently, their labor allocation in period 0 did not reflect the potential of a transfer. As a result, their labor allocation and therefore behavior does not change from the base case with no transfers.

Anticipatory Transfers

Let's consider an alternative scenario in which the government or international community decides to give anticipatory transfers of the same size (T) to households in advance of a shock. From the model context, they make the transfer in period 0. We assume that the anticipatory transfer takes place with a message that the transfer is associated with a high probability of a shock. In the context of the model, the household can therefore potentially change its labor allocation in period 0 to try to preserve assets. Households can now allocate their labor to agriculture ($L_{a'}$), to asset preservation (L_p), or leisure. We assume there is a cost to preserving assets $c(L_p)$ that increases in the amount of labor allocated to it. By allocating some labor to asset preservation, some share of assets $\gamma(L_p)$ is preserved, where $\gamma(0) = 0$.

In expectation, the household's expected income is now:

$$E(Y_h) = (1-p)[f(L_{ah}; M_h) + r\theta(A_h)] + p\big[\lambda f(L_{ah}; M_h) + r\theta\big((\lambda + \gamma(L_{ph}))A_h\big)\big] + T - c(L_{ph}) \tag{6}$$

We assume that households are not required to allocate labor to asset preservation, so we can assert that $L_{ph} \geq 0$, and there is some value L_{ph} such that $\lambda + \gamma(\tilde{L}_{ph}) = 1$, and obviously at equilibrium $L_{ph}^* \leq \tilde{L}_{ph}$.

Analysis

Given the model structure, from a policy perspective there are three interesting issues. First, we want to know what happens to labor allocated to agriculture under both transfer scenarios. Second, we want to think about what happens to income (and therefore food insecurity) under both transfer scenarios when a shock occurs. Third, we want to consider the perspective of the public entity providing the transfers.

Agricultural Labor

Under either no transfers or post-emergency transfers only, households will set the amount of agricultural labor equal to the expected value marginal product of leisure. Under appropriate curvature assumptions, the household will choose an amount of agricultural labor L_{ah}^* such that:

$$\frac{\partial f}{\partial L_a}(1+(\lambda-1)p) = RU_s \tag{7}$$

where RU_s is the utility value of leisure relative to expected income. Note that the quantity $(\lambda\text{-}1)p$ is negative by construction, so the chosen labor allocation to agriculture is decreasing in the expected probability of a shock and the expected loss due to the shock. Further, because the transfer is unexpected, it does not affect household decision making.

There are two potential scenarios to consider when households receive anticipatory transfers. First, L_p^* could be zero, if the net value of protecting assets in labor terms is below the value marginal product of labor in agriculture.[12] Within the model, this condition could occur for households with lower asset levels, as the marginal value of protecting those assets would be relatively low. Alternatively, this could occur when the combination of endowments leaves the household close to the food insecurity line $\bar{Y}$; in those cases, the marginal product of labor in agriculture would be relatively high. In either of these cases, the equilibrium amount of agricultural labor would be the same as in equation (7).

The second scenario occurs when households do choose to allocate some labor to asset protection. The equilibrium in this case occurs when the marginal value of utility with respect to agricultural labor is equal to the marginal value of labor with respect to labor allocated to asset protection. In the latter component, note that asset protection both creates utility through its value in preserving income (e.g., through the return on assets) and through its value in maintaining the value of assets at the end of period 1. Suppressing arguments, the equilibrium (L_a^*, L_p^*)occurs where:

$$\frac{\partial U}{\partial E(Y)}\frac{\partial f}{\partial L_a}(1+(\lambda-1)p) = \frac{\partial U}{\partial E(Y)}\left[pr\frac{\partial \theta}{\partial A}\frac{\partial \gamma}{\partial L_p} - \frac{\partial c}{\partial L_p}\right] + \frac{\partial U}{\partial K_1}\frac{\partial \gamma}{\partial L_p} \tag{8}$$

Though the form of equation (8) is complex, it can help us to think about the terms separately to compare the equilibrium with the equilibrium implied by equation (7). It is important to consider the household labor endowment as fixed, so although the terms beyond the initial marginal utility term on the left are the same as the left side of equation (7), because there is a positive amount of labor allocated to protecting assets, at equilibrium the marginal utility with respect to expected income must be higher. In fact, households allocating some labor to protecting assets will not just equate the marginal returns to expected income from agricultural labor and asset protection labor but will also consider the value of asset protection labor in period 1 in utility terms—the higher relative value the household places on assets at the end of period 1, the more labor will be allocated to asset protection. Finally, this discussion implies that less labor will be allocated to both leisure and agriculture at equilibrium when some labor is allocated to asset protection.

Household Income

Next, we want to consider what happens to household income under both emergency and anticipatory transfers. First, consider the household income for a household experiencing a shock and receiving a post-emergency transfer. The household's income is the same as in equation (5), except we can evaluate that expression at the optimal amount of agricultural labor:

$$Y_{hT} = \lambda f({L_{ah}}^*; M_h) + r\theta(\lambda A_h) + T \tag{9}$$

The household will have a resulting asset base of $K_{1h} = \lambda A_h$.

If the household receives the anticipatory transfer, then its post-shock income will be:

$$Y_{hT} = \lambda f({L_{ah}}^*; M_h) + r\theta\big((\lambda + \gamma(L_{ph}^*))A_h\big) + T - c(L_{ph}^*) \tag{10}$$

Here we note, again, two possible scenarios. First, it could be that the household does not allocate labor to protecting assets. If so, then equation (10) collapses to equation (9), and the household would equate receiving an

[12] Note that households could, in theory, also send labor away for seasonal migration to attempt to earn money in a region with different exposure to risk (e.g. Stark, 1991), using the transfer to invest in migration (e.g. Bryan, Chowdhury, and Mobarak, 2014). We abstract away from that possibility here, with the thought that households would invest first in asset preservation.

anticipatory transfer with a post-emergency transfer. Second, if the household does allocate labor to protecting assets, then there are two income differences—the optimal amount of labor in agriculture is lower, so there is a lower agricultural income, and then there is a term related to the labor used in protecting assets: $r\theta\left(\gamma\left(L_{ph}^{*}\right)A_{h}\right) - c(L_{ph}^{*})$. It is ambiguous whether this quantity is positive or negative, as it depends upon the relative return to assets and functional forms. However, it is worth noting that the overall income is likely to fall, due to the utility households obtain from their asset holdings at the end of period 1—they effectively can trade off income in the present for higher incomes from their assets in the future.

Household Summary

To summarize, anticipatory transfers relative to emergency transfers can lead to the following behavior changes, holding the transfer amount constant. A first difference is that household may choose to allocate some labor to protecting assets under anticipatory transfers; that would in turn potentially lower their agricultural income but would raise their income from assets both now and in the future (represented in the model by the utility of asset holdings in period 1). A second difference is that overall household income in the face of a shock could be lower. Empirically, then, we would expect a difference in actions to protect assets (between households receiving anticipatory versus emergency transfers), and differences in asset holdings after the shock, but assuming the transfer sizes are the same, importantly we would not necessarily expect contemporaneous income to be higher from the anticipatory transfer and in fact it could be lower.

Perspective from the Transfer Provider (Donor)

Now that we understand better how households might react to anticipatory transfers relative to emergency transfers provided in an emergency. Next, we want to consider the transfer provider perspective. The goal of this section is to consider the objective function of the transfer provider or donor, and the tradeoffs they face in deciding between anticipatory action and emergency action for making transfers, as well as further considerations beyond the household model that might make the decision more complicated.

Implicit in the rationale for making transfers at all, above, is that governments or others are concerned about the level of food insecurity. The primary goal of providing transfers is to minimize the level of food insecurity in the village subject to the budget constraint. A second goal could be to minimize the need for future transfers to the same village. We then also need to consider the more realistic case in which there may also be tradeoffs between helping villages or affected areas from a specific shock.

As we assume that all households receive transfers regardless of whether they are anticipatory or not, the total budget available for a village is B, with $B \leq NT$, where N is the number of households and T is the transfer value. In this one village setting, the transfer provider will set the value of T such that it minimizes the number of food insecure in the case of a shock. So, there are two relatively clear potential outcomes. First, it could be that the poorest household in the village can be made food secure with a transfer T^* lower than B/N; if so, then the transfer lever is set at T^*. If not, then the transfer level is set at T=B/N, and some share of the poorest households in the village remain food insecure post-shock.

Next, we want to think through how anticipatory transfers would differ from emergency transfers in this simple case. From the donor's perspective, the expected value of the anticipatory transfer budget is pNT^*, while it is NT^* for emergency transfers; because there is only a chance *p* of the shock occurring, the expected value of the budget is lower (since it could have been used elsewhere if the shock doesn't occur).

The insight from the household model is that household assets post-shock are higher in the anticipatory transfer case than the emergency transfer case. The difference relates to the amount of labor each household h decides to allocate to asset preservation L_{ph}, and at equilibrium we can write that amount as γ^*, where $0 \leq \gamma^* \leq 1-\lambda$.[13] So from the perspective of anticipatory transfers, the decision rule can be written as:

$$(1-p)NT^* \leq f\left(\sum_{h=1}^{N} \gamma_h^*\right) \tag{11}$$

[13] We omit the math from the main discussion but recall that we specify the loss of assets as l in each case, which drops out when we take the difference.

On the left-hand side, the difference between anticipatory and emergency transfers is the inverse of the probability of a shock, multiplied by the total transfer budget. If there is a higher probability of a shock, then the potential for misallocating transfers is reduced. The right-hand side is a function of increased asset holdings; we specify it as a function since donors may not require a 1:1 correspondence between money in the budget on the left and asset value on the right. Here, there is some value p^* below which emergency transfers are preferred, and above which anticipatory transfers are preferred.

Case One: Uncertainty about the probability of a shock

We next want to think through extensions to the model. So far, we have modeled the probability of a shock as a well-known parameter. However, in reality it is not—whereas the broad implications of an El Nino year are pretty well known, for example, we do not necessarily know which areas will experience drought or have more normal rainfall, or where floods would occur as a result of expected weather pattern changes. More specifically, weather forecasting investments differ substantially by country, and in some countries, there will be a lot more uncertainty about shock probabilities than other countries.

Within the one village model, there are two possible modifications we can make. First, recall that the total value of the anticipatory transfers was pNT. Now, if p is uncertain, we can think of it as a random variable with mean μ_p and an associated variance σ_p^2. Now, the expected value of anticipatory transfers becomes $\mu_p NT$, rather than the total value. If the donor is risk neutral, there is no change to the equilibrium suggested in equation (11) above, other than substituting μ_p for p. However, if the donor is risk averse, then there is a penalty function associated with the variance of p included on the left-hand side:

$$(1-\mu_p)NT^* + \theta(\sigma_p^2) \leq f(\textstyle\sum_{h=1}^{N} \gamma_h^*) \tag{12}$$

The penalty function represents the cost of uncertainty in making anticipatory payments to those potentially in need. If donors are particularly risk averse, then the increase in $\theta(.)$ will be particularly high even for low levels of variance; if the variance is quite large, this function is also expected to be large.

Since p is uncertain, it is a little more difficult to think about the value of p for which the donor switches preferences from anticipatory to emergency action. However, for purposes of comparison, we can substitute the previous equilibrium value p* into equation (11), and subtract it from equation (12), and then reorganize to find:

$$\mu_p - p^* = \theta(\sigma_p^2) \tag{13}$$

Equation (13) is quite flexible, in that it states that as donors are more risk averse or as the probability of a shock is more uncertain, then anticipatory action becomes less attractive relative to emergency action in the context of a shock. Investments that can help lower the uncertainty of shocks—such as weather prediction investments—could help reduce the inherent uncertainty, so directly reducing the variance parameter σ_p^2.

Case 2: Multiple Villages

Next, consider the case in which there are M villages that could be affected by the shock, where we can index them by m=1, …, M, and each village has its own probability of a shock, p_m and population N_m. If all the villages were affected by a shock, then the total amount of funding required to deliver transfers would be $B_M = \sum_{m=1}^{M} N_m T$. With the larger budget required for transfers, we now assume that the total amount of funding available for transfers is B<BM. Therefore, the donor will have to choose a targeting mechanism as well as considering whether to provide anticipatory or emergency transfers.

Equitable Targeting

A first potential mechanism is to simply set the transfer level at $T^* = B/\sum_{m=1}^{M} N_m$, effectively allocating the transfers evenly over all M villages. That will leave the most vulnerable food insecure but would be the most equitable distribution of transfers and the least costly version, since targeting is costly. In this case, the comparison between anticipatory and emergency transfers is relatively straightforward and parallels the one village case. The expected value of anticipatory transfers from the donor perspective is $\sum_{m=1}^{M} p_m N_m T^*$, which implies that the difference between the value of anticipatory and emergency transfers is:

$$B(1 - \frac{\sum_{m=1}^{M} p_m N_m}{\sum_{j=1}^{M} N_j}) \leq f(\sum_{m=1}^{M} \sum_{h=1}^{N} \gamma_{mh}^{*}) \quad (14)$$

The difference between equation (11) and equation (14) is that the probabilities and values of assets retained from anticipatory transfers have to be aggregated both over farmers and villages.

Targeting Specific Villages

In a second scenario, the donor picks a subset of the villages to receive transfers. There are several reasons that this scenario could take place: it could be that there is quite a bit of variation in probabilities, and it is plausible to target high probability of shock communities; a specific sub-region could be targeted for transfers for ease of delivery or other reasons; or there could be a set of villages with lower income potential, and so donors could be interested in targeting those villages. In any of these cases, we can define a set of J villages that receive transfers, and the remaining M-J villages do not. We then define that $T^* = B / \sum_{m=1}^{J} N_m$, so the transfer budget is completely used, and some households remain food insecure even under emergency transfers at the point at which the budget is fully allocated.

We further note that there is a cost to targeting, which is not as much related to any of the model's parameters as much as it relates to the complexity of targeting. Therefore, this cost is simply written as C and applies regardless of whether the transfers are anticipatory or emergency. It therefore does not affect the decision between anticipatory and emergency transfers; the decision in equation (14) for the equitable transfer scenario can be slightly modified to instead write:

$$B(1 - \frac{\sum_{m=1}^{J} p_m N_m}{\sum_{j=1}^{J} N_j}) \leq f\left(\sum_{m=1}^{J} \sum_{h=1}^{N} \gamma_{mh}^{*}\right) \quad (15)$$

Note that we now only aggregate over the J villages that receive transfers; in the other M-J villages, there are no transfers, so there cannot be any increased asset holdings.

Targeting Vulnerable Households

In a third scenario, the donor could try to target vulnerable households in the M villages with transfers. To this point, we have ignored the possibility of within-village targeting, partially because it is costly. There are two potential costs—first, we have to know something about the households to be able to target; we cannot perfectly observe their income or consumption expenditures without a long household survey, but an analyst would need some proxy measures for either a proxy means test or another targeting method. Collecting and analyzing that data is costly, and imperfect. The second cost relates to that imperfection—it is certain that there will be both inclusion errors (transfers go to households that would not have been food insecure) and exclusion errors, or transfers do not go to households that become food insecure in the face of a shock (Coady, Grosh and Hoddinott, 2004).

Nonetheless, there could very well be a difference between anticipatory and emergency transfers if targeting within locations is attempted, because there may be visible evidence that some vulnerable households were affected in the case of emergency transfers. Let's define the subset of households that meet the targeting criteria as R_m, so the amount of anticipatory transfers would be based on the sum over all targeted individuals. We assume here that $R_m < N_m \forall m \in M$. If some additional households are revealed as vulnerable post-shock, we can define the additional households that would be helped with emergency transfers as δ_m, with the modified assumption that $R_m + \delta_m < N_m \forall m \in M$.

The comparison between anticipatory and emergency transfers is slightly different from equation (15), due to one difference. The left-hand side looks quite similar, in that we just average over the targeted households rather than over each entire village or just over the subset of targeted villages. However, on the right-hand side we add a term which represents the net change in inclusion and exclusion errors made with emergency transfers, which we define as $\varphi(\delta_1, \ldots, \delta_M)$. It can take on both negative and positive values; it takes on negative values if the additional targeted households leads to a larger reduction in food insecure households than is caused by the reduction in the transfer amount; if, instead, it takes on a positive value, that is because more households end up being targeted, but errors were minimal in advance of the shock and the reduction in transfer values leads to a net increase in food insecure households.

$$B\left(1-\frac{\sum_{m=1}^{M} p_m R_m}{\sum_{j=1}^{M} R_j}\right) \leq f\left(\sum_{m=1}^{M}\sum_{h=1}^{R}\gamma_{mh}^{*}\right)+\varphi(\delta_1,\ldots,\delta_M) \tag{16}$$

References

Alley, R. B., Emanuel, K. A., & Zhang, F. (2019). Advances in weather prediction. *Science*, 363(6425), 342-344.

Ambler, K., A. de Brauw, E. Maruyama, and Moussavi, S. (2023). Addressing Irregular Migration through Principled Programmatic Approaches: Examining the West African Route. Rome and Washington, DC: World Food Programme and International Food Policy Research Institute.

Balana, B., Adeyanju, D., Clingain, C., Andam, K., de Brauw, A., Yohanna, I., Olarawaju, O., and Schneider, M. (2023) "Anticipatory cash transfers for climate resilience: Findings from a randomized experiment in Northeast Nigeria," *IFPRI Strategy Support Program Working Paper.*

Bhowmik, J., Irfanullah, H.M., and Selim, S.A. (2021) "Empirical evidence from Bangladesh of assessing climate hazard-related loss and damage and state of adaptive capacity to address them," *Climate Risk Management*, vol. 31.

Chen, S., M. Ravallion, and Wang, Y. (2006). "Di Bao: A Guaranteed Minimum Income in China?" World Bank Policy Research Working Paper no. 3805.

Coady, D., M. Grosh, and Hoddinott, J. (2004). *Targeting of Transfers in Developing Countries: Review of Lessons and Experience*. World Bank, Washington, DC.

Costella, C., Jaime, C., Arrighi, J., Coughlan de Perez, E., Suarez, P., and van Aalst, M. (2017) "Scalable and Sustainable: How to Build Anticipatory Capacity into Social Protection Systems," *IDS Bulletin*, vol. 48, no. 4, pp. 31-46.

De Brauw, A. (2019). "Migration out of Rural Areas, and its Implications for Rural Livelihoods," *Annual Review of Resource Economics* 11: 461-481.

Funk, Chris, et al. (2019) "Recognizing the famine early warning system network: Over 30 years of drought early warning science advances and partnerships promoting global food security," *American Meteorological Society*, vol. 100, issue 6, pp. 1011-1027.

Gros, C., Bailey, M., Schwager, S., Hassan, A., Zingg, R., Uddin, M.M., Shahjahan, M., Islam, H., Lux, S., Jaime, C., and Coughlan de Perez, E. (2019) "Household-level effects of providing forecast-based cash in anticipation of extreme weather events: Quasi-experimental evidence from humanitarian interventions in the 2017 floods in Bangladesh," *International Journal of Disaster Risk Reduction*, vol. 41.

IPCC (2023) "Summary for Policymakers." In: *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

Nobre, G.G., Pasqui, M., Quaresima, S., Pieretto, S., and Bonifacio, R., (2023) "Forecasting, thresholds, and triggers: Towards developing a forecast-based financing system for droughts in Mozambique," *Climate Services,* vol. 30.

Pople, A., Hill, R., Dercon, S., and Brunckhorst, B. (2021) "Anticipatory Cash Transfers in Climate Disaster Response," CSAE working paper, No. 2021-07.

WFP (2022) "Anticipatory Cash Transfers and Early Warning Information Ahead of Drought in Ethiopia," Climate and Disaster Reduction Service, World Food Programme.

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