Parametric Insurance

An Emerging Tool for Financial Risk Management

Government Finance Officers Association

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Parametric Insurance: An Emerging Tool for Financial Risk Management

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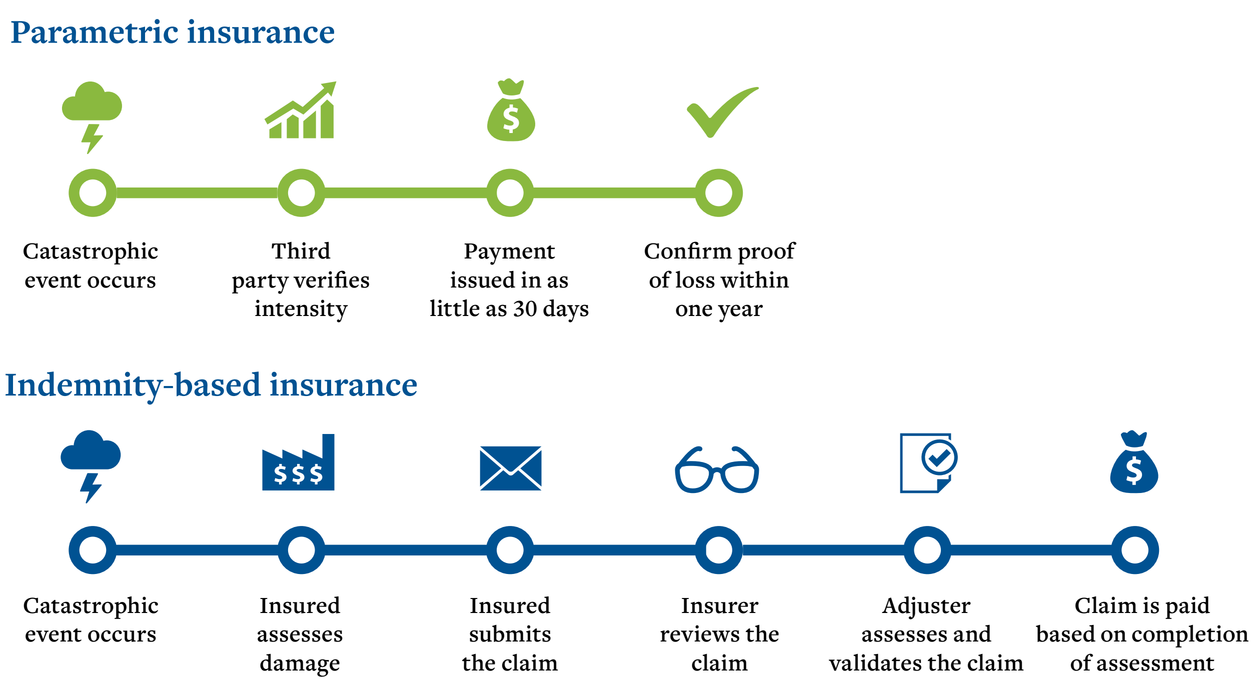
Local governments have a duty to respond quickly and decisively to extreme events and provide continuity in critical public service through adverse circumstances. Reserves or "rainy day funds," federal assistance, and indemnity-based insurance* programs are the primary tools governments have used to manage risk associated with events, such as natural disasters, recessions, etc., that have the potential to disrupt public services.

In recent years, a type of insurance instrument called "parametric insurance" has generated interest in local governments in North America to help fulfill risk management needs that aren't met by indemnity-based insurance, federal assistance, or rainy day funds. Parametric insurance is not new—it has been around for over 20 years. It has been used to protect Caribbean nations against natural disasters and insure energy companies against disruption to their revenue stream due to unusually cold summers or warm winters, for example. For state and local governments, parametric insurance can provide resources to cover damages not covered by federal assistance or indemnity insurance or that go beyond what a government's reserves can cover.

The idea behind parametric is quite simple. Exhibit 1 illustrates the process for payout from a parametric policy and compares it to that for traditional indemnity insurance. Let's walk through the essential steps shown in the Exhibit.

As a first step in a parametric policy, for any given risk event that the insured wishes to protect against, an objective measure of that event's impact is established. To illustrate, local wind speed could represent a hurricane's financial impact, and local

Exhibit 1. Parametric Versus Indemnity-based Insurance**



* Indemnity insurance is a contractual agreement in which one party guarantees compensation for actual or potential losses or damages sustained by another party. As we will see, this is different from parametric insurance, which is determined based on the event intensity alone.

** Exhibit used with permission from Swiss Re.

ground-shaking intensity could represent an earthquake's financial impact. The insured receives a payout of predetermined size if a threshold intensity of the event in question is met or exceeded. To illustrate with hurricanes, a payout of $5 million might be triggered if wind speeds in the insured's location exceed 80 miles per hour. The size of the payout is not directly calibrated to actual losses the insured experiences from the event, as it is with a traditional indemnity policy. The limit of the parametric policy is determined by past experience, exposure to risk, and anticipated resources needed to assist recovery after an event. The sizes of the payouts are also predetermined and are based on the intensity of the event the insured experiences. Also, the insured is not required to use the money to mitigate any particular loss or type of loss. For example, the insured may be required to use the payment from a traditional property insurance policy to repair the property that is the subject of the policy. A parametric policy can be used to offset any expense the insured experiences arising from the insured event.

The initial payout is not directly calibrated to an actual loss; it is determined based on the event intensity alone (e.g., the local wind speed of a hurricane). Therefore, parametric does not require the in-depth process to assess damages, submit a claim, and wait for insurance adjusters to do their work, as is found with traditional indemnity policies. Instead, the client alleges that the threshold intensity of the event has been met or exceeded. The allegation is verified by a third party that is mutually agreed upon ahead of time (it is not verified by the insurer). Thus, the time between the catastrophic event and the payout will typically be much shorter than with indemnity insurance. This is because third-party verification on the intensity of the event can happen almost immediately. Parametric is also free of the debate with adjusters that sometimes accompanies indemnity insurance. Finally, in Exhibit 1, you will note that the end of the parametric process requires confirmation that the insured experienced a loss equal to or greater than the amount of the payout that was received.[†] The form that loss takes is flexible. It does not have to be tied to damage to specific property and could cover costs as diverse as overtime for public safety personnel and lost tax revenue from the closure of local merchants.

The time between the catastrophic event and the payout will typically be much shorter with a parametric policy versus indemnity insurance.

In this paper, we will review the most import things local governments need to know about parametric insurance, including:

- Why local governments might wish to consider parametric insurance.
- Who is using parametric insurance, including a review of the experiences with parametric of two U.S. local governments and one state government.
- How to explore the use of a parametric policy.
- A review of the advantages and disadvantages of parametric insurance.

[†] This requirement makes parametric an "insurance" policy. Otherwise, it would be just a derivative contract.

WHY PARAMETRIC INSURANCE NOW?

It is important for local governments to consider new risk management tools, like parametric insurance, because the number of disasters has been increasing over time, as Exhibit 2 shows.* The rate of increase has been much faster than the rate of population growth. Additionally, research shows that there is also a trend of significantly increasing aggregate financial losses from disasters.[1]

Parametric insurance can supplement local governments' traditional means of risk management: federal (and state/provincial) assistance, indemnity insurance, and reserves.

Let's start with federal assistance (e.g., the U.S. Federal Emergency Management Agency or FEMA). Federal assistance will not cover all of the losses a local government experiences. First, the federal government must declare that an event qualifies for assistance. A local government could still experience significant losses from an event that is not declared eligible for assistance. Second, even for qualifying events, assistance recipients are still responsible for a significant share of the reimbursable costs (e.g., typically, FEMA requires 25% of the cost be borne by the recipient), and other costs may not be reimbursable. A leading example of a non-reimbursable cost is lost revenue if part of the tax base suffers damage and is no longer able to contribute the same revenue to local government. Finally, federal assistance may take a long time to materialize—perhaps years in some cases. Parametric policies can help cover losses that aren't covered by federal assistance and can deliver the payout quickly. Some local governments might also be eligible for similar assistance from their state or provincial government. However, the limitations of federal insurance often apply to state/provincial assistance too.

Traditional indemnity insurance policies provide coverage for a government's physical assets and provide protection in many different loss scenarios. Because these policies provide protection against losses arising from so many causes, a policy that provides a high dollar amount of coverage can be very expensive. This limits the amount of coverage a government can obtain and/or it requires significant deductible payments to make the policy affordable. A parametric policy could supplement a traditional indemnity policy by focusing on the specific loss scenario (i.e., earthquakes, hurricanes) that is most likely to cause extreme damage. Thus, the parametric policy could help cover deductible costs and/or damages in excess of the traditional indemnity policy's coverage limits, or items that are sublimited** or excluded under the indemnity policy.

Further, indemnity policies don't cover losses outside of damage to physical assets. For example, an indemnity policy wouldn't cover overtime costs for public safety personnel. A "business interruption" indemnity policy could cover lost revenue from damage to the insured physical asset but would not help if an extreme event left the facility undamaged but disrupted the underlying economic activity that produces revenue. For example, a business interruption policy for a marine port would only help if the actual port facility was damaged. If an extreme event limited ingress/egress to the port without damaging the physical facility, then a traditional indemnity-based business interruption policy would not apply. A parametric policy could be designed to provide a payout regardless of the physical condition of the gate.†

Reserves traditionally have acted as a form of self-insurance for local governments. However, many local governments will find it impractical to accumulate

* The authors of the study used to create Exhibit 2 believe that increase in the number of presidentially declared disasters has several causes, including global climate change, increased urbanization, and increased asset values in risky geographic areas.

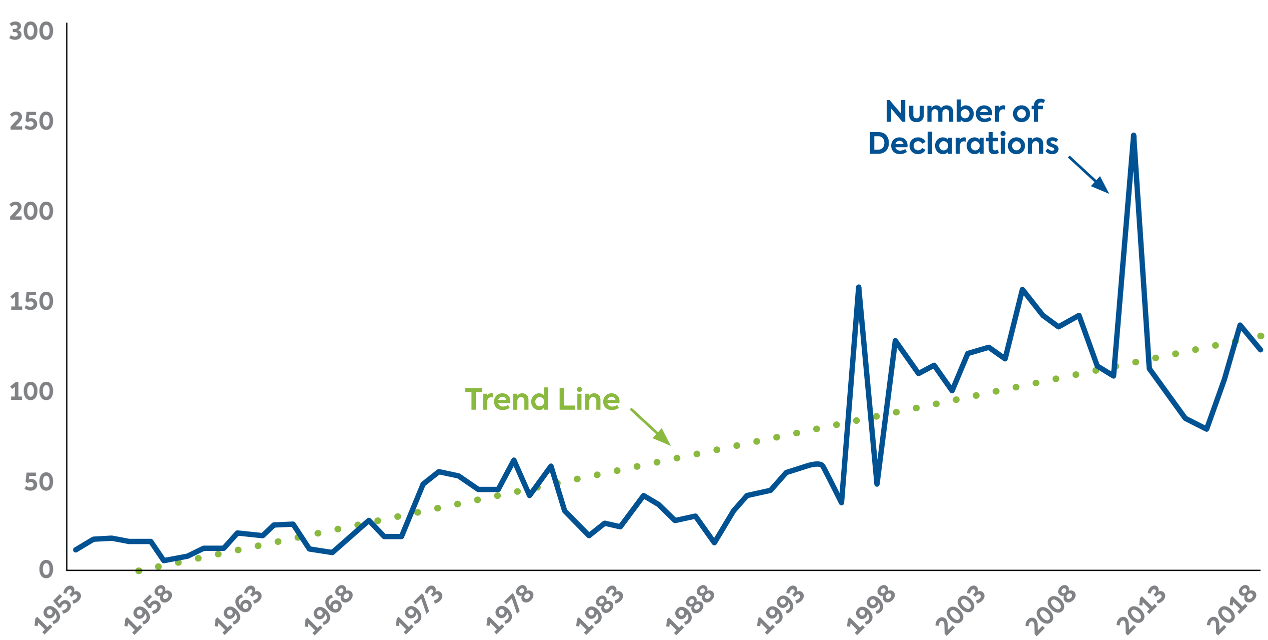
**A sublimit is a limitation in an insurance policy on the amount of coverage available to cover a specific type of loss

† This type of policy is often referred to as "non-damage business interruption" coverage.

enough reserves to cover the most extreme scenarios or could find their reserves exhausted by multiple smaller events. This could be because the local government is unable to generate sufficient excess resources to build the reserve to an adequate level quickly enough. Or perhaps a large reserve will attract political pressure to use the reserves for something other than risk management. Parametric insurance can act as a safety net if a government's reserves prove insufficient, and it may be more resistant to political pressure to spend the premium money on something else.

A final reason why local governments should think about the potential of parametric insurance is that the insurance market is starting to favor it, which means it could provide a better value to the insured than traditional indemnity insurance, in some cases. As of this writing, at least some of the value advantage of parametric is due to cyclical market forces that could prove temporary. However, there are some forces that suggest parametric could now have a natural value advantage. First, as we saw earlier, parametric policies don't have a claim administration and adjustment process. This process represents a cost of indemnity insurance that is passed along to customers. Second, the increased prevalence and accessibility of data and data collection devices makes parametric policies more practical to design and administer as they've ever been. For example, for a parametric policy to protect against flood risk water, gauges could be deployed around a community to measure the level of water in key areas of the community and report that data in real or near-real time. Finally, the globalization of financial markets means that more funds are available to support parametric policies than in the past.‡

Exhibit 2. Number of U.S. Presidentially Declared Disasters



‡ Parametric policies are legally required to be backed by the financial resources required to pay out the policy, should the parameter for payment be met.

WHO USES PARAMETRIC INSURANCE?

As mentioned earlier, parametric insurance has been used in private sector applications for many years and in international public sector applications. Protection against catastrophic events like hurricanes and earthquakes are common uses, but many other uses have been created. Some examples include:

» Crop insurance based on the amount of rainfall or drought.

» Delayed flight insurance for travelers based on the duration of the delay.

» Waterborne logistics insurance based on excessively high or low water levels on commercial waterways.

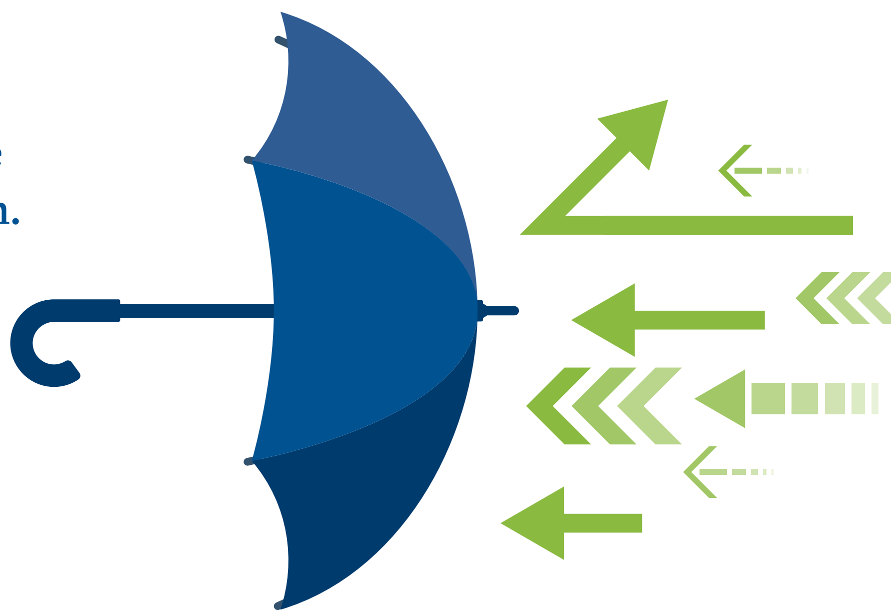
Of course, readers of this paper will be most interested in governments within North America. We will discuss three that are noteworthy because of the diversity of their experiences:

» Miami-Dade Public Schools (M-DCPS) in Florida (345,000 students) procured a parametric policy for hurricanes but discontinued the policy after three years.

» The State of Utah (population of 3.2 million) procured a parametric policy for earthquakes and is now considering more parametric polices to cover other risks.

» The City of Miami Beach in Florida is much smaller than our other two examples (population of about 92,000). The city investigated a parametric policy for interruption of tourism revenue but did not purchase one. It did, however, purchase a parametric policy for hurricanes, to supplement its existing indemnity insurance program.

Parametric insurance is flexible in its design. A parametric policy doesn't have to be limited to the types of risks governments typically address with insurance.



HOW CAN GOVERNMENTS EXPLORE THE USE OF A PARAMETRIC POLICY?

Because parametric insurance has important differences from traditional indemnity insurance, exploring the use of a parametric policy is not the same as for traditional insurance. In the following pages, we will describe how to investigate a parametric policy based on the experiences of our three case study governments.

Form a Team

Because parametric is not common in local government, it is wise to create a working group or team to help think through the implications of purchasing a policy. For instance, the local government's risk manager can help think through how it can best complement other insurance instruments, and the finance officer can contribute how the policy can best complement the reserve strategy.

The team should also engage a knowledgeable broker. Not all brokers are equally well-versed in the features of parametric policies. The governments we spoke with benefited from working with knowledgeable brokers. They also involved the insurance carriers directly in the conversation. As the seller of the insurance product, the insurance carrier was able to contribute important expertise to the decision-making process.

Identify the Risk (and Financial Disruption) You Want to Protect Against

For many local governments, the risk will be an obvious vulnerability to a catastrophic event. For M-DCPS, this was hurricanes. M-DCPS had a $100 million wind deductible on its traditional property insurance. It also was exposed to potential lost revenues if schools were closed due to a hurricane, such as lunch fees and federal support that is distributed according to the number of days students are in school. Finally, due to FEMA requirements, M-DCPS had a $17 million obligation to maintain insurance coverage for buildings for which FEMA has already provided damage reimbursement.* M-DCPS was also weary of the potential long FEMA reimbursement process.

The State of Utah procured a parametric policy for earthquakes. Utah is exposed to fault lines, but earthquakes are rare in the state. Utah experienced a significant quake in 1934, and studies by the United States Geological Survey show that large quakes are possible, including in the vicinity of Salt Lake City. Utah saw a parametric policy as a good supplement to its existing indemnity-based earthquake coverage. The payout from a policy could be used to cover deductibles or damages in excess of the maximum coverage limit, for example.

Could a Parametric Policy Cover a Recession?

A common source of budgetary instability is a recession. A market for parametric insurance to protect against recessions does not yet exist. However, the insurance industry experts we spoke with thought that it was entirely possible that such a market could develop in time.

* The intent of this regulation is for FEMA to avoid paying to again recover assets for which it has previously paid.

Parametric insurance is flexible in its design. As such, a parametric policy doesn't have to be limited to the types of risks governments typically address with insurance, like physical damage to a building. The City of Miami Beach was interested in insuring a potentially volatile revenue stream. Its tourism-based revenue (e.g., a resort tax and food and beverage tax) constitute around 20% of its total governmental funds' revenues and 10% of general fund's revenues. Tourism can be reduced for many reasons. A hurricane is not the only cause of lost tourism revenue, so a parametric policy tied to wind speeds would not fully address this risk. For instance, hurricane near misses can scare off tourists, even if Miami Beach never actually is touched by the hurricane. Also, other events that have nothing to do with hurricanes can reduce tourism. Here are some examples:

» The Zika virus scare in 2016 kept tourists away from Florida.

» Major sargassum seaweed blooms can wash up on shore and pile up in great quantities. Rot smells sulfurous, attracts insects, and repels tourists.

» Brazil is a major contributor of international visitors to Miami Beach. Downturns in the Brazilian economy are felt in Miami Beach.

» The events of September 11, 2001, reduced tourism in many parts of the United States, including Miami Beach.

Miami Beach couldn't predict these events would happen, but it was mindful of the potential for other unforeseeable events to reduce tourism. Therefore, Miami Beach sought a parametric insurance instrument that could provide coverage against a variety of tourism-disrupting events.

Miami Beach intended to use parametric insurance for budget stabilization. This is a common use outside of the public sector. Perhaps it will also start to become more common in the public sector. For instance, GFOA spoke with one insurance carrier that was investigating the market for a parametric instrument to protect against overruns in the snow removal budget for cities further north than Miami Beach. Local governments do not budget an amount sufficient to remove unlimited amounts of snow, of course. So a parametric policy could trigger upon the total inches of snowfall exceeding a predefined threshold in a given snow season.

Take Stock of Your Other Risk Management Tools

Parametric insurance is best thought of as a complement to other risk management tools, not a replacement. Therefore, the process of investigating a parametric policy should include a review of your existing risk management tools to see where opportunities to complement them exist.

Reserves are a good place to start. The most fundamental question is: How does the amount of reserves you have compare to your exposures? By identifying the major risks, you are subject to and the range of potential damages that might result.* A government can determine the assurance its reserves offer. GFOA has developed tools and methods for local governments to conduct this analysis.[2]

An important consideration with reserves is the political risk that public officials will want to use the reserves for something other than risk management. For many governments, this risk probably increases as their reserve gets larger. Hence, a government's discipline in respecting the purpose of its reserve is an important consideration. If a government has a strong reserve policy that clearly identifies the reserve as a risk management tool and has an institutional

* Including costs like public safety staff time, lost revenue due to impairment of taxpaying properties, etc.

> Parametric insurance is best thought of as a complement to other risk management tools, not a replacement.

culture where the policy is respected, then perhaps larger reserves are a good response to any gap between a government's uncovered exposure and its willingness to take on that risk. If a government lacks such a policy and culture, then a parametric insurance policy might be a better response.

A government should also review its existing insurance program. For instance, Utah was not satisfied with the amount of traditional insurance it had in place for earthquake risk. Parametric insurance proved to be a more affordable option for increasing its insurance coverage. Furthermore, the payout from the parametric insurance would be flexible to use as Utah saw fit and would not be tied to a particular building. Utah could use this money to offset any number of different costs that the state might incur as a result of an earthquake.

In addition to the amount of existing insurance already in place, governments should consider when that insurance would come into play. For example, we saw earlier that M-DCPS has a $100 million deductible on its traditional indemnity insurance for wind damage. A parametric policy could help offset this by providing resources to help pay the deductible costs (along with whatever other damages outside of property M-DCPS might experience as a result of a powerful hurricane).

Federal assistance is an element of risk management. Parametric insurance can complement federal assistance by providing coverage for losses that are ineligible for federal assistance. A government can take stock of important potential losses it could experience that would be ineligible. Lost revenue due to damages to major taxpayers in the jurisdiction is one good example.

Finally, a local government might consider its internal borrowing capacity. If a government has idle financial resources in accounting funds that don't have exposure to the same risks as the general government, then those funds might be able to provide a temporary source of liquidity in an emergency. Similar to reserves, a local government should have a strong policy to govern internal borrowing and a political culture of respect for the policy in order for internal borrowing to be used responsibly.[3]

Going Broader: The Miami Regional Resilience Strategy

Often, the risks a local government is concerned about will be shared with nearby public and private organizations. Resilient305 is a shared strategy of local governments in the Miami area to develop a shared response to risks of common concern to all. You can learn more about the approach used by these governments to develop a collaborative approach to risk and access some of their risk analysis tools at the Resilient305 website.[4]

Design the Parametric Policy

An important goal of designing a parametric policy is to reduce "basis risk." This refers to the potential for mismatch between the losses the insured experiences and the payments received. For example, M-DCPS was concerned about damage to its school buildings from hurricanes. Hence, a parametric policy based on wind speed would minimize basis risk for M-DCPS because a higher wind speed would presumably cause greater damages. The City of Miami Beach was concerned about lost tourism revenue. Hurricanes that hit Miami Beach were just one risk of many with the potential to reduce tourism revenue. Hence, a parametric policy based on wind speed would present high basis risk for Miami Beach.

The design should start with defining the geographies to be included in the parametric policy and the coverage levels for those geographies. Especially for larger governments, not all geographic areas in the jurisdiction will have the same exposure to a given risk. For example, Utah's parametric quake policy is focused on areas of the state where there are a greater concentration of assets near seismically exposed locations. M-DCPS also took into account the location of its physical assets (e.g., school buildings) and designed the policy to trigger when wind speeds reached the threshold levels in the parts of the district with a higher concentration of physical assets.

In some cases, the exposure that the government wants to protect against is not correlated with the location of its own physical assets. Perhaps impairment of the tax base from a natural disaster is a concern, in which case the location of top taxpayers might be most relevant. Or perhaps providing an adequate public safety response to vulnerable populations is an issue that parametric is intended to address. Then the location of vulnerable populations is key.

After defining the geographies for the policy, the "index" for the policy is established. The index is the measurement that will be used to decide if the policy triggers (e.g., wind speed). Here are some characteristics of a good index:

Strong correlation between the index and the potential loss. This minimizes basis risk. We saw earlier the example of wind speed as both a good index for M-DCPS and a poor index for Miami Beach's tourism revenue. Utah used "peak spectral acceleration," which is one way to express earthquake-related ground shaking at affected locations. It can provide a good approximation of the vibration (and damage) experienced by a building. This provides a closer correlation to the damage Utah might experience than would be provided by a more popularly known measure of earthquakes, like the Richter scale, which measures the magnitude of an earthquake at its center.

Administered by a trusted third party. This makes the index neutral in its application and immune to the moral hazards that might arise if the index was administered by the insured or the insurer. The index should also be a widely accepted measure, without room for debate on how it is calculated. For example, the National Hurricane Center is a good third party for hurricane data and the United States Geological Survey (USGS) for earthquakes. In another example, the New York Metropolitan Transportation Agency uses water gauges deployed by the USGS and National Oceanic and Atmospheric Administration for a policy to protect against flooding in train tunnels. Third-party private firms can also set up and monitor indexes for parametric policies. The cost of a third-party firm, if such a firm is necessary, can be included in the policy premium.

Historical data available. Ideally, there will be many years' worth of historical data that will be available for the index. The more years of data, the more comfort the insurer and insured have in modeling the index. This allows both the insured and insurer to see what kind of variation the measure has experienced in the past. Variation is a primary ingredient of risk.*

* Potential for loss is the other primary ingredient.

The index examples we have focused on so far might be fairly obvious, like wind speed for hurricanes and ground acceleration for earthquakes. Let's look at the City of Miami Beach for a nonobvious example. In order to approximate its exposure to lost tourism revenue, the city considered revenue per available hotel rooms or "RevPAR." This is a standard metric used by the hotel industry, calculated by multiplying a hotel's average daily room rate by its occupancy rate. RevPAR satisfied the criteria for an index we defined above. It offered a close fit with the risk of declining tourism revenue. If room rates or occupancy rates were declining, the city's main source of tourism revenue, a 4% hotel room tax would also decline. The statistic is available from reputable third-party firms.

Once an appropriate index is identified, the payout structure can be defined. The payout structure should be informed by the review of the government's other risk management tools. For example, experience had taught M-DCPS and its elected officials that it was wise to maintain a reserve to address damage from hurricanes. Hence, the payout structure was designed to trigger only if a hurricane impacted a large portion of the district. M-DCPS assumed that if a hurricane only impacted a smaller portion of the district, then its reserves and traditional indemnity insurance would be adequate. Earlier in this paper, we have also seen how the amount of coverage, size of deductibles, and maximum coverage limits of an existing indemnity insurance program could also influence the amount of parametric insurance that is appropriate for a given situation. Exposure to potential losses that are ineligible for federal assistance could be another consideration.

With that in mind, let's take a look at a fictionalized payout structure for hurricanes in Exhibit 3, which is similar to that used in the market for parametric insurance. Note that Exhibit 3 is just based on the per occurrence limit for the entire jurisdiction. As we described earlier, it is also possible to have different payout structures for different geographic areas within the insured's jurisdiction.

Simulated Experiences

Computer simulations can sometimes supplement or even substitute for historical experiences. Simulations could show the potential impacts future extreme events would have on a local government.

Exhibit 3. Illustration of Parametric Payout Structure for Hurricanes

Term of parametric policy: Three years
Aggregate payout limit: $20 million over the term
Per occurrence limit: $10 million per hurricane

Index Values and Associated Payouts

Wind speed at the insured's location (One minute sustained)	Payout as percent of per occurrence limit
70 mph	5%
80 mph	25%
90 mph	50%
100 mph	75%
110 mph and above	100%

There are some notable features of Exhibit 3. The index values and associated payouts are tiered so that the insured receives larger payouts for more severe events. A tiered policy allows the policy payment to increase with the intensity of the event, which will also correlate to more economic losses.

A tiered payout structure could also provide coverage for less severe events. For instance, a lesser storm could still cause some damage and presumably would be far less likely to receive federal disaster assistance. Finally, there is an aggregate payout limit for the policy. So, for example, if the insured experienced three very severe hurricanes over three years, it could likely receive a smaller total payout across all three than the per-occurrence payout table suggests. This is because the aggregate limit would be met by the combination of the three storms.

The City of Miami Beach wanted to protect against declines in tourism revenue. The policy trigger that was considered was based on "RevPAR." You may recall that RevPAR is an industry standard measure of hotel room revenue. Using RevPAR would capture downturns in tourism caused by any event, not just hurricanes. Let's examine two hypothetical payout structures that are representative of the options considered by Miami Beach. The first structure could be oriented toward offsetting the impact of an extreme event that causes a major disruption to tourism. A policy could trigger if there was a 15% reduction in RevPAR from the preceding year. The payout schedule could be tiered, similar to Exhibit 3. To illustrate, it could start at about $2 million and increase for larger declines in RevPAR, with a maximum payout of $10 million in a year. An annual premium for such a policy might be around $1.15 million. This kind of policy would be sufficient to compensate Miami Beach for a loss in revenue between 15% and 70%.

A second payout structure could stabilize more common but less severe negative variation in tourism revenue. This could feature a tiered payout with an annual limit of $4.25 million if Miami Beach experienced 12 months of lower RevPAR. The annual premium might be $500,000, and the payout structure would be sufficient to cover losses equal to between 5% and 25% of tourism revenues. We'll see what the city decided in the next section.

Examine the Cost-Benefit of the Policy

Once the policy has been defined, it is possible to compare the potential benefit to the cost. In fact, this step can be done almost in parallel with the design of the policy. An important feature of a cost-benefit analysis is that it considers a long-term time horizon. This is because the events that a parametric policy provides coverage against need to be considered over a longer time period to get an accurate sense of their potential impact. For instance, if we looked at just a one-year-ahead time horizon, there is a good chance that government in a region at risk for hurricanes would not experience a hurricane in that year. However, if we looked at a 20-year or 30-year time horizon, for example, there is a good chance that the government would experience at least one event and possibly more. Hence, the longer time period would give a more accurate view of government's exposure and what parametric could do to offset this exposure.

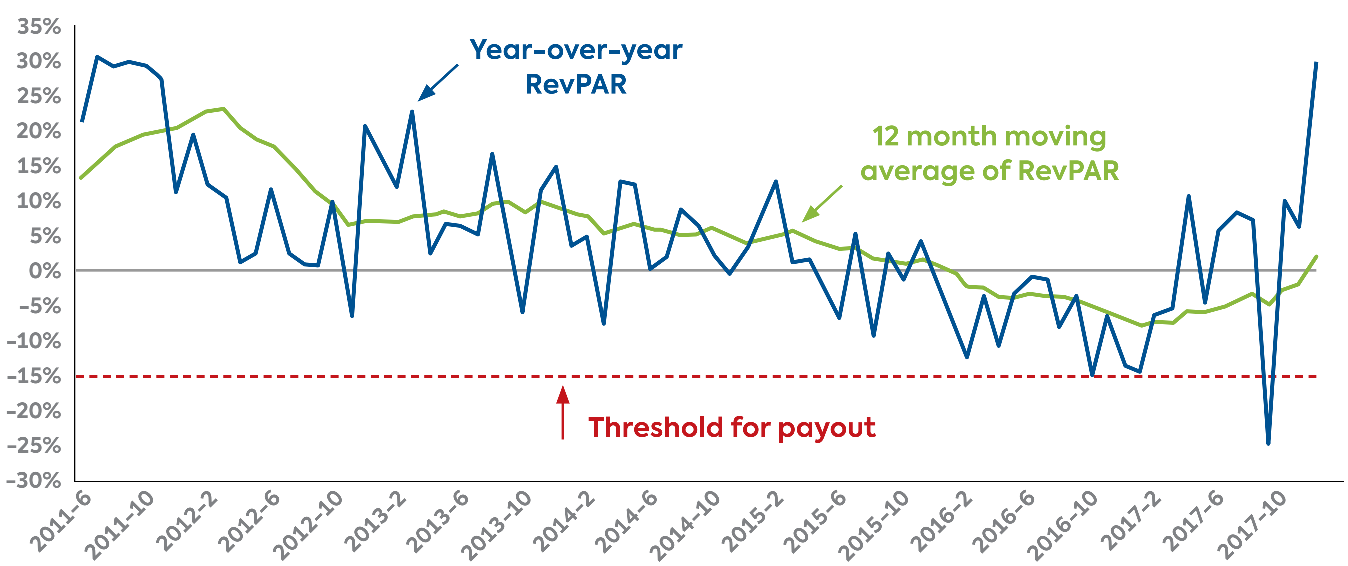
A less critical but useful feature of a cost-benefit analysis is to compare the parametric policy to an alternative course of action. One particularly appropriate course of action might be where the government accumulates the premium payments it would have made in a reserve and essentially "self-insures." Such an analysis should take into account two important advantages parametric policies have over self-insuring through reserves: 1) the parametric policy provides full coverage immediately. Reserves could take years to accumulate to an amount that provides sufficient self-insurance capacity or be replenished after they have been used; and 2) the parametric policy eliminates the political risk of reserves being diverted to purposes other than risk management.

Let's now look at two ways an analysis could be conducted. One common approach is to imagine that the policy had been in place for several years, such as

10, 20, and even longer. Then the premium payments can be compared to the payouts that would have been received given the events that the government actually experienced in its history. The virtue of this "backcasting" method is its simplicity, but it does have disadvantages as well. Starting in the next paragraph, we'll examine backcasting in more detail, including showing how Miami Beach used it to evaluate its potential tourism revenue insurance policy. After that, we will examine the second of our two analytical methods: Monte Carlo simulation. Monte Carlo simulation takes a forward-looking view and thereby avoids the pitfalls of backcasting.

In Exhibit 4, we have an illustration of backcasting of the first hypothetical payout structure we described for Miami Beach, where a 15% reduction in RevPAR would trigger a payout.* Exhibit 4 shows both the year-over-year changes in RevPAR and a 12-month moving average (i.e., the average RevPAR for the preceding 12 months). The policy the city was considering was based on annual RevPAR. We can see that the payout line was not crossed once by the annual moving average line, during the period shown on the graph. It was only crossed twice by the monthly line. Assuming the policy had been in place for all seven years, this would have resulted in no payouts compared to about $7.5 million in total premiums paid. One important thing Miami Beach learned from this analysis is that RevPAR (and, hence, the city's tourism revenue) tends to bounce back relatively quickly from the downturns. It is human tendency to vividly remember high-point and low-point experiences and for those to color how we judge a situation. Therefore, it would be natural for people in the Miami Beach city government to vividly recall the drop (e.g., the month where RevPAR went below the red line) but have a vaguer recollection of the return to normal. This means people might overestimate how frequently revenue declines happen and how long they last. The analysis helped Miami Beach get a clearer sense of the historical behavior of its revenue. Ultimately, Miami Beach decided that the parametric insurance product did not represent a sufficient value and decided to build up a larger reserve to protect against tourism tax volatility. It did, however, investigate a separate parametric policy for hurricane damage and did purchase that policy.

Exhibit 4. Backcasting Analysis for Miami Beach



* Note that some of the elements of this exhibit have been adjusted by GFOA, but the results are roughly similar to the analysis actually conducted by the City of Miami Beach.

Though backcasting does have the virtue of considering a long-term time horizon, the drawback is that there is an implicit assumption that a local government's history represents a complete range of the possibilities that it might experience and discounts the possibility of worse events in the future. Psychological research has shown that human beings are systematically prone to severely underestimate future volatility.[6] Historical data is certainly an important analytical tool, but it could serve to aggravate our inborn tendency to underestimate future volatility by anchoring us in the events of the past.[7] For instance, imagine a local government performed a backcasting analysis in 2006 to assess its vulnerability to economic downturns. It would have found itself unprepared for what came soon after. In another example, GFOA assisted the City of Colorado Springs, Colorado, to assess its financial risks to extreme events, including wildfires. The city had just experienced the worst wildfire in Colorado's history. GFOA knew that this fire did not necessarily represent the worst possible wildfire, so GFOA augmented the city's expectation for the size of future fires. This was fortunate because shortly after GFOA finished its analysis, the city experienced the new largest wildfire in Colorado history.

An alternative to backcasting that resolves this disadvantage is Monte Carlo simulation. Monte Carlo uses past history (or other data about the likelihood and potential magnitude of extreme events) to create a range of future possibilities. This range allows for the possibility of events more extreme than has actually occurred in the past. The simulation then produces thousands of possible scenarios of what the future might look like based on the assumed likelihood and potential magnitude of extreme events. The analyst can then find out how often scenarios occur that meet a given condition, such as how often the payouts received from a parametric policy outweigh the premiums paid over a long-term time period. No policy will ever pay out more than it costs in most scenarios. (Or if it does, the insurer will probably not last long!) A good simulation model could also account for the other advantages of parametric insurance, such as the ability to provide full coverage immediately (as opposed to building up and internal reserve) and decreased vulnerability to political risk, compared to an internal reserve. Hence, a local government will have to decide if the probability on an offer of receiving a net financial benefit from the policy is worth the other benefits of parametric insurance (e.g., full coverage on day one, eliminating the political risk of reserves, etc.). A fuller explanation of how to perform a Monte Carlo analysis is beyond the scope of this paper, but GFOA has published many other resources that describe Monte Carlo in more detail, including how to access open source analytical tools that require nothing more than Microsoft Excel.[8]

Commit to a Long-term Strategy

Just as the cost-benefit analysis period needs to be long term, the purchasing strategy for parametric needs to be long term. Without a long-term strategy, a government risks making suboptimal purchasing decisions. For example, one common decision-making error is called "recency bias," where more recent events are overweighted in decision-making and less recent events are underweighted. This can be seen with residential flood insurance, where more people purchase flood insurance in the immediate aftermath of a flood. But after a few years, the number of people who have retained the insurance declines—even though the risk of flood may be no different. One of the insurance brokers we interviewed shared a story about a client that illustrates the pitfalls of recency bias. This client was facing a "hard" insurance market (policies were more expensive). Therefore, the client decided to self-insure with a reserve and save themselves the higher premium costs. However, the client then experienced some sizable losses and had a significant decline in its reserves. This motivated the client to go back to buying insurance, despite the new, higher prices on policies. The client then went for several years paying higher premiums while experiencing no further losses! If the client had stayed its original course, it would have been much better off because it would have built its self-insurance reserve back up.

Of course, committing to a long-term strategy is easier said than done. For example, M-DCPS was faced with a hardening market for its traditional indemnity insurance. As the price of the indemnity policies went up, the parametric insurance policy no longer fit within district's budget for insurance. To make the case for a consistent parametric strategy, Utah has stressed the value of parametric for replacing lost revenue, the role of parametric insurance in the state government's larger insurance program, and the value of parametric insurance for preparing the state to recover from high-impact earthquakes. Of course, if the government develops a history of receiving payouts from parametric policies, the case for retaining the policy will be that much easier to make.

CONCLUSION

Parametric insurance can supplement a government's traditional financial risk management tools of reserves and indemnity-based insurance. This is a potentially valuable financial instrument given the increasing volatility and uncertainty that many governments face. We will conclude this paper by reviewing the advantages and disadvantages of parametric insurance.

First, let's review the advantages of parametric relative to other risk management tools in the table below.

Versus Reserves
Immediate coverage. Reserves must be built up over time.
Mitigate political risk. Politics could lead large reserves to be redirected to purposes other than risk management.
Versus Indemnity-based Insurance
Streamlined claims. Straight-forward and transparent claims submission and review process, resulting in faster claims.
Broader protection against impacts of an extreme event. Payouts are based on the event itself, not damage to a particular asset. Hence, coverage is provided for costs that are not related to any particular asset or for damage to an asset not covered by indemnity policies.
Can address entirely different risk categories. Parametric policies can be designed to cover risks for which traditional indemnity insurance is simply unavailable.
May have price advantages. Parametric policies may now enjoy some price advantages that make it a better value than traditional indemnity insurance, in some cases.
Versus Indemnity-based Insurance
Much faster payout. Parametric typically pays out in about 30 days. Federal assistance may take months or even years to materialize.
More flexible use of funds. Parametric proceeds can be used to cover any loss. Some types of losses are ineligible for federal assistance.
Contractual obligation. A parametric insurance policy is a contractual agreement to provide a given amount of money under well-defined circumstances. Eligibility for federal government assistance is not as well defined. For example, there is some subjectivity involved in whether the U.S. President will declare a given area an emergency in the aftermath of an event.

> Optimizing the use of parametric insurance necessitates a savvy long-term perspective.

Parametric insurance policies are, of course, not without their disadvantages. The most important potential pitfall is basis risk, or the potential for a mismatch between the losses experienced by the insured and the coverage provided by the policy. An indemnity policy on a building will usually have less potential for basis risk, if the goal is just to protect against building damage. Of course, governments usually have more concerns than just building damage, so minimizing basis risk requires thoughtful selection of the geographic coverage of the policy and the policy index.

Parametric policies also have some disadvantages relative to reserves. First, parametric policies are not as flexible. Reserves can be used to respond to virtually any loss the local government experiences. A parametric policy has to be built around some particular type of loss (e.g., hurricanes, earthquakes, tourism revenue, etc.). Furthermore, if a government has a strong reserve policy and the discipline to stick to the policy, then it has minimized the political risk of reserves being redirected to uses besides risk management. Eliminating political risk is one of the major advantages of parametric over reserves.

Finally, optimizing the use of parametric insurance necessitates a savvy long-term perspective. This is not to say that parametric insurance requires a savvy long-term perspective to be of any value, but a government needs this outlook to get the most out of the policy.

In closing, parametric insurance presents an opportunity for governments to better manage their risk and provide continuity of important public services through adverse circumstances. Like any tool, parametric is not a fit for every situation or for every government, but there are many situations where parametric insurance could be a valuable part of a government's risk management tool set.

ENDNOTES

[1] Information and exhibit on trends in disasters are from: Vera Brusentsev and Wayne Vroman. "Disasters in the United States: Frequency, Costs, and Compensation." W.E. Upjohn Institute for Employment Research. 2017.

[2] See: Shayne C. Kavanagh. "A Risk-Based Analysis of General Fund Reserve Requirements." Government Finance Officers Association. 2013. GFOA has also developed probabilistic methods based on techniques developed by probabilitymanagement.org.

[3] Shayne Kavanagh and Elizabeth Fu. "Last Line of Financial Defense? Internal Loans in Emergency Situations." *Government Finance Review*. December 2019. (Vol. 35 No. 6)

[4] http://www.mbrisingabove.com/your-city-at-work/resilience-strategy/resilient-305/

[5] www.investopedia.com

[6] This is called the "overconfidence bias." For example, research has found that people underestimate the range of unknown future possibilities by about 50%, compared to the range that a statistical analysis would produce.

[7] This is called the "anchoring bias."

[8] See for example: Sam L. Savage and Shayne Kavanagh. "Probability Management in Financial Planning." *Government Finance Review*. February 2014.

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