What do We Know About the Effectiveness of Ex-Ante Risk Management Strategies in Latin America and the Caribbean?[1]

Development can occur only by successfully confronting risk and pursuing opportunity. Risk management, in turn, can build the capacity to reduce the losses and improve the benefits that people may experience while conducting their lives and pursuing development opportunities (WDR, 2014, p. 5). While the number of years under a large recession has decreased in the last three decades for Latin American and the Caribbean, households in this region are facing other aggregate shocks increasingly. That is the case of natural disasters and the incidence of crime, which has risen in the last thirty years (WDR, 2014, p. 9).

While household income in developing countries vary remarkably, consumption remains relatively stable (Townsend, 1994; Morduch, 1993; Paxon, 1992; Jacoby and Skoufias, 1997). In the absence of formal insurance, this suggests that informal institutions allow households to counter at least some of the effects of aggregate shocks. On the one hand, household may smooth consumption after a shock has realized. For example, savings are used to buffer consumption from income shocks (Paxon, 1992). In the presence of imperfect credit markets, Rosenzweig and Wolpin (1993) document that bullocks are a large share of non-land and building wealth in India, and are bought and sold in higher rates than other assets and are sold off when profit realizations are low.

Missing or incomplete markets are, however, obstacles for households to fully smooth an aggregate shock ex-post. Informal risk sharing among individuals within a village is also

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incomplete. In response, many households rely on ex-ante risk management, or income smoothing –rather than consumption smoothing. Ex-ante mechanisms address what households (and to that extent, public and private instruments) can do to reduce or prevent the occurrence of risks and mitigate the impact of risk if an adverse event occurs. Households and governments possess several strategies for managing risks ex-ante, which can help protect their wellbeing with varied effectiveness (Baez, Kronick and Mason, 2013 and Baez, 2006).

This paper reviews the existing evidence regarding three kinds of ex-ante aggregate risk management (or income smoothing) strategies, focusing when possible in Latin America and the Caribbean: 1) income diversification, occupational choice, agricultural technology and migration; 2) capital and insurance markets and 3) social protection and labor market programs. The emphasis is on household strategies in section 1, and on government programs or private sector initiatives on sections 2 and 3. The objective of this document is to review the literature regarding the evidence on the effectiveness of ex-ante risk management strategies, identify whether there are policy options that improve the capacity of households to optimally manage the risk caused by aggregate shocks and the knowledge gaps where more research is needed to illuminate policy choices.

I. **Income Diversification, Occupational Choice, Agricultural Technology and Migration**

Intra-household income diversification has been documented in a high fraction of households in Latin America and the Caribbean (Banerjee and Duflo, 2007). In Guatemala, for example, 65 percent of the rural extremely poor individuals report in surveys that they get some income from self-employment in agriculture, 86 percent work as laborers outside agriculture, and 24 percent are self-employed outside agriculture. 84 percent of the rural extremely poor individuals in Guatemala report that they conduct more than one type of activity to earn a living.

This number is smaller, but not negligible ─between 10 and 20 percent ─ in Nicaragua, Panama, and Mexico (Banerjee and Duflo, 2007).

The income diversification and occupational choice of many poor Latin American individuals imply their lack of specialization and a small size of businesses. The average number of paid employees of a business created by someone who lives under 2 dollars a day range between 0.14 in rural Nicaragua to 0.53 in urban Panama. Businesses are operated on average by between 1 to 3 people ─ most of them being family members. Most of these businesses have very few assets as well (Banerjee and Duflo, 2007).

In Agriculture, farmers may favor variability-reducing inputs and production techniques, such as using more labor than would be called for on the grounds of profit maximization alone (Antle, 1987), less fertilizer than optimal to reduce losses in bad times (Bliss and Stern, 1982; Lamb, 2003; Dercon and Christiaensen, 2011), or limit production to cut potential losses once weather information has been learned (Walker and Ryan, 1990). Farmers also shift to more conservative and less profitable production modes, and this behavior is exacerbated for the poorest farmers, increasing inequalities (Rosenzweig and Binswanger, 1993, Fafchamps and Kurosaki, 2000). Some land-tenure systems, such as sharecropping, provide a risk-sharing device between landlord and tenant. Farmers in Cuyo Cuyo, Peru, rely on agricultural practices such as planting disperse fields, as documented by Goland (1993).

The absence of formal ex-ante risk management mechanisms generates sub-optimal production decisions for agricultural producers. Examples of these costs include a delay in production by two weeks, which can reduce yields up to 20% (Bliss and Stern, 1982) and the choice of expensive safer crops that cost farmers between 2% (Fafchamps and Kurosaki, 2000) and 20% (Dercon, 1996) of farmers income. In particular, evidence shows that field-scattering in

Latin America reduces yields on average by 7%, explained by the additional travel and transport required to tend dispersed plots (Goland, 1993).

Migration, both domestic and international may help households cope with risks. Families may decide ex-ante to diversify their pooled risked by living in locations exposed to different risks. Because families exposed to a systemic shock may try to sell their assets simultaneously in a local market, remittances from other local or international markets may prove more effectively as smoothing income. Evidence shows that in households with overseas migrants, exogenous changes in income lead to changes in remittances of the opposite sign. In such households, the results show a replacement rate of household domestic income by remittances of roughly 60 percent (Yang and Choi, 2007). Migrants are more likely to move to places that are not affected by aggregated shocks that do impact their family members' income, particularly if these ones are poor, rural, and have limited access to ex-ante and ex-post smoothing mechanisms such as credit and insurance (Paulson, 2000).

Relatedly, *inter-household marriage arrangements* and intra-familial implicit contracts is another strategy that allows rural households to mitigate aggregate shocks. Farm households afflicted with more variable profits tend to engage in longer-distance, and therefore less affected by similar aggregated shocks, marriage-related migration (Rosenzweig and Stark, 1989). There is also evidence of re-allocating members to urban areas in order to insure against adopting risky asset portfolios at home (rural areas). This intra-familial implicit contracts allow the family to undertake riskier agricultural activities because the migrant will support them through aggregate shocks.

A set of ex-ante strategies were more effective in mitigating the impact of the coffee shock in Central America than ex-post strategies. For example, by diversifying the income

sources or having migrant members before the coffee shock, coffee households were better able to mitigate the adverse impact of the crisis, which decreased 61% of coffee farmers' income during 1998-2001. Similarly, higher education (using the maximum level of education in the household in 1998) was associated with a four percent increase in consumption growth, which is consistent with the hypothesis that human capital may have allowed households to mitigate the negative impact from the crisis by either finding higher return occupations or increasing farm efficiency. Even though the comparison of the effectiveness of ex-ante and ex-post strategies has not been studied systematically, the dominant role of ex-ante strategies in this context for consumption smoothing and the observation that households that predominantly used ex-post coping mechanisms did worse suggests that, at least qualitatively, ex-ante strategies have been more effective (Vakis, Kruger and Mason, 2004).

Internal labor mobility may be a more effective policy for poverty reduction than international migration, and it is central to the urbanization process in the developing countries (World Bank 2014). However, rigorous empirical evidence on the impacts of internal migration is scarce (Human Development Report 2009). Some of the open questions are related to the role of migrant control over remittances and their remitting decisions; sensitivity of remittance flows to the costs of sending remittances; and general equilibrium effects of temporary migration, both at the origin and at the destination. (World Bank 2014).

II. Capital and Insurance Markets

Most Latin American countries still lack efficient credit markets, access to full formal insurance and a developed commodity futures markets. For example, most of farmers affected by ENSO floods in Colombia in 2010, the worst of the last 40 years, were uninsured; producers in some cases purchase partial insurance. Flower growers, in Colombia, for example, insure their

infrastructure (greenhouses) and machinery in case of hail or flooding, but not their plants (Garcia-Romero and Molina, 2015). Capital and insurance markets are relevant because people are better able to manage risk when they have a safe place to save money as well as access to credit when they need. When asked in a survey how possible it would be within the next month to come up with emergency funds equal to 1/20 of gross national income (GNI) per capita in local currency—$2,600 in the United States, 76 percent of adults globally reported that it would be possible to come up with that amount. However, less than half of surveyed adults report being able to come up with funds in Latin America and the Caribbean (Demirguc-Kunt, 2015).

When capital and insurance markets are missing or imperfect, decisions of economic agents are suboptimal. For example, farm investments are lower than in fully efficient allocations that would exist in the presence of capital and insurance markets. Formal *insurance* could mitigate the losses associated with ex-ante informal risk-mitigating behavior, provided either by the market or as a policy instrument. There are two types of insurance associated with agricultural production that have been studied: crop insurance and weather-index insurance.

Crop insurance is particularly relevant when disastrous yields are the predominant source of income variation, but it has been proved disappointing. Crop insurance has proved attractive mainly to agricultural development banks, particularly when it is tied to farm credit on a compulsory basis. In the event of an insured disaster, the indemnity is paid directly to the bank to cancel the farmer's debt. Therefore, from the bank's point of view, this is an effective way to reduce loan defaults and thus protect its capital assets. The farmer, however, often perceives insurance as another cost attached to the loan; the insurance premium is simply added to the interest rate. The main problem related to crop insurance, however, is moral hazard. Moral hazard arises when farmers fail to take reasonable precautions against crop losses because they

can rely on yield compensation from the insurer. This behavior increases the premium because either the actual losses are higher than actuarial calculations had suggested, and/or because the insurer needs to monitor farmers more frequently. Some Latin American governments have subsidized this type of insurance, but it has been shown that there is a substantial net social loss from the subsidies (Hazell, Pomareda, and Valdés, 1986).

Weather insurance, on the other hand, solves the moral hazard as well as adverse selection because payouts depend only on observable rainfall realizations. Weather index insurance, further, has great promise to reduce the poverty consequences of aggregated shocks, given the strong correlation between weather shocks and consumption (Kazianga and Udry, 2006, Karlan et al 2013). The existing evidence shows that weather insurance can increase production areas and aggregate farm investment (Cai, 2012, Karlan et al 2013). In particular, aggregate farm investment responds strongly positively to the insurance treatment, and that the mix of investment shifts towards inputs that have returns that are highly correlated with the index that is insured.

Some of the pitfalls of weather index insurance are price sensitivity, the existence of basis risk, trust, and the possibility that aggregate investment decreases in an environment in which farm investment is strongly weighted towards risk reduction (e.g., irrigation). In insurance experimental studies, the estimated demand for insurance is very steep. Some estimates find between 11 – 15 percent purchase at market prices; between 38 - 42 percent purchase at a 50 percent discount (roughly actuarially fair prices); and 60 -67 percent purchase at a 75 percent discount (Cole et al, 2012, Karlan et al, 2013, Mobarak and Rosenzweig, 2012). A second unresolved issue that affects weather insurance demand is the mismatch between the rainfall-index-based payouts and the actual losses incurred by the policy holders (basis risk, or residual

risk left uninsured by the index). Informal risk sharing, by covering household losses that are the consequence of basis risk, enhance the benefits from formal index insurance contracts that permit increased risk-taking. In other words, when the community network is less diversified and therefore better at providing support following household-specific losses (like death, illness, theft) than for losses that affect the whole community (such as a delayed monsoon), members of those groups are more likely to purchase index insurance. Selling index-based weather insurance through traditional informal groups, with pre-defined sharing rules, increases take-up—suggesting that groups are better placed to reduce basis risk (Berhane et al, 2013). Finally, there are important frictions, such as trust and recency bias, or the overweighting of recent events, in the insurance market. This means that farmers do not seem to have complete trust that payouts will be made when rainfall trigger events occur, so the demand for index insurance is quite sensitive to the experience of the farmer and others in his social network with the insurance product. This could easily lead to insurance market failures if not addressed in the design of policies, since insurance offers its largest benefit for low-probability high-loss events, but rare payouts decrease demand.

Further research is needed to understand how to overcome adverse selection and moral hazard problems in more general crop insurance as well as the extent and implications for welfare of basis risk. One important step towards this goal would be to study how improving product design and data infrastructure could increase the connection between insurance payouts and shocks to farm profits (Karlan et al, 2013). Another relevant issue is to collect evidence regarding how to increase trust by, for example, increasing states of the world with payouts, and properly link insurance programs with trusted institutions and proper regulation. Behavioral economics would also suggest analyzing how mental accounting, as well as "nudges" like

framing, timing and bundling with other processes affect the decision to purchase insurance has implications for how insurance is sold (Thaler and Sunstein,2009, Karlan et al, 2013).

Finally, it would be important to better understand the interaction of insurance and the demand of credit services, by measuring whether relaxing risks constraints, additional constraints in a complementary market such as credit are also relaxed. In particular, agricultural insurance can facilitate access to credit, because it can be used as collateral (Carter, Long, and Boucher, 2011). This in turn can allow for technological adaptation and the undertaking of riskier, and more profitable, investments by farmers. On the one hand, in experimental studies, weather index insurance has proven more effective in allocating resources efficiently than cash grants alone, suggesting that credit market policy alone will not suffice to generate higher farm investment (Karlan et al, 2013). In fact, evidence shows that farmers came up with resources to increase investment merely as a consequence of getting rainfall insurance. There is evidence also showing that other risk management instruments, such as government transfers, did increase access to credit by households in beneficiary municipalities (Angelucci and De Giorgi, 2006).

Regarding demand for weather insurance, policy decisions on whether to promote formal insurance at all depend on the specific reasons that informal risk sharing is incomplete (Kinnan, 2011). Another important step in this research agenda is therefore to understand why and how specific attributes of communities affect their abilities to provide informal insurance against idiosyncratic losses and aggregate losses. The likelihood of default, or of not reciprocating with transfers among informal arrangements is low, because of the personal relationships between the agents involved, the high amount of available information, and the repeated nature of the interactions, which make exclusion from future transactions a costly punishment for defaulting. However, there are community characteristics that enhance and limit the group's ability to fully

protect against losses (e.g. land inequality), that condition the group's ability to solve commitment and monitoring problems and self-insure and that ultimately determine the demand and take-up of formal insurance.

III. Social Protection and Labor Market Programs

Over the last decade, conditional cash transfer (CCT) programs significantly reduced poverty and inequality in developing countries. Pre-existing *Conditional Cash Transfers (CCTs)* aimed at inducing poor parents to send their children to school and care more for their health, can additionally play an important role mitigating the effects of aggregate shocks. In particular, CCT programs can provide an additional benefit to recipients in acting as safety nets for the schooling of the poor. CCTs also allow households to diversify their income portfolio enhancing the ability of the poor to protect against adverse economic shocks.

Conditional Cash Transfers have been effective at mitigating the adverse effect of aggregated shocks in Latin America. The conditional transfer provided by the Progresa program in Mexico had a strong mitigating effect on the school enrollment response to an income shock (De Janvry, Finan, Sadoulet and Vakis, 2006). A disaster that affects the whole community reduces school enrollment by 3.2 percentage points, but this effect is completely mitigated by Progresa. Elementary school children, indigenous children, and children of agricultural workers are more affected by severe natural disasters than secondary school children, non-indigenous children, and children of non-agricultural workers, respectively. Conversely girls are more affected by a severe natural disaster than boys. In all cases, Progresa either largely or completely erases the negative effects of shocks on schooling. In similar villages without Progresa coverage (control villages), a temporary disaster had both an immediate effect in taking some children out

of school, and a long-term impact through the state dependence effect. By contrast, as the conditionality applied to school and not to work, the conditional transfer did not have much of an effect in refraining parents from responding to an income shock by increasing child work. In Nicaragua, "Red de Proteccion Social", a conditional cash program that supplements poor rural households' incomes seems to have mitigated the adverse impact of the coffee shock. In particular, a recent impact evaluation of the program finds that program beneficiary households involved in the coffee sector have faired better in a number of socio-economic outcomes compared to non-participating coffee households (Maluccio, 2003). In Honduras, the PRAF program (Programa de Asignacion Familiar, or Family Allowance Program) allowed coffee-dependent households to sustain the same consumption levels on average as non-coffee dependent households despite the fall in coffee-related income. Honduras' PRAF transfers were equivalent to roughly 3% of total household consumption on average, but were substantially higher for the poorest households (Coady, Olinto and Valdes, 2004). Mexico's PROCAMPO (Program for Direct Assistance in Agriculture) program in Mexico, was introduced to compensate farmers for the anticipated negative effect of the North American Free Trade Agreement (NAFTA). PROCAMPO made all beneficiary households better off by the cash transfers compared to the income levels they would have achieved without the transfers. Had there been no PROCAMPO program, household income would, on average, have declined by 3.9 percent (Sadoulet, de Janvry and Davis, 2001).

Transfer, conditional or unconditional, can also help families deal with shocks by allowing them to engage in risky activities, given that irrespective of the outcome of their business, they are still guaranteed to receive the transfer as long as they fulfill the conditionality. Mexico's Oportunidades (Progresa) increases the income-generating potential of poor families:

the proceeds from the transfer were used in the course of five years to increase family income generating capacity (Gertler, Martinez, and Rubio-Codina 2007). Through Bolsa-Família, Brazil's CCT program, households up to a certain income threshold and with children or pregnant women receive governmental transfers as long as they meet some requirements related to investments in children's human capital. Created in 2003, the program was designed to target the poorest families in the country. Bolsa-Familia allowed beneficiary families to start up a new business as a secondary activity, although not as the main economic activity (Lichand, 2010).

Transfers can also help alleviate liquidity constraints emerging from market failures. For example, the incomplete nature of property rights in the ejido system in Mexico prevents farmers from using the land as collateral to access credit. Mexico's PROCAMPO, a cash transfer program created to compensate the predicted reduction in income for farmers due to the lower international prices they would be facing due to NAFTA, had an important role relaxing liquidity constraints among farmers living in ejidos. PROCAMPO's payment of about roughly 46 percent of gross maize income who obtained the average yield, allowed farmers to generate additional income between 1.5 and 2.6 times the size of the transfer. Liquidity constraints were alleviated both through the cash provided but also through increased credit. In particular, PROCAMPO qualification certificates could be used as collateral against which to borrow from commercial banks or input retailers, giving beneficiaries flexibility in the timing when cash is available against the cost of the interest charged. The transfer relaxed liquidity constraints mainly to households with medium and large farms, large proportion of working age adults to dependents, nonindigenous backgrounds, and located in the Center and Gulf regions, reflecting that the transfer allowed households to capture marginal income opportunities (Sadoulet, de Janvry and Davis, 2001). Similar results regarding the indirect effect of transfers on relaxing liquidity

constraints have been found in the African context as well (Gilligan, Hoddinnot, and Taffesse, 2008). Progresa's non-beneficiary households living in eligible municipalities (and therefore other households did receive the transfer) received loans from family, friends, or informal moneylenders when hit by an idiosyncratic shock and reduced their precautionary savings, showing that informal risk mechanisms in a community interact with public policies augmenting their effect. In fact, households hit by an idiosyncratic shock were 2.6 percentage points more likely to receive loans or transfers if they lived in treatment villages. Moreover, they borrowed and received about 22 pesos more per month, showing another channel through which Progresa may enable households to insure against risk by borrowing more (Angelucci and De Giorgi, 2006).

Food aid programs in response to crop failures has proven effective in decreasing malnutrition effects in children, but their targeting is imperfect (Yamano, Alderman and Christiaesen, 2005, Dercon and Krishnan, 2003). In Ethiopia, children in communities who received food aid grew on average 2.0 cm faster in a six-month period than if no food aid would have been available, or average about 46% of the negative impact on child growth following from crop damage (Yamano, Alderman and Christiaensen, 2005). Informal risk sharing occurs through households within villages sharing the food provided by the government program (Dercon and Krishnan, 2003). These results demonstrate that food aid is an effective policy tool in reducing the malnutrition effect of bad rainfall shocks on agricultural production.

Evidence is needed to evaluate the effectiveness of CCTs in reducing child labor as a coping mechanism by households in developing countries.

IV. Other Ex-Ante Risk Management Strategies: Trade, Adaptation to Shocks and Technological Innovation

Access to infrastructure may help household manage aggregate risk through several pathways. One of the ways infrastructure access can achieve this goal is through allowing households to be inter-connected, muting the price effects of local productivity shocks, providing access to foreign markets which could be not affected by shocks. Evidence shows that in settings where agricultural technologies are rain-fed and risky, and regional famines are commonplace, the famine-rainfall link is essentially eliminated in local markets that have access to railroads (Burgess and Donaldson, 2010). The expansion of railroads made local prices less responsive, local nominal incomes more responsive, and local real incomes less responsive to local productivity shocks. Therefore, investments in transportation infrastructure can play a key role in raising welfare by lessening the degree to which productivity shocks translate into real income volatility. Cross-country analyses from 151 countries over the 1960–2003 period also find that trade openness, together with national educational attainment rates and financial sector development are key moderators of the effects of natural disasters in developing countries (Toya and Skidmore, 2007).

A related body of literature has examined the extent to which *adaptation* to aggregate shocks has occurred in different sectors and world locations, and the kind and determinants of adaptative measures that seem to yield better outcomes at smoothing consumption and protect individuals' investments. Adaptation is central to understand how economic agents manage risks, as the losses and information from past aggregate shocks encourage people to develop and adopt precautionary measures[2]. An important determinant of the success of adaptation to aggregate

[2] In fact, a critical current question in economics is how quickly economic agents adjust to such one type of aggregate shocks, ie, environmental change. This review emphasizes the ex-ante strategies that individuals rely on to

shocks may be *technology*. Technological advances in certain areas of the world have allowed to mitigate the effect of extreme weather and therefore improve a host of economic and health outcomes. Irrigation has been used to supply crops with a more reliable source of water: irrigation water can substitute for deficient rainfall (especially in terms of its inter-temporal distribution, but potentially also in terms of quantity) and supply the additional evapo-transpirative water demand of crops that are exposed to increased temperatures (Howden et al. 2007, Parry, 2007, Mendelsohn and Dinar, 1999). Out of agriculture, there is evidence of adaptation to extreme events, such as cyclones (Hsiang and Narita, 2012). However, this adaptive magnitude is small: only 3% of the estimated impact of increased tropical cyclones will be "adapted away" in the long run.

Lastly, a potentially first-order adaptation mechanism is *innovation*. In a panel of 30 countries over 25 years, the amount of risk-mitigating innovation in a country increases with the severity of its recent natural disasters: earthquakes, droughts and floods (Miao and Popp, 2013). For example, an additional $1 billion in economic losses from drought in the past five years increases current patent applications regarding drought-resistant crops by approximately 20%. Similarly large effects on patenting are found for earthquakes and floods.

adapt to aggregate shocks that could be related to environmental change. For studies related to long-term adaptation to environmental change, see Mendelsohn, Nordhaus, and Shaw (1994), Schlenker, Hanemann, and Fisher (2005), Deschenes and Greenstone (2007), Schlenker and Roberts (2009), Fisher et al. (2012), Baez, Kronick and Mason (2013), Burke and Emerick (2015).

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