CAN PARAMETRIC MICROINSURANCE IMPROVE THE FINANCIAL RESILIENCE OF LOW INCOME HOUSEHOLDS IN THE UNITED STATES?

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Can Parametric Microinsurance Improve the Financial Resilience of Low-Income Households in the United States?[1]

A Proof-of-Concept Examination

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1. Introduction

Disaster risk is escalating around the globe and in the United States (Gall et al. 2011; Hoeppe 2016; USGCRP 2018; Coronese et al. 2019). With longer and more intense wildfire seasons, record numbers of acres and structures are being burned (Abatzoglou and Williams 2016; Williams et al. 2019). Coastal communities are facing rising flood risks as storm patterns shift and sea levels rise (e.g., Garner et al. 2017; Sweet et al. 2020). Localized extreme weather events are becoming more frequent with costly consequences (Stott 2016). Earthquakes continue to pose significant risks for portions of the U.S., with more people living or working in areas of high or moderate seismic hazard than ever before (Petersen et al. 2020). In addition, compound and cascading hazards are increasing (Cutter 2018; AghaKouchak et al. 2020). The consequences of these rising disasters, however, are not borne evenly.

A growing body of research—reviewed below—finds that the poor are disproportionately harmed from disasters, both worldwide and in the United States (Fothergill

[1] We would like to thank the Lloyd's Tercentenary Research Foundation for support of this work. We would like to thank the following individuals for helpful conversations on this topic: Alex Bernhardt, Jonathan Gonzalez, Alex Kaplan, Reese May, and Andy Read. Views and errors are our own.

and Peek 2004; Hallegatte et al. 2020). A natural disaster is a negative economic shock—an event of limited duration where income declines and/or necessary expenditures increase. Lower-income households typically do not have sufficient liquid savings to fund the necessary repairs and recovery. These households are also often locked out of access to credit (Collier and Ellis 2020). Governmental aid programs, contrary to some misconceptions, are typically inadequate and often extremely delayed, leaving households suffering for weeks, months, or even years before funds arrive. Lower-income households are usually uninsured, as indemnity-based disaster policies available in the U.S. are unaffordable for them.

These constraints on post-disaster financing have spillover impacts for all aspects of life. Having the resources to be able to rebuild and repair damages is linked to emotional well-being, physical health, mental health, educational attainment, and the stability of families (Farrell and Greig 2018; McKnigh 2019). Without the resources to recover, households turn to coping mechanisms that can have long-term negative impacts and limit their ability to build wealth (Jacobsen et al. 2009). This is a challenge for a large number of families in the U.S. For 2020, the poverty rate, as estimated by the U.S. Census for the contiguous U.S., was roughly 12%. An even larger percentage of households qualify as low-income. U.S. disaster policy, despite the needs of this population, offers little that is means-tested or specifically designed to help these households.[2]

One potential tool to help improve the financial resilience of lower-income households is parametric microinsurance. Microinsurance refers to insurance policies that have low premiums and lower coverage limits and are designed for poorer populations. Parametric insurance rapidly pays out a set amount based on observable measures of the disaster, such as wind speed in a certain location. When the designated parameter is reached, a payout is triggered. Since costly and time-consuming loss adjusting is not needed for parametric policies, the transaction costs are much lower, opening up the ability to provide lower-limit insurance policies, for which premium revenue would otherwise be insufficient to cover expenses.

Most examples of parametric microinsurance policies come from developing countries, where such products have been piloted and implemented for the last couple decades.

[2] See: https://riskcenter.wharton.upenn.edu/digital-dialogues/improvingdisasterrecovery/

Microinsurance has been offered for a range of coverages, including life and health, as well as crop and livestock insurance to help smallholders with weather-related losses and provide financial stability in the face of drought, floods, or other perils (e.g., Barnett et al. 2008). Beyond recovery, microinsurance can play an important role in allowing risk-taking activities that would increase income or assets, and thus help lift people out of poverty, such as when crop insurance allows for the planting of riskier, but higher-revenue crops. While a critical role for risk transfer, this paper is limited to the role of insurance in protecting lower-income households in developed nations from sliding further into poverty as a result of insufficient resources for disaster recovery. The paper thus explores whether and how the concept of parametric microinsurance can be extended to the U.S. to provide post-disaster financial resilience to lower-income households. To date, there have been no microinsurance products offered in the U.S., although that is soon about to change. This past summer, Puerto Rico's insurance commissioner introduced regulations to enable the launch of parametric microinsurance products to protect low-income families on the island from natural disasters. At least one firm, Raincoat, is ready to begin offering such a product.

This paper presents a proof-of-concept for implementing parametric microinsurance in the U.S., with spillover lessons for other highly developed countries. Section 2 begins with an overview of the recovery needs and disaster financing available to low-income households in the U.S. Section 3 provides a more detailed overview of parametric microinsurance and Section 4 discusses the challenges with offering this product. Section 5 then details five different distribution models for how parametric microinsurance could be adopted, with policies being provided through either: (1) an aggregator, (2) a mobile-based technology, (3) linking to other products or retailers, (4) a community captive, or (5) a public sector insurer. Section 6 discusses implementation steps. Section 7 concludes with reflections on next steps for exploring this potential solution in the U.S.

2. The Recovery Needs of Low-Income Households in the United States

2.1 Disproportionately Harmed

A growing body of research has found that worldwide, and in the United States, poorer households are disproportionately impacted by disasters and this is often not reflected in aggregate loss estimates or examination of the impact of disasters on macroeconomic indicators (e.g., Kim 2012; Hallegatte et al. 2017; Sawada and Takasaki 2017). In the U.S., a mix of qualitative and quantitative studies across different locations all indicate that lower income groups and minorities suffer disproportionately from disasters and recover less quickly than more privileged residents (Bolin and Bolton 1986; Fothergill et al. 1999; Brunsma et al. 2010; Fussell and Harris 2014). Without financial safety nets, disasters can act as tipping points for low-income households. Families and individuals might default on loans, accumulate debt, exhaust small savings for other purposes like education, and even lose their homes (Pastor et al. 2006).

Disasters create myriad additional expenses for households. These range from immediate ones like covering evacuation costs and temporary housing to longer-term expenses like repairing homes and businesses, replacing damaged goods, or permanently relocating. Beyond property damage, families might have to cover a number of unexpected costs for extended periods. For example, when electricity was lost for weeks to months in parts of Puerto Rico following Hurricane Maria in 2017, households incurred high unexpected costs from having to purchase generators and constant fuel to keep their homes habitable when the grid was down (Fausset et al. 2017). Households may have to defer other expenses, such as healthcare and debt servicing, in order to pay these disaster costs (Farrell and Greig 2018).

Wealth inequalities are substantial and increasing in the United States. Inequality has detrimental effects on other forms of social stratification, including educational attainment, physical health, and emotional well-being (Hansen 2014; Keister 2014; Shapiro 2017). Rising natural hazard damages have been found to compound social and wealth inequities (Howell

and Elliott 2019). Prior research demonstrates that low-income residents recover less quickly when compared with more-privileged residents, who may even benefit financially post-disaster (Brunsma et al. 2010; Fussell and Harris 2014). Slower recovery is typical not only for low-income households, but also those with specific racial or ethnic backgrounds and areas with lower cost rental units (Kamel and Loukaitou-Sideris 2004; Tafti and Romlison 2019).

Economic factors that influence a household's post-disaster recovery include a household's income, savings, and demographic characteristics (Tierney 2006). Historical disparities and existing inequities lead to uneven impacts from disasters (Finch et al. 2010). Additionally, recovery depends on ability to access alternative forms of employment in the face of job instability (Tanner et al. 2015). Hard-hit disaster areas are often characterized by slowed income and employment growth. Economic activity may shift to the edges of disaster zones, where damage is minor, but these short-term shifts can permanently alter the spatial distribution of employment and income, possibly exacerbating wealth inequities (Xiao and Nilawar 2013).

Low-income renters face their own post-disaster challenges. Renting in the United States is at a 50 year high, with over 36% of households renting as of 2016 (Cilluffo et al. 2017). While renters are not responsible for building repairs, their possessions may be damaged. Beyond costs sustained from damaged possessions, renters may have to pay higher rents post-disaster if rents are raised after significant repairs or due to high demand for a reduced number of units (Peacock et al., 2014). If a flood makes a rental unit uninhabitable, residents can effectively become evicted by a storm. Eviction carries with it numerous negative impacts for families (Desmond 2016). One study finds that local damages are more likely to impact the finances of low-income renters who may lose local jobs, need to relocate, and/or pay higher rents due to reduced housing stock, but have limited savings to draw on (Elliott and Howell 2017). Several additional factors can slow the recovery of rental housing, including that original construction materials for rental units, particularly multi-unit buildings, are often low quality and poorly maintained and therefore subject to greater damage, and that costs of repair are greater and disaster assistance typically becomes available later for rental properties (Comerio 1998; Fussell 2015).

2.2 Insufficient Recovery Resources

Risk management and social protection is usually high in developed countries and they have well developed insurance markets (Holzmann et al. 2003). Indeed, the United States and Canada accounted for over 57 percent of nonlife insurance premiums in the global market in 2019[3] and the U.S. is the world's largest and one of the most sophisticated insurance markets. However, despite an overall high level of insurance penetration, and despite every state in the country having been impacted by at least one billion-dollar disaster since 1980,[4] a significant portion of the U.S. population is uninsured or underinsured for natural disasters, with low-income households, in particular, often lacking protection (e.g., FEMA 2018).[5]

This low penetration of insurance among lower-income families is troubling since they struggle with access to any of the other primary sources of funds for recovery: savings, credit, or governmental aid. Roughly 40% of households do not have $400 in liquid funds for an emergency (Board of Governors of the Federal Reserve System 2018). The first line of assistance for disaster victims is often a loan, yet financing options typically fail for lower-income households as they may not have the resources to take on additional debt or may be locked out of access to credit altogether. Indeed, it has been found that over half of applicants to the disaster loan program of the Small Business Administration—the federal loan program for disaster victims—are rejected as uncreditworthy (Collier and Ellis 2020).

Without savings or a loan, households turn to aid. While NGOs may provide some needed support, this is difficult to predict ex-ante. And contrary to many perceptions, federal disaster aid is limited and delayed, making it an inadequate recovery source. Federal assistance is only provided following large disasters that receive a Presidential disaster declaration. Even for these events, households may not get immediate funds. Between 2005 and 2014, grants from the Federal Emergency Management Agency (FEMA) to households were authorized in only 35 percent of major disaster declarations. When provided, these household grants are capped at a bit over $33,000 and typically only average a few thousand dollars. According to

[3] See: https://www.swissre.com/institute/research/sigma-research/sigma-2020-04/us-canada.html
[4] See: https://www.ncdc.noaa.gov/billions/
[5] On renters insurance, see: https://www.iii.org/press-release/number-of-renters-is-on-the-rise-but-few-of-them-have-insurance-092214

FEMA, the program "is not a substitute for insurance and cannot compensate for all losses caused by a disaster; it is intended to meet basic needs" (FEMA 2016). Other potential sources of federal aid, such as programs financed by Congressional appropriations to the Department of Housing and Urban Development, are uncertain, and when funded, take many months, or more typically years, to get funds to households. They are designed for long-term recovery and hazard mitigation, not the financial needs in the weeks and months following a disaster. An analysis of Hurricane Sandy, for example, found that there was the least assistance for immediate rebuilding, with negative long-term economic impacts for homeowners (Madajewicz and Coirolo 2016).

While in some situations, households may be able to turn to friends or family for assistance, in a disaster, entire neighborhoods may be hit simultaneously. As such, resilience typically requires that disaster risks be transferred out of the community (Jacobsen et al. 2009), but, as noted, this is rarely done for low-income communities in the U.S. This dichotomy of insufficient aid and unaffordable insurance premiums has contributed to an enduring disaster recovery gap for low-income households. This may also explain why research on Hurricane Katrina has documented that the recovery process itself post-storm was equivalent to a second-order disaster for some, further exacerbating inequalities for low-income and non-white residents compared to wealthier residents (Elliott et al. 2009; Adams 2013).

3. Overview of Parametric Microinsurance

As discussed in the previous section, low-income households in the United States are often left struggling post-disaster, as they lack sufficient liquid savings, are denied access to credit, and cannot afford standard disaster insurance policies. Insurance is most critical for these households, but they are least able to afford it. Microinsurance has been developed and piloted in many lower-income and emerging economies around the world to overcome this challenge. Can the concept also help lower-income households in the United States?

Microinsurance refers to low-coverage, low-premium insurance policies that are designed to protect low-income people against specific perils. Microinsurance policies have typically been offered in the developing world for health insurance, life insurance, and

agricultural insurance. Definitions of microinsurance do not usually include any dollar limit, but clearly the amount and type of coverage that would be needed will vary by country and context. In the United States, lower-income families will need a substantially higher absolute value payout, for example, to find value in the coverage than would be needed by households in the least developed countries. Given the targeted consumer and the required price point, microinsurance must also be simple and accessible and the delivery process must be efficient (Churchill and McCord 2012).

Due to these needs, microinsurance is almost always a parametric product (sometimes called index-based insurance). Parametric insurance pays the insured a set amount based on an objective measure of a particular event, instead of based on the amount of damage sustained. In the U.S., most consumers are more familiar with indemnity insurance, which would compensate the insured exactly for a loss (subject to deductibles and coverage limits). With a parametric policy for natural disasters, the amount paid is set in the policy contract and is related to a measure of the hazard, such as windspeed in a certain location or the height of a set of stream gauges.

The indicator that determines the payout is referred to as the trigger (there could also be multiple triggers that must be met for payment). A good trigger will be measured and reported rapidly and by an independent third-party so that there can be no manipulation of the trigger to impede or facilitate payouts. It will also be highly correlated the insured's loss. The potential difference between the actual loss and the payout is referred to as basis risk, and is one downside of parametric insurance. Care must be taken in designing the trigger to minimize the basis risk to the insured. This is especially true for vulnerable populations that are dependent on the microinsurance funds for recovery.

Basis risk, however, is a cost that must be accepted to secure the benefits of parametric insurance, which enable microinsurance to be written in the first place. Indemnity-based insurance has administrative and transaction costs that can swamp the premium revenue on microinsurance, making it simply not a viable model. Parametric insurance, in contrast, has much lower administrative costs. Processing claims does not require expensive and time-consuming adjusters. This ease in determining claims also means that payouts are made much

more rapidly with parametric products, often in a matter of days. Parametric insurance also provides important flexibility to the insured. The funds can be used for any immediate need, many of which are hard to predict before the disaster occurs.

Parametric microinsurance will need to be designed to comply with the U.S. insurance regulatory environment. In the U.S., insurance is regulated at a state level through offices of insurance commissioners, who focus on solvency and marketplace regulation, including consumer protections. Each state insurance commissioner has jurisdiction over any microinsurance products in their state. As both parametric and microinsurance are new to a U.S. residential market, commissioners will likely have a few concerns and new standards or approaches may be needed. For example, several commissioners have noted that any parametric product must have a "proof-of-loss" requirement to be considered insurance and not a derivative. Any approach to establishing proof-of-loss, however, must be rapid and inexpensive in order to not undermine the benefits of parametric products in the first place. While not designed for low-income households, one of the first residential parametric products on the market, Jumpstart,[6] an earthquake policy in California, was able to meet this requirement with a simple text message from the insured that they have sustained costs. Other programs internationally have made use of rapid assessment teams that provide very quick, high-level assessments of damage, typically in one of only two or three categories (such as high or low), which could be used as a proof-of-loss and linked to either a high or low payout. Satellite images, drone data, or social media could also be used for this purpose (Kryvasheyeu et al. 2016).

As noted in the introduction, in July 2020, Puerto Rico introduced new regulations for parametric microinsurance for catastrophes.[7] Puerto Rico is the first U.S. state or territory where an insurance commissioner has introduced regulations allowing parametric products to be developed for low-income families. As stated in the regulation, allowing catastrophic microinsurance in the Puerto Rican market will create new alternatives for affordable coverage. Puerto Rico's enabling of parametric micro-insurance products stems from its experience

[6] See: https://www.jumpstartrecovery.com/

[7] Regla Número 103 del Reglamento del Código de Seguros de Puerto Rico: "Requisitos para el sometimiento y la tramitación de microseguros catastróficos de tipo paramétrico en líneas personales."

following Hurricane Maria in 2017 and the need for new market solutions tailored to the needs of low-income households. As of 2019, the U.S. Census estimated the Puerto Rican poverty rate at close to 43%.

The regulations include that the Insurance Commissioner's Office must ensure that rates are not excessive, inadequate, unfairly unequal, or otherwise undermine the purpose of microinsurance. Therefore, rates are subject to a premium limit that should not exceed two percent of an individual's annual income or the minimum wage ($7.25 per hour). For 2020, in order to consider a policy microinsurance, the premium cannot exceed $261 per year or $21.75 per month. This premium limit is established for policies that cover only one catastrophic risk, but insurers can also offer policies with multi-risk coverage. Microinsurance premiums can be established for annual or monthly terms, allowing products to be offered for specific seasons. Insurance payouts must be made within 10 days of a triggering event. These regulations are so new, that at the time of writing, no products are yet to market.

4. Market Challenges

Providing insurance coverage to lower-income households presents numerous challenges. The first is the absolute necessity of keeping the premiums as low as possible given the affordability constraints of the targeted population. A parametric product is thus essential, since, as discussed in the previous section, it can lower administrative costs to the point where a low-coverage and low-premium product is viable. Allowing for monthly instead of annual payments can help lower-income households that may not have sufficient funds to cover an annual premium in one payment and can allow for seasonal products, as well. Microinsurance may also benefit from community pricing, where a set premium is charged in an entire community, instead of underwriting different subgroups; this can help maintain affordability if the cross-subsidies do not create too much anti-selection; it is also much simpler to explain and administer and can help scale the product (Garand et al. 2012). Scaling can be critical for microinsurance to achieve a high enough volume, given low premiums, to reach profitability (Angove and Tande 2012).

Premiums are based, of course, on the risk cost, which will depend on the underlying hazard and payout structure. These costs must be compared with what potential households are able to pay for disaster coverage. This, in turn, will depend on the specific population targeted. Those at the very bottom of the income distribution likely need direct public assistance and may not be the target group for microinsurance. Microinsurance may be more beneficially aimed at those that have limited means, but do have some source of moderately predictable income, for example. A detailed analysis of the target consumer group will thus be necessary for designing any product.

The design process—including consumer research, hazard modeling, pricing, and developing policy terms—can itself be costly. In developing countries, lack of objective data for the trigger and limited historical data to use as an input to hazard modeling can present hurdles, but these will be less of a challenge in the United States. Still, data on the target population will need to be obtained and detailed modeling undertaken, often in an iterative process of exploring triggers, coverages, and prices. It may be the case that the premium generated off microinsurance is too low to support a product design team; internationally, external teams funded by donors have sometimes played this role (Mapfumo et al. 2017).

Indeed, while microinsurance has occasionally developed as a standalone business model, more often it has been supported by the public sector, since microinsurance unites insurance with clear social objectives and achieving profitability is a challenge. Public sector support can take many forms. It could be direct funding, such as providing resources for development of the program or offering premium support to insureds. Funding could also be accompanied by a more formal public-private partnership that encompasses many aspects of the process from design to delivery.

As microinsurance is adapted to the United States, then, an important question is whether it is a partially subsidized social safety net program, some new form of public-private partnership, or a standalone private sector business model. Since among the many pilots of microinsurance that have been launched around the world, very few have succeeded as standalone, long-term, private-sector business models, we focus in this paper on how the public and private sectors can work together to provide financial resiliency for low-income

households through microinsurance. Such a program could help rectify the currently insufficient levels of public sector post-disaster support in the U.S. for low-income groups and enhance their resiliency.

Public sector funding for microinsurance programs need not necessarily require new funding vehicles. Grant funding for the design and creation of microinsurance products could potentially be provided by the new Building Resilient Infrastructure in Communities program in the Federal Emergency Management Agency (FEMA), for example, or as part of local use of Community Development Block Grant - Disaster Relief funds from the Department of Housing and Urban Development. Congress, state legislatures, or local governments, could also create an assistance program to provide premium-support to qualifying households to purchase microinsurance policies against disasters.

Regardless of the design of any public-private partnership, the program will have to address the ongoing challenge of limited demand for disaster insurance at any income level. This is due to lack of knowledge about disaster risks, insufficient financial and insurance literacy, well-documented behavioral biases when evaluating risks, mistrust of the firm or agency offering the product, concern the insurance does not meet individual needs, as well as budget constraints. Lower-income consumers, in particular, may have less access to educational materials about risk and may be less familiar with insurance concepts. To overcome these hurdles, a well-developed consumer education campaign is likely needed and should be coupled to a very simple and easy-to-understand and easy-to-use product. Given the dominance of indemnity-insurance in the U.S. market, regulators may request that product materials make clear that a parametric payout is made without regard to the damages that may be realized. To aid understanding about the product, consumers could be given information that will allow them to assess their losses under different disaster conditions and compare those losses to the parametric payout. Outreach may be most impactful when done by trusted intermediaries already engaging with the target population.

In addition, product design decisions can help demonstrate more value to consumers in order to spur greater demand. For instance, the risk management function of insurance can be abstract; coupling insurance with some other tangible benefit can help improve demand for the

product. This could be a complementary product, like a disaster kit, or an annual rebate if no claim is filed. Further, since insurance value is often realized after a payout, insurance programs can be designed to provide some lower-level, but higher-frequency payouts, in addition to larger, but less frequent, payouts for catastrophic events. This can lead to more continual demonstration of the benefits of insurance, maintain insurance literacy, and test the claims management system for when a larger scale disaster does strike.

5. Distribution Channels and Delivery Models

Distribution of insurance refers to all the activities that must take place between the holder of the risk and the client, including policy origination, collecting premiums, marketing, sales, and claims-payments (Smith et al. 2012). This could involve multiple partners beyond just the insurance company. It can be a slow process to get to a sustainable microinsurance model, but prior efforts indicate that success is possible. As has been noted for microinsurance in the developing world: "It takes time (sometimes years) for the ultimate beneficiaries of index insurance products to begin to truly appreciate the benefits of the cover, for delivery channels to build their sales and administration capacity and for (re)insurers to adjust and improve the product so as to better attend to client demand," (Bernhardt 2014). This is likely to apply in the U.S., as well.

In this section, we provide a conceptual overview of five delivery models that have the potential to be used in the U.S. market for parametric microinsurance. Which of these would prove to be successful would depend on a more detailed investigation of the context and institutional details. As noted above, before designing and pricing a microinsurance product, it would also be necessary to understand the needs of the target population, including the type and range of costs they might incur post-disaster, other sources of financial support, and their previous coping strategies (Garand et al. 2012). This can help guarantee the product is designed to meet needs. In practice, many models could operate simultaneously and target different groups.

5.1. Aggregator Model

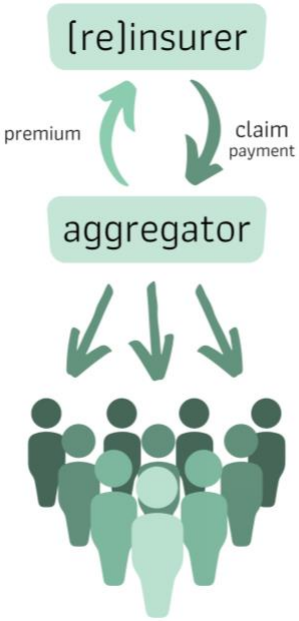
At times, even with a parametric approach, the transaction costs of providing policies to individual households will still prove too high to make the policy affordable to these insureds. In addition, households may not be well-positioned to handle the basis risk. Both of these challenges can be addressed through a model in which another institution, referred to as the aggregator, purchases a policy and then disburses the claims to the individual households. The aggregator may be a non-profit that works in a community, a local governmental agency, or a disaster relief non-governmental organization (NGO). This model is sometimes referred to as a "meso-level" model.

In this approach, the aggregator is the intermediary between the insureds and the (re)insurance firm providing the coverage. The aggregator negotiates an insurance contract with the (re)insurer and holds the policy. When claims are paid, the aggregator disburses funds to the individual households. Figure 1 provides a schematic of this model. Generally, the aggregator has complete freedom in how to make these disbursements. To ensure households are aware of their coverage, it would be preferable for the aggregator to establish procedures and policies for how disbursement will be undertaken before a disaster occurs and to make all households aware of the process. Disbursement could be done by simply paying a set amount to all those impacted, or it could be through visits to assess damage, or by examining satellite or aerial photographs to determine damage, for example. Amounts paid could also vary by income of the impacted household, or other metrics. To limit basis risk, the aggregator would need to have a process for allocating more funds to those with higher damage levels.

Potential aggregators are often those whose social goals can also be achieved through insurance for the populations they serve. This could be an NGO focused on poverty reduction, disaster recovery, or housing affordability, for example. The goals of these groups could be supported by helping to ensure financial recovery for those they assist through microinsurance. Such an NGO likely already has trust in the community, which is valuable when introducing a new concept and product, as microinsurance would be to most of the U.S. A public sector agency could also play the role of an aggregator. A public agency could support the policy in other ways, as well, such as through premium support or with accompanying risk reduction

and/or education programs. This may, thus, be a useful model for a public-private partnership around microinsurance.

Figure 1. Aggregator Model



Presumably, the aggregator would collect premiums from the households that would be covered. The aggregator, however, as just mentioned, may also be positioned to subsidize premiums with donor or governmental funds. If the households paid no premiums, an aggregator model could morph from being microinsurance to instead being an aid program administered by the aggregator and financed through insurance. For instance, a government agency or relief NGO could design a program of disaster assistance for lower-income families and then fully or partially fund this through risk transfer. In the United States, governmental disaster aid is not means-tested and this type of program could be a useful complement to other existing programs. The program could have clear rules for how funds would be disbursed. This program could purchase (re)insurance instead of needing to hold sufficient reserves for a disaster event. While potentially beneficial, this would not strictly be microinsurance.

5.2. Mobile Model

The expansion of mobile phones across households has opened up mobile-based business models for microinsurance. As of 2019, around 96% of Americans owned a phone, with 81% of people having a smartphone; among adults making less than $30,000, 95% still have a cell phone and 71% have a smartphone (Pew Research 2019). In mobile-based models, an insurer offers policies directly to households through a mobile application. Mobile technologies can allow for policies to be purchased, premiums paid, claims received, and can also be used for consumer communication and education. Mobile-based technologies can improve efficiency and widen the geographic scope over which policies are offered. Mobile-based approaches are just one example of how technology is transforming the insurance sector, including microinsurance (e.g., Smit et al. 2017).

Using mobile phones to distribute insurance builds on the development of mobile-based financial transactions. Smart card technology or mobile money platforms (such as M-PESA,[8] originally launched in Kenya) can allow for premium and claims payments among even the unbanked. These types of platforms allow the user to store, send, and receive funds on a mobile phone. Mobile phone applications lower operational costs and reduce inefficiencies for insurers, allowing them to potentially offer many low-premium policies at a high volume, making microinsurance more financially viable. These applications can also increase trust by increasing communication between the consumer and the insurers and also provide more value-add services and benefits that can improve the risk management practices of clients, like localized weather forecasts and updated information about claims processes. Chatbots and interactive interfaces can provide detailed information on risk management beyond the insurance policy.

Mobile-based technologies have already been used in the insurance sector in the U.S. for standard property insurance. On example, for instance, is the company Lemonade. Lemonade delivers insurance policies and handles claims through desktop and mobile apps using chatbots. There has been a rapid increase globally in the number of mobile microinsurance products, across product areas like life, health, accident, cattle, crop, and travel

[8] See more details at: https://www.worldremit.com/en/kenya/mobile-money/m-pesa

insurance (Tellex-Merchan and Zetterli 2014). Many of these in the developing world are done in partnership with mobile network operators. In the U.S., a mobile-based microinsurance product could be done via an app on smartphones and not necessarily involve a mobile carrier.

Mobile-based models can have other benefits. Following Hurricanes Maria in Puerto Rico or Harvey in Texas, for example, many of those affected lost essential documents such as insurance policy papers, land ownership records, and personal identification needed to file a claim. Mobile-based parametric policies that use blockchain would allow any important information needed for distributing a claim to be stored in a highly secure and immutable manner. While insurance will increasingly be offered through mobile platforms in general, parametric insurance is particularly well suited for mobile platforms. Blockchain is a digital ledger of transactions that is duplicated and distributed across the entire network of computer systems on the blockchain. Blockchain uses smart contracts, which is computer code representing an agreement between two parties. It is self-executing, meaning that when the terms of the contract are reached (i.e. by an external trigger), the contract executes and the agreed-upon transaction occurs. Because the contract is executed automatically when the conditions are met, this allows for quicker payouts. There is no need for intermediaries to manage and approve the transfer. Blockchain, therefore, allows a well-designed interface to have minimal transaction costs. Blockchain's ability to securely manage digital identities through encryption also allows for proof of counterparty, which creates potential for unbanked populations to quickly receive payments.

5.3. Joint Product Model and Joint Sale Model

The third distribution model is for an insurer to partner with another firm either to automatically couple sale of the insurance to another product, or to simply make the insurance product available at the time the consumer is buying something else. These types of partnerships can vary in structure. The involvement of the partner could range from passively making the insurance available at the point another product is bought to actively marketing it or attaching it to sale of their product. The benefit of these partnerships is that the insurer has

access to a much wider customer base. A drawback can be that the partners may not know much about insurance or be effective educators about the product to consumers.

In the first version, a commercial enterprise finds it attractive to increase insurance penetration among its customers, or finds is worthwhile to allow insurance to be bundled to their product as part of a social service. For instance, perhaps landlords require a microinsurance product as part of signing a lease, knowing this will then lessen the likelihood a tenant misses a payment post-disaster. It could also be the case that a public sector program finds coupling the insurance to the program beneficial for recipients, perhaps partially supporting the purchase with public funds. For example, a Low Income Home Energy Assistance Program may also purchase a parametric microinsurance policy for their beneficiaries.

In the second version of this model, an insurer partners with one or more retail outlets or other firms to sell the microinsurance policy. The key benefit of this approach is access to a larger potential client base. It can also lower the costs of marketing and distribution, by drawing on an already existing network. Experience from other countries suggests that insurers may want to partner with many firms to sell their product in order to develop broad access to customers (Smith et al. 2012).

For either version of this model, in order to keep fees sufficiently low for the service the partner firm provides, it may work best if the partner also benefits in some way from the insurance, such that they are willing to sell the coverage, even if not highly compensated for doing so. For example, the insurance coverage could include paying an insured's utility bill in the event of a disaster, such that a utility company would also benefit from helping market the product, or could include a certain amount to pay off credit card debt and thus would also be offered with taking out a credit card. It also works better for insurance purchase if the partner is a well-trusted brand (Smith et al. 2012).

5.4. Community Captive Model

A captive insurance company is one that is wholly owned and controlled by the insureds and used to provide coverage for their own risks. Like any other insurance company in the U.S.,

captives are regulated by state departments of insurance. Captives tend to be created when insurance is difficult to obtain or is too expensive in the private market. They retain premium and directly access reinsurance markets. Captives can be more insulated from market pricing changes and can decide how to best use any accumulated premiums. There are many different structures for captives (WillisTowersWatson 2011). It is important to note that since captives are regulated entities, using a captive is distinct from self-insurance, since the capital levels required in the captive cannot be pulled out and diverted to other uses.

Several public-sector entities have captives, from school districts and utilities to municipalities. Theoretically, a municipal captive could be used to write microinsurance policies directly to lower income households in the municipality's jurisdiction. Any accumulated revenue could be used to invest in risk reduction measures targeted at the properties and neighborhoods being offered the coverage. Given that the captive is controlled by the local government, they could also couple the insurance to social programs or subsidize the policies with public funds. Such funds may be needed to initially capitalize the captive for offering the policies, for example. While a captive provides an existing insurance structure that can be harnessed for microinsurance, establishing a captive initially is not an easy or inexpensive undertaking. It may not prove cost-effective if done only for the microinsurance line. A detailed feasibility study would need to be undertaken for any municipality considering formation of a captive.

5.5. Public Sector Insurance Program

In the United States there exist many quasi- to fully public disaster insurance programs. At the federal level this includes the National Flood Insurance Program (NFIP), which writes standalone flood policies to members of participating communities (Kousky 2018). All states in the southeast U.S. exposed to hurricane risk have residual market mechanisms, also called wind pools or beach plans, which offer wind coverage to those unable to secure coverage in the voluntary market (either stand-alone wind coverage or full dwelling policies) (Kousky 2011; Hornstein 2016). The state of California has the California Earthquake Authority (Marshall 2018) and also uses its Fair Access to Insurance Requirements (FAIR) plan to cover wildfire risk.

Such government disaster insurance programs exist in almost all developed countries (e.g., McAneney et al. 2016).

Any of these public sector disaster insurance programs could also offer a parametric microinsurance policy. For example, the NFIP, in addition to the standard policies it offers, could make available a microinsurance policy for residents of participating communities that meet pre-determined income criteria. Such policies could include a proof-of-loss that harnesses new technology, such as drones, or by using the rapid assessment teams FEMA deploys after disasters for the Individual Assistance program. The policies could be offered as one flat payments in the case of loss, such as $5,000 or $10,000, or could be designed as two or three tiers depending on the severity of the event. Congress could work with FEMA to make microinsurance policies that would satisfy the mandatory purchase requirement for those who meet a certain income level, such as those below a certain percentage of area mean income or those below the federal poverty level. State residual market mechanisms could similarly design microinsurance offerings.

6. Conclusion and Next Steps

This paper has provided a proof-of-concept examination of bringing parametric microinsurance programs to the United States, with lessons for other developed nations. Lower-income households are disproportionally impacted by disasters and struggle financially post-disaster to fund the necessary repairs and rebuilding and with meeting other unexpected disaster costs, with spillover impacts into many other areas of well-being. Parametric microinsurance has proved a viable approach to improving the financial resilience of lower-income households in other locations around the globe. Five promising delivery models adapted for a U.S. context are proposed in this paper: providing microinsurance (1) through an aggregator, (2) through a mobile-based application, (3) as a joint product or joint sale, (4) through a community captive, or (5) through a public-sector disaster insurance program.

For adoption and expansion of this potential solution, further research and development along several dimensions is needed. First, while there is a robust literature on the differential impacts of disasters on disadvantaged communities, none of this research

documents in detail the specific financial costs faced by various households for different perils, their current sources of support, and the gap in post-disaster financing that needs to be closed. Such research will be necessary for development of useful and robust microinsurance policies.

Second, work will need to be done to determine the best regulatory approaches for enabling a strong microinsurance market in the United States. Puerto Rico is leading the effort on this and other jurisdictions will need to explore the possibility, as well. Regulators also oversee insurance agents and will need to identify any regulatory requirements if insurance distribution for microinsurance policies bypasses these agents or is undertaken by others, as suggested in some of the models in Section 5. Another concern of regulators is consumer understanding. More research is needed on the financial and insurance literacy of potential customers and on the best approaches for education about the role of parametric insurance, its triggers, and payout structure.

Parametric microinsurance is a tool to improve the resilience of some of the most vulnerable households. As such, it would benefit from public support. Policymakers, working with researchers and all stakeholders, will need to explore what role this should take going forward. For instance, is there public funding to help cover the cost of premiums for certain groups? Or funds to cover the development and piloting phase of a microinsurance program? Could the public sector partner in outreach and education? Beyond the public sector, are there philanthropic donors that could help develop this concept? For example, the Bill and Melinda Gates Foundation provides tens of millions of dollars in funding to launch the Micro Insurance Agency and expand microinsurance in many developing countries. These conversations need to begin in a U.S. context.

As with all forms of risk transfer, insurance is most powerful in building resilience when tightly linked to both risk reduction, risk communication, and disaster preparedness and recovery. We need robust integrated risk management strategies to ensure that those located in high risk areas, particularly those that are low income, are better equipped to be financially resilient after disasters. Officials need to work together across all levels of government and with non-governmental organizations and the private sector to create new and innovative solutions to help fill gaps in disaster preparedness and recovery.

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