The Economics of Sovereign Insurance in Low- and Middle-Income Countries

Michael R. Carter, *University of California-Davis*

Marcos M. Sugastti, *University of California-Davis*

April 2024

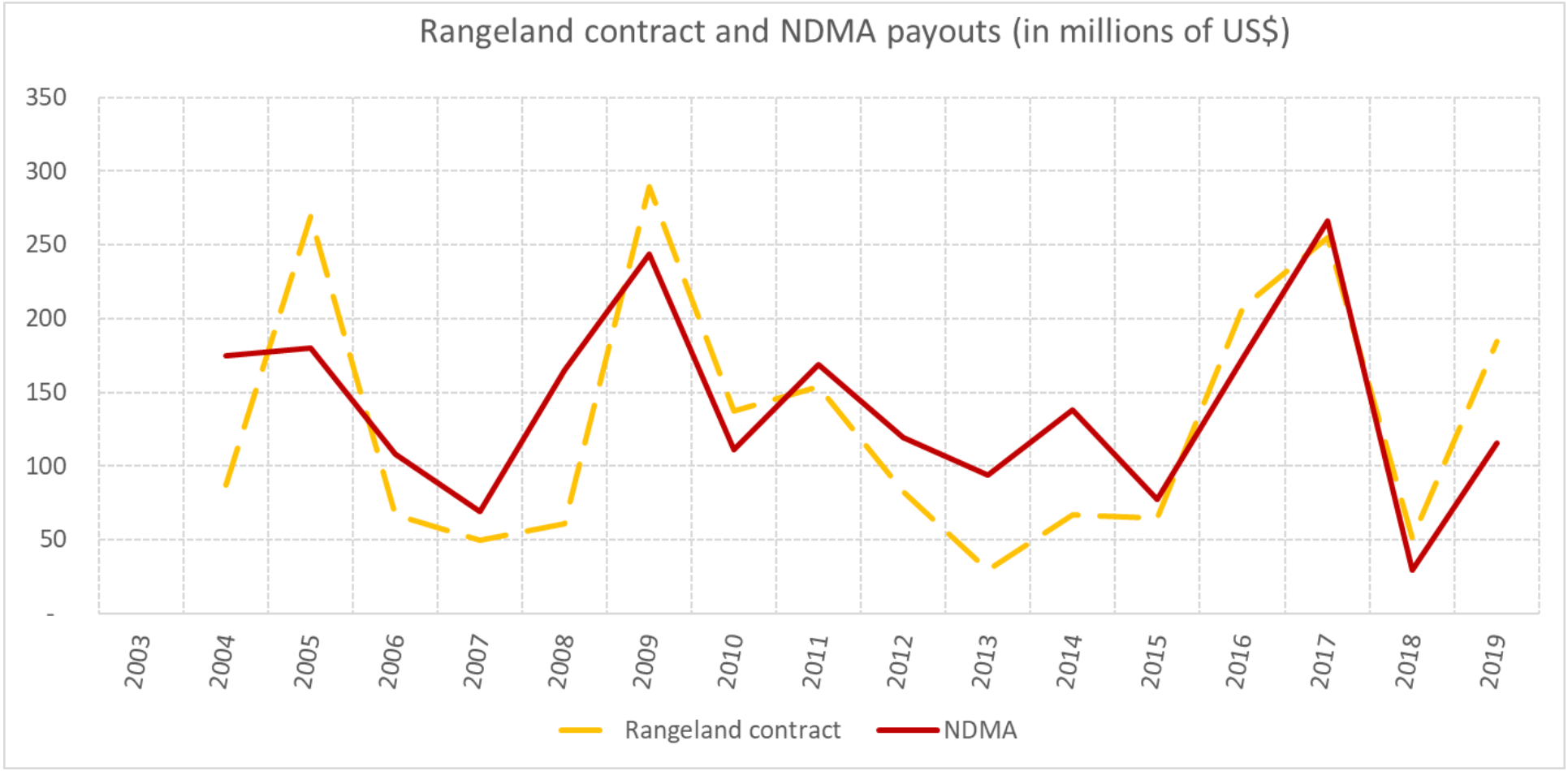
Disaster risk financing and social protection

- Climate-related shocks will worsen with climate change, both in terms of frequency and intensity
  - Poor and near-poor people are more exposed to and often more vulnerable to natural hazards, partly due to the quality and type of assets they own
- Governments have access to various disaster risk financing instruments:
  - Budgetary tools: contingency or reserve funds
  - Market-based risk-transfer solutions: insurance
  - Lines of contingent credit, ex post sovereign borrowing
- Recommendation is to combine different instruments using a risk-layering approach (Clarke *et al.*, 2017)
  - Consider the fixed and opportunity costs of the various instruments, then use each instrument until exhausted before engaging the next one
  - The presence of basis risk (systematic patterns of failure of parametric insurance products) complicates this cost calculation

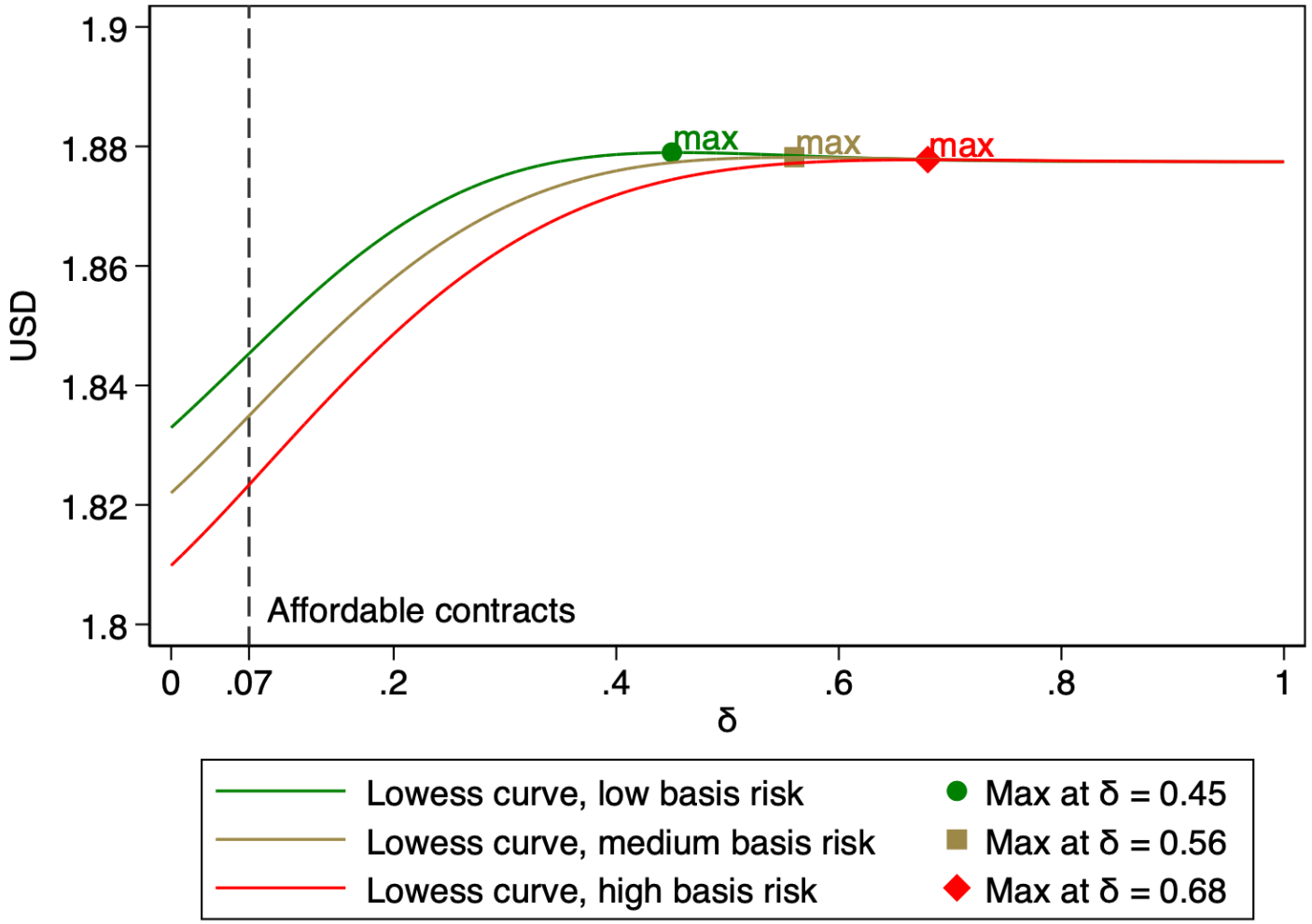
Motivating example: Droughts in Kenya

- In Northern Kenya, a large share of the population depends on pastoralism, meaning their livelihood is intertwined with their existing cattle stock
- The region faces extreme weather patterns, from droughts to flash floods
  - Long rains (March - May)
  - Short rains (October - December)
- Droughts are challenging for pastoralists since animals die or become malnourished and therefore low value when household budgets come under pressure
- Government faces the challenge to provide some form of social protection during these covariate shocks, possibly through income support
- From a public finance perspective, when does it make sense for the government to purchase sovereign index insurance?
  - For now, we focus on comparing it to reserve funds as an alternative policy

Motivating example: Basis risk under sovereign parametric insurance contract

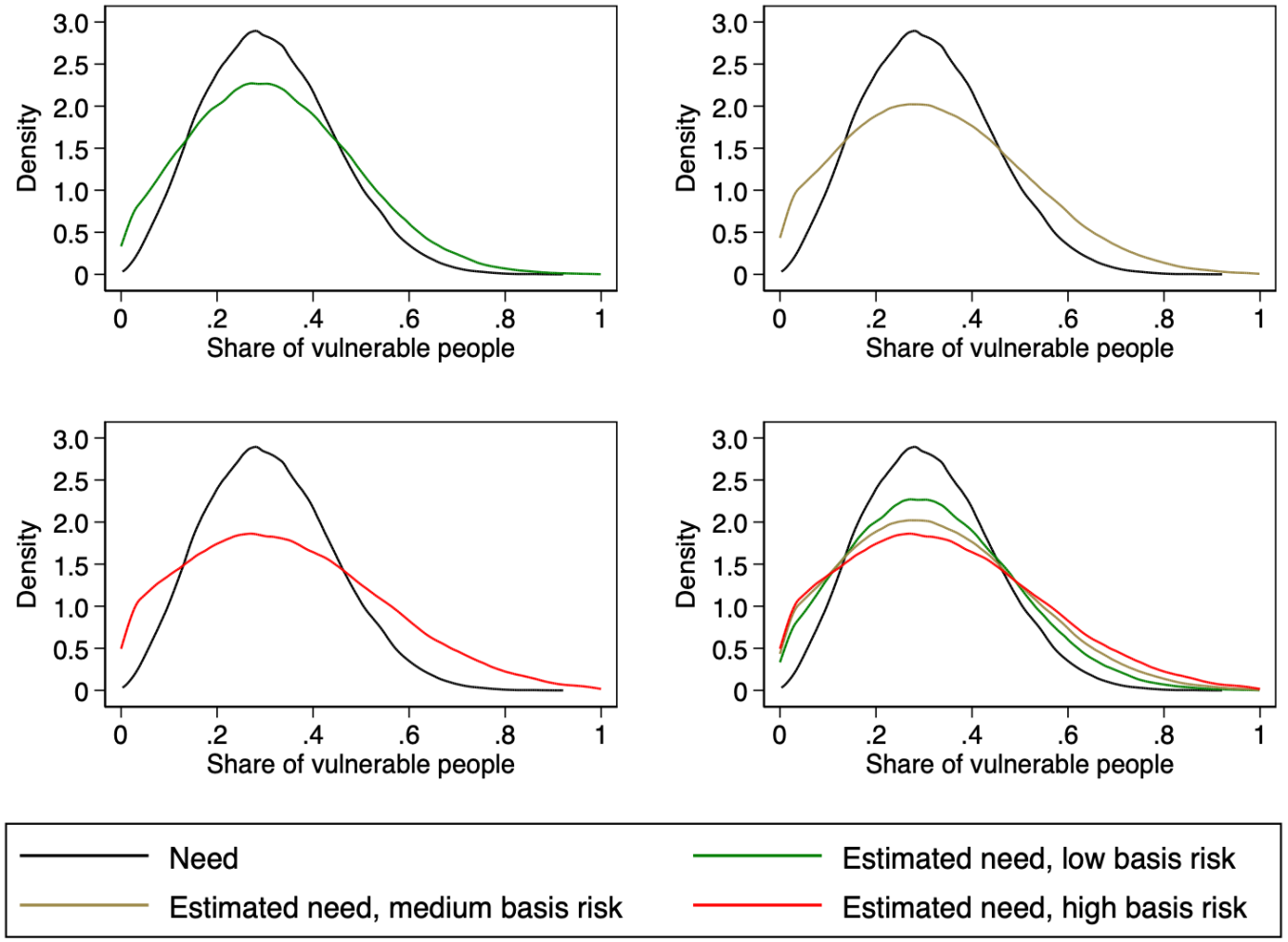


Preview of results: certainty equivalents



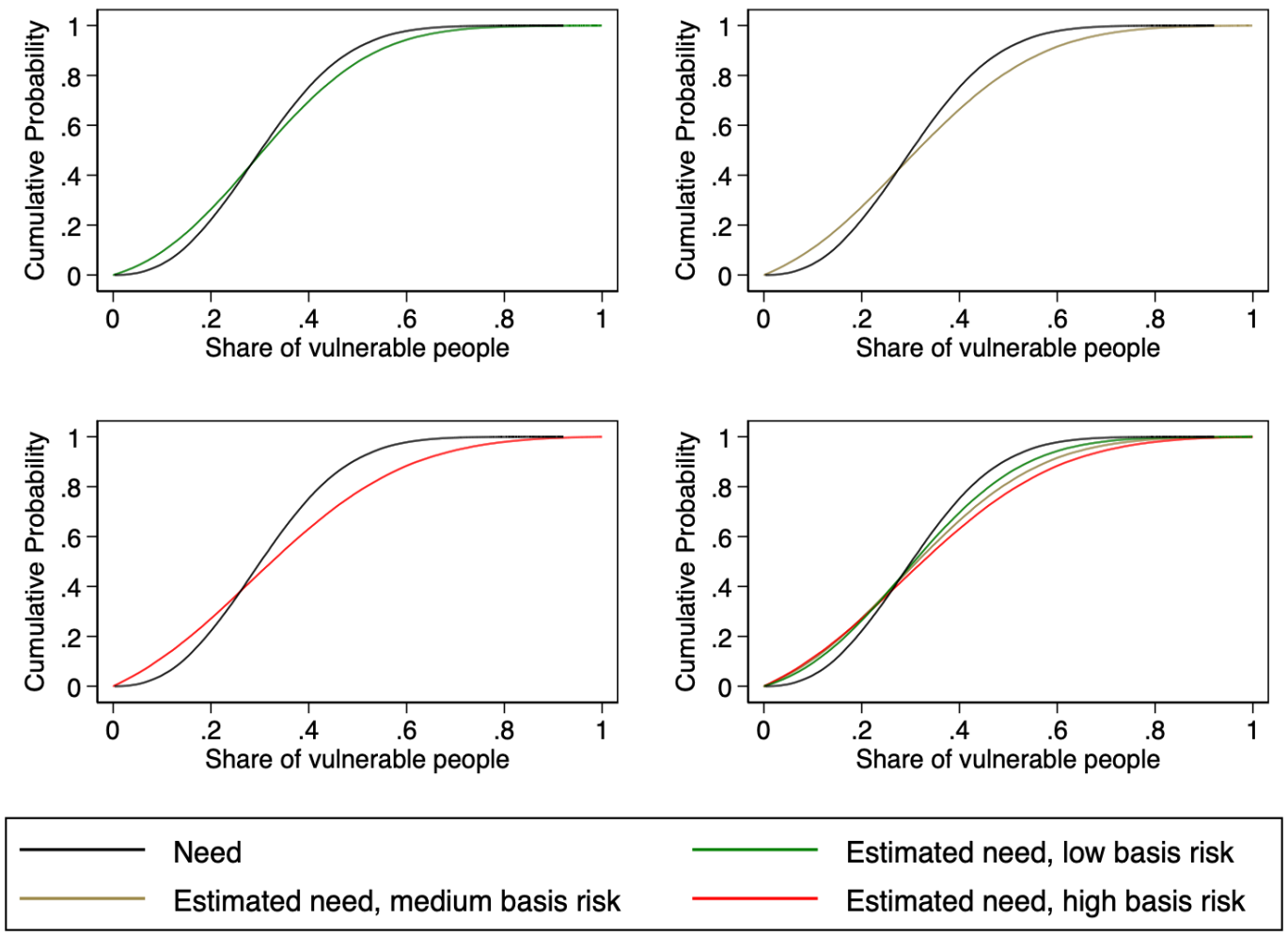
- Consider that vulnerable people start at the $1.90 a day poverty line
- A drought shock makes their budget drop to $1.40 a day
- Optimal disaster risk finance policy can bring them close to their initial state
- Results seem only somewhat sensitive to basis risk

True need and need estimations



- We simulate true need following a Weibull distribution that matches the Kenya data
- We simulate need estimations as true need + an error term to reflect imprecision in estimations
- Error terms are distributed normal with different variances to represent different levels of basis risk

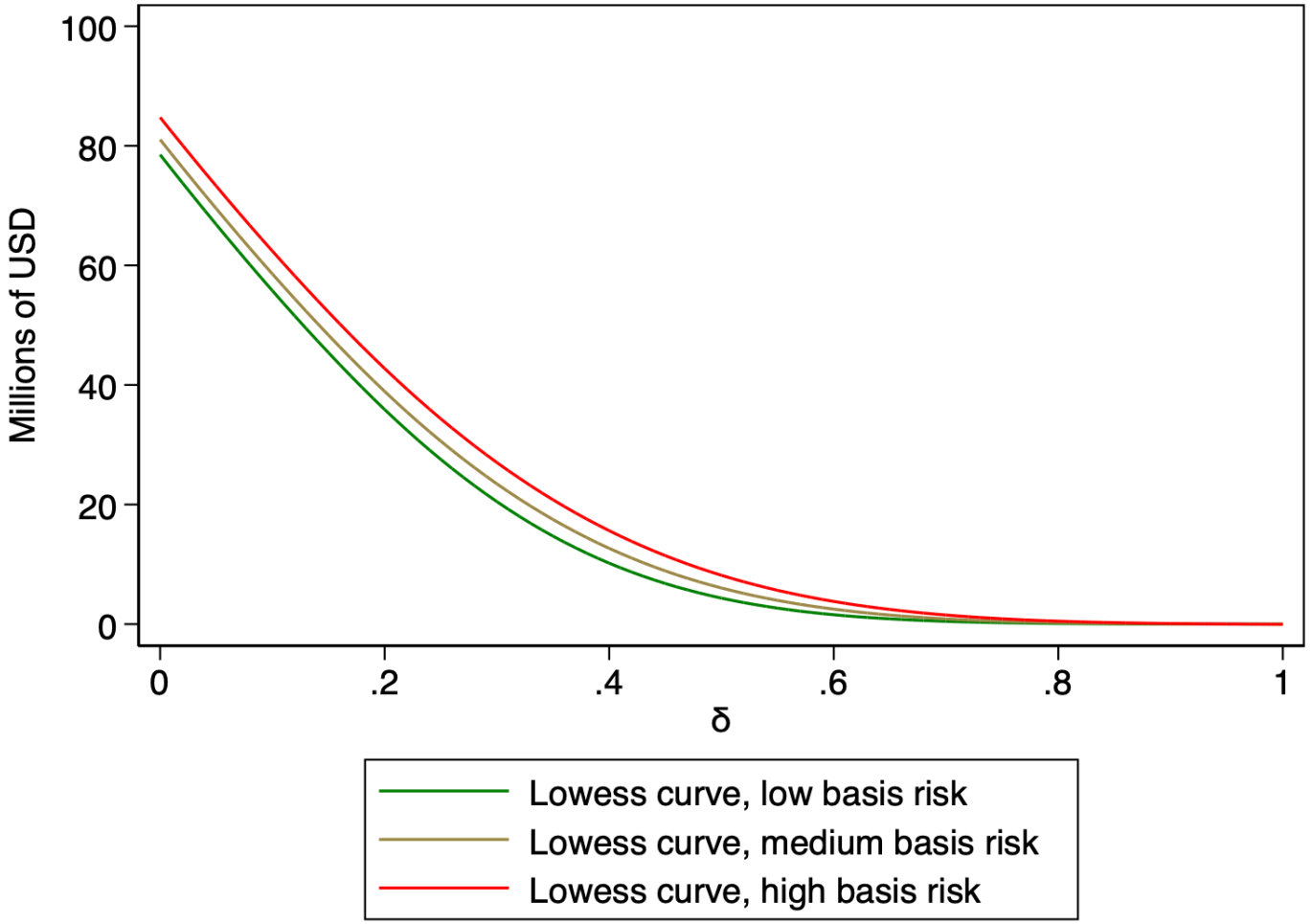
True need and need estimations



- We simulate true need following a Weibull distribution that matches the Kenya data
- We simulate need estimations as true need + an error term to reflect imprecision in estimations
- Error terms are distributed normal with different variances to represent different levels of basis risk

Insurance contracts available

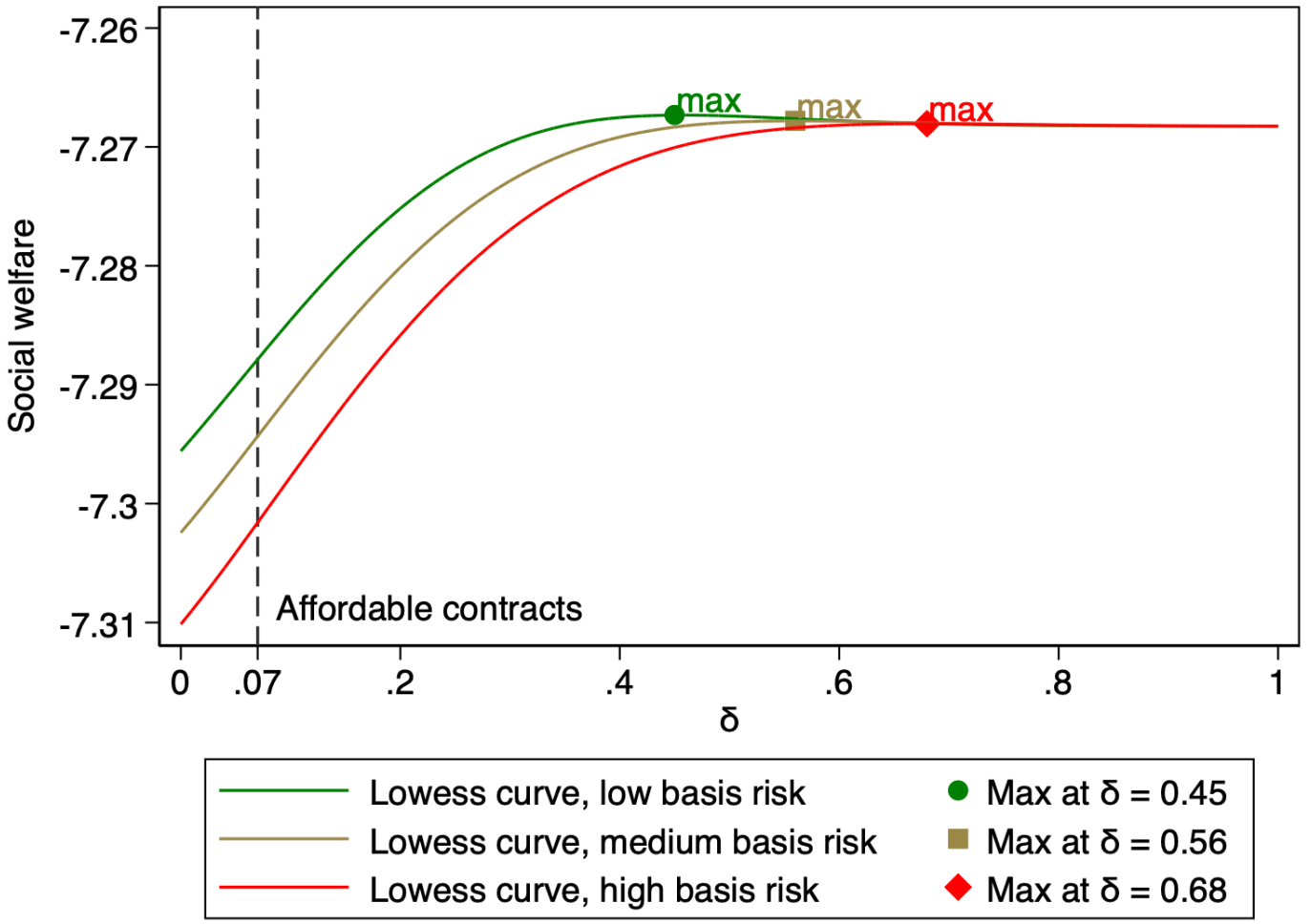
- We characterize different insurance contracts by their deductible $\delta \in [0, 1]$.
- For each contract, the indemnity payment for a given period equals: $\max[\text{Estimated Need} - \delta * \text{Maximum Need}, 0]$.
- Figure shows actuarially fair premiums for all possible contracts, marked up by 10%.



Government's problem: Maximizing social welfare within a fixed social protection budget

- Government lacks the flexibility to expand its budget when the number of poor people increases due to stochastic factors, meaning it might not get to cover the entirety of the social protection need in each period
- Government covers the social protection need using two instruments on which it wholly spends its budget: ex ante budget allocation (reserve fund) and insurance
  - Available budget is the size of the average historical need
  - Choice of contract fully determines the amount set aside as a reserve fund
- An index insurance contract passes the quality standard if offers higher social welfare than a no-insurance policy with the same total budget
  - Insurance may or may not improve performance, depending on its pattern of failure
- Government chooses optimal contract based on the δ that maximizes social welfare

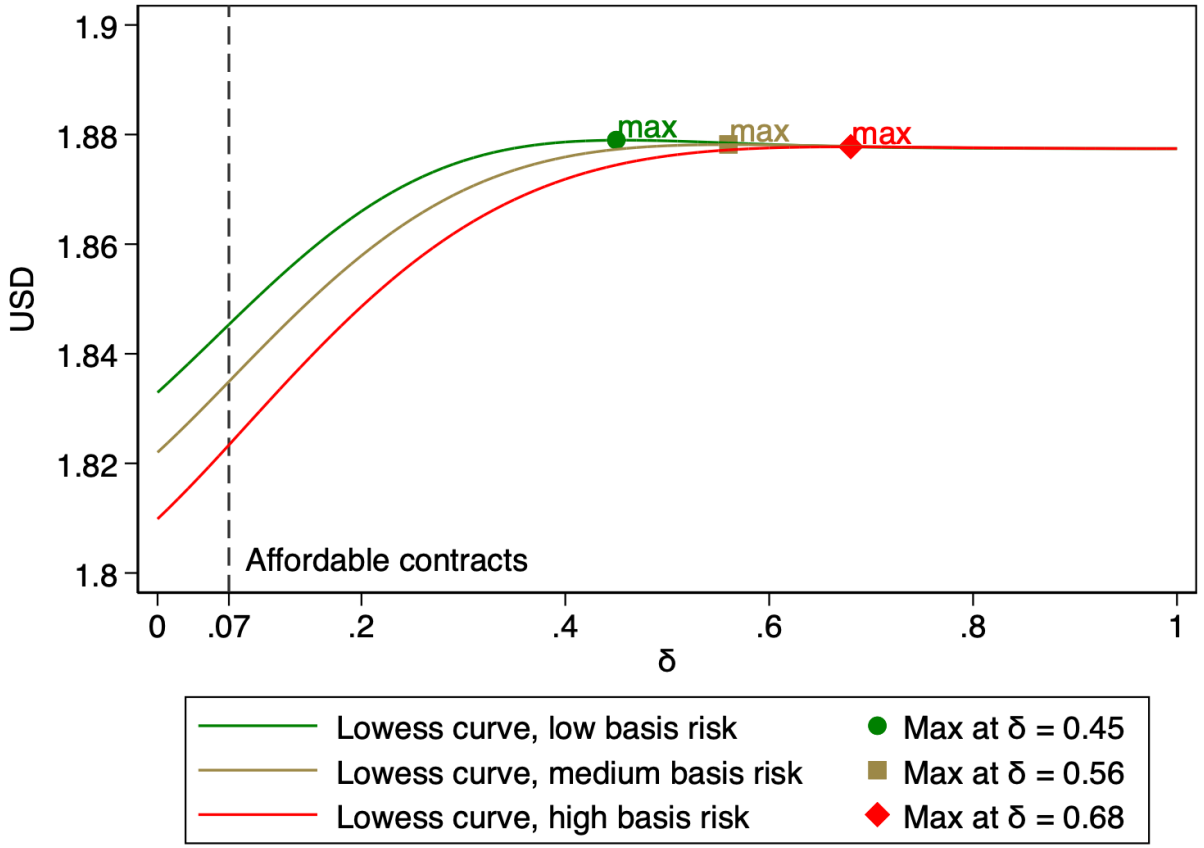
Results: social welfare

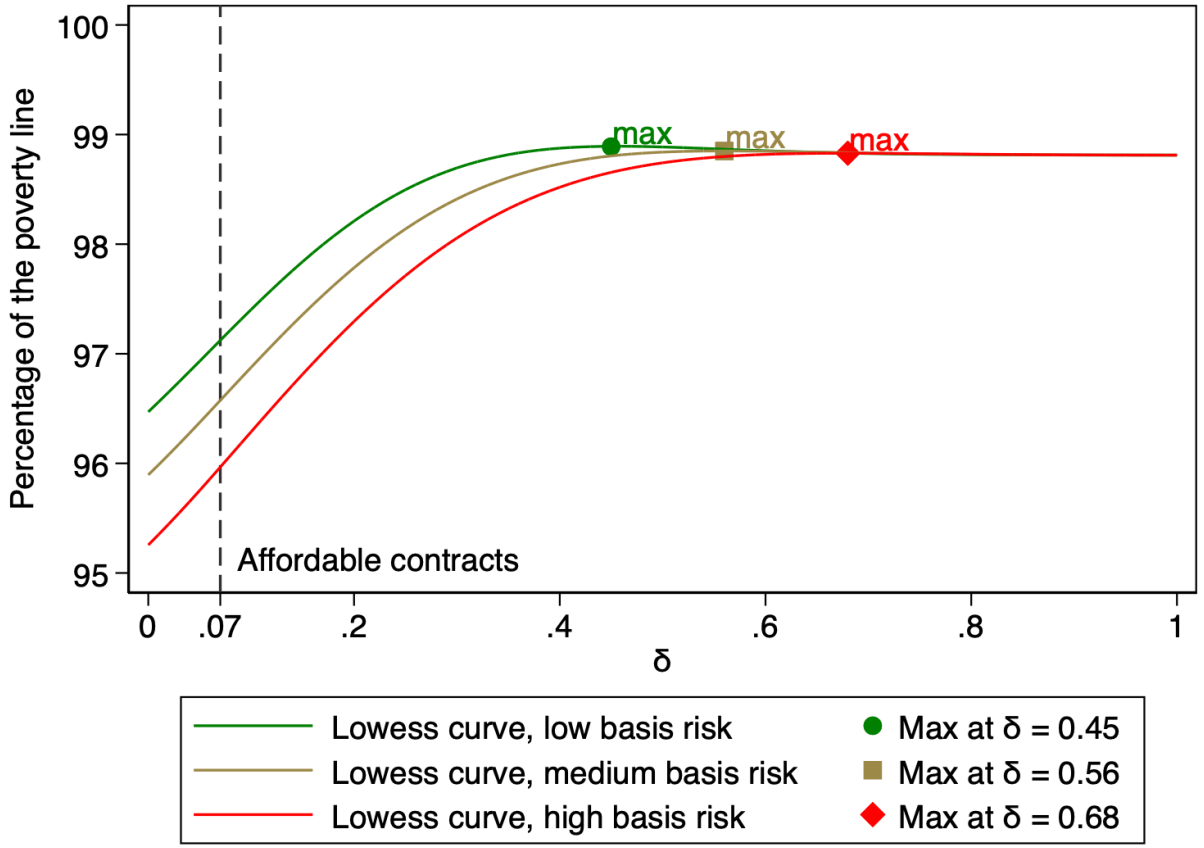


10% markup

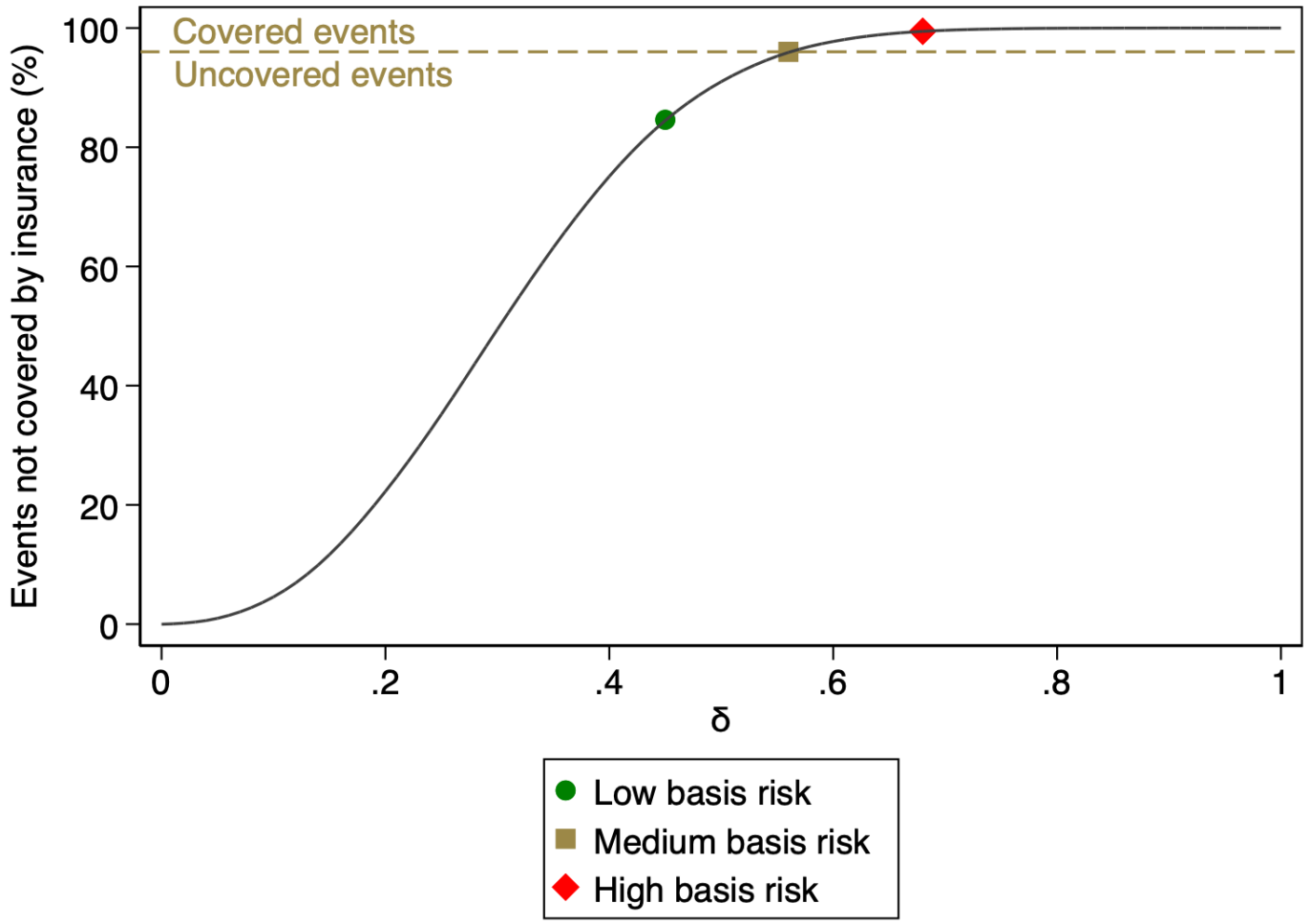
- For the medium basis risk case, the optimal contract the government can choose covers all shocks estimated to hit at least 56% of the vulnerable population
- The reserve fund (initial budget minus contract premium) is available to help address the need not covered by indemnity payments

Results: certainty equivalents





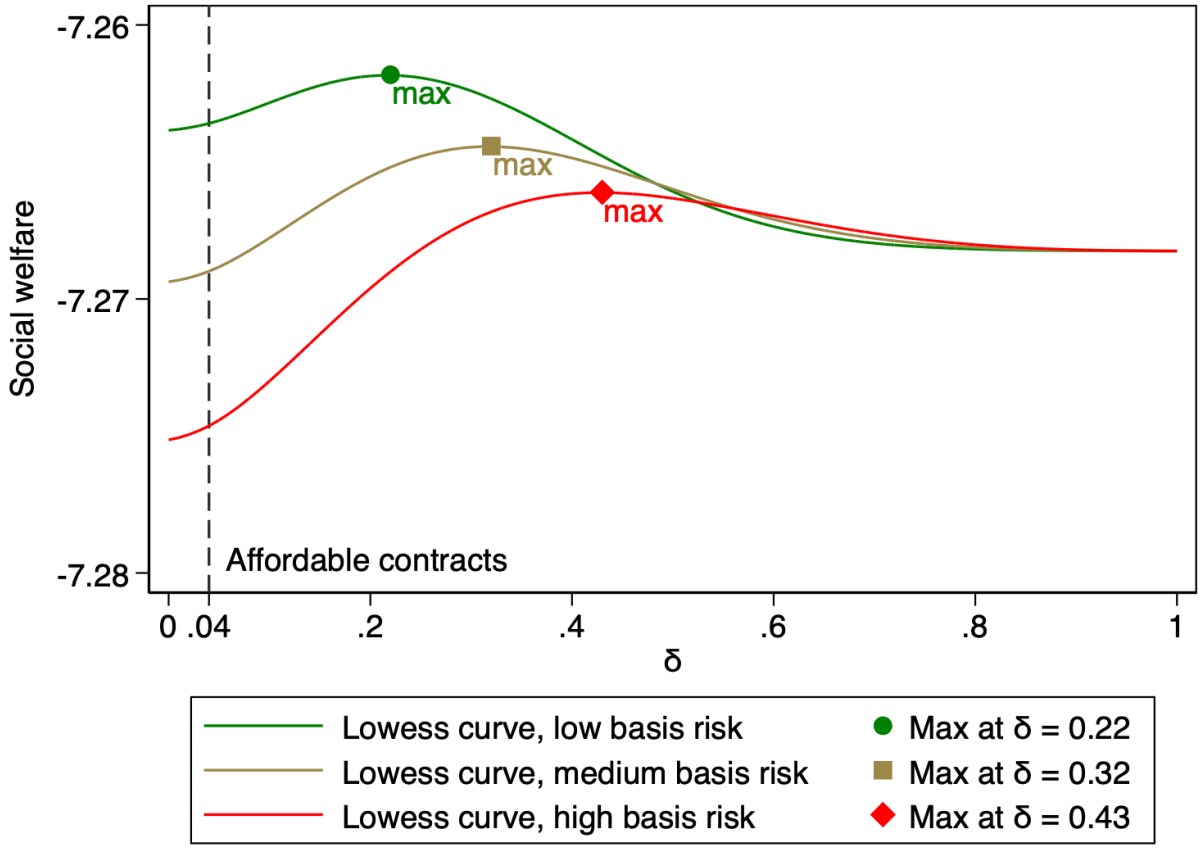
Results: events not covered by insurance



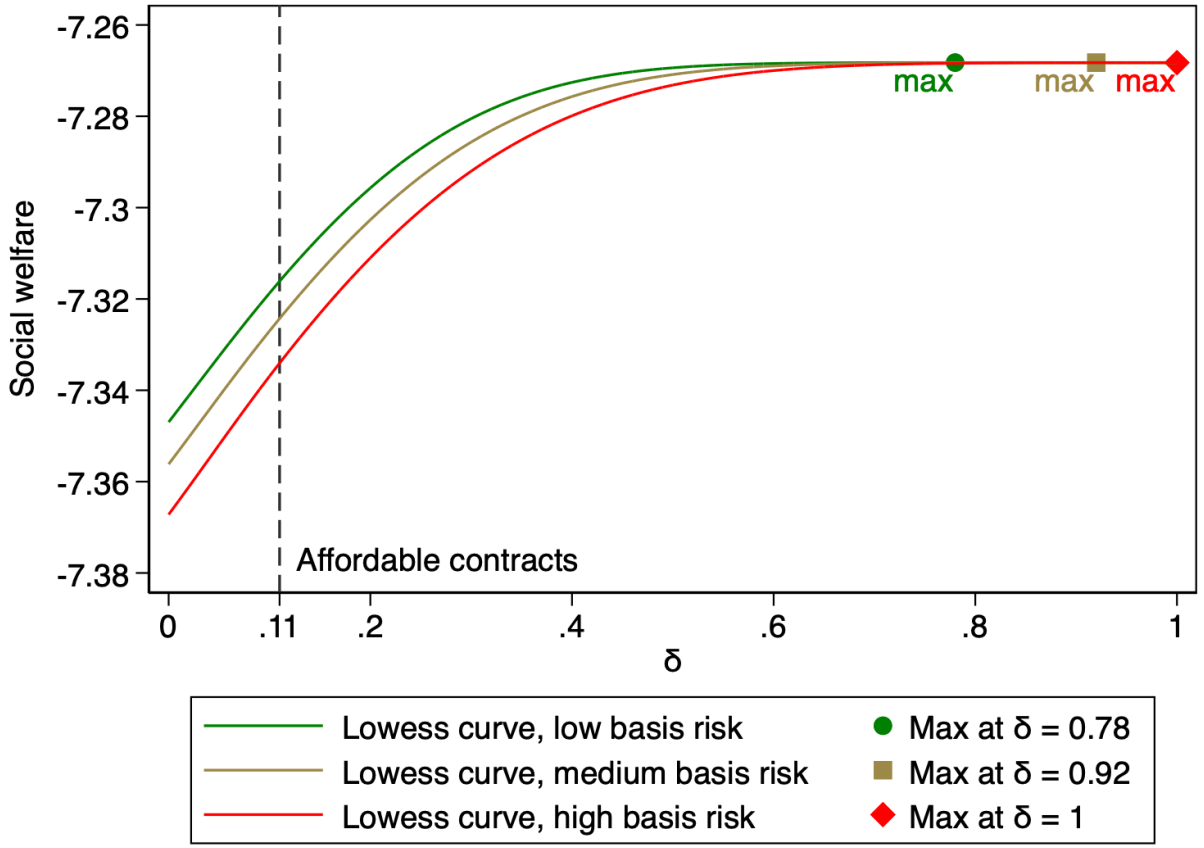
10% markup

- Under the optimal contract, insurance would end up covering only very low probability events
- Shocks that hit at least 56% of the vulnerable population correspond to the top 4% worst events
- Coverage via insurance seems more sensitive to basis risk

Social welfare under alternative markups

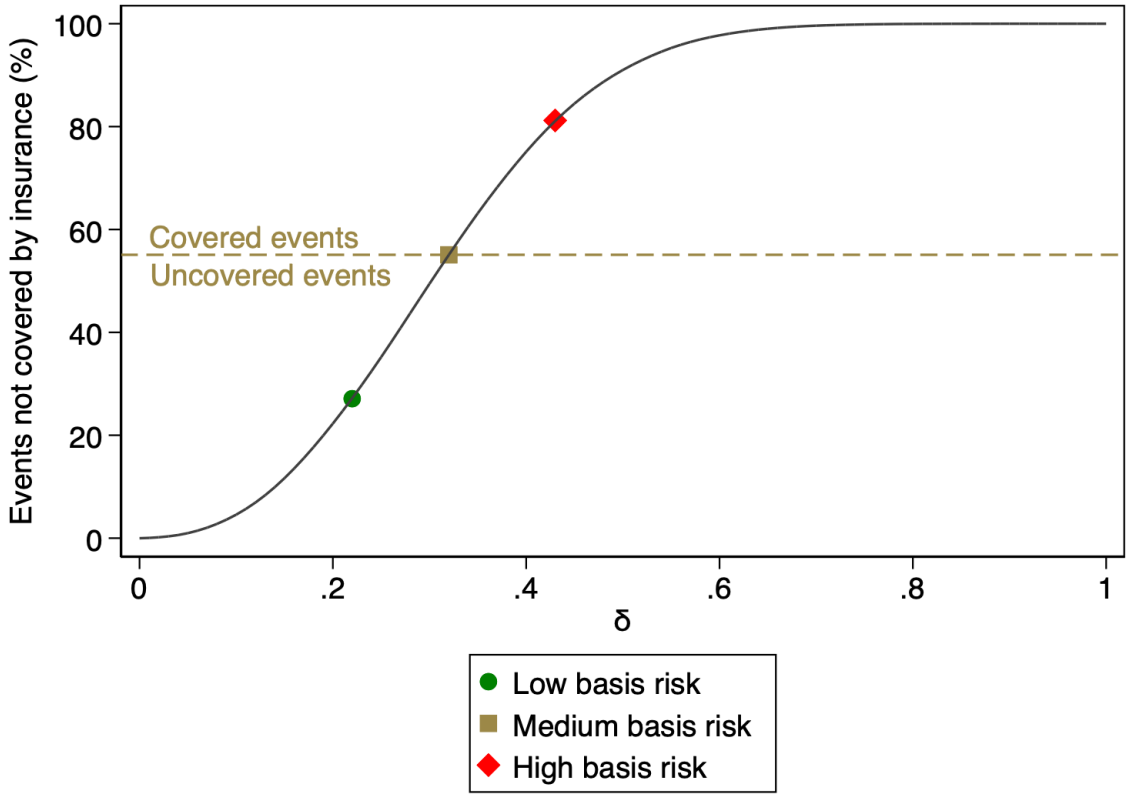


No markup

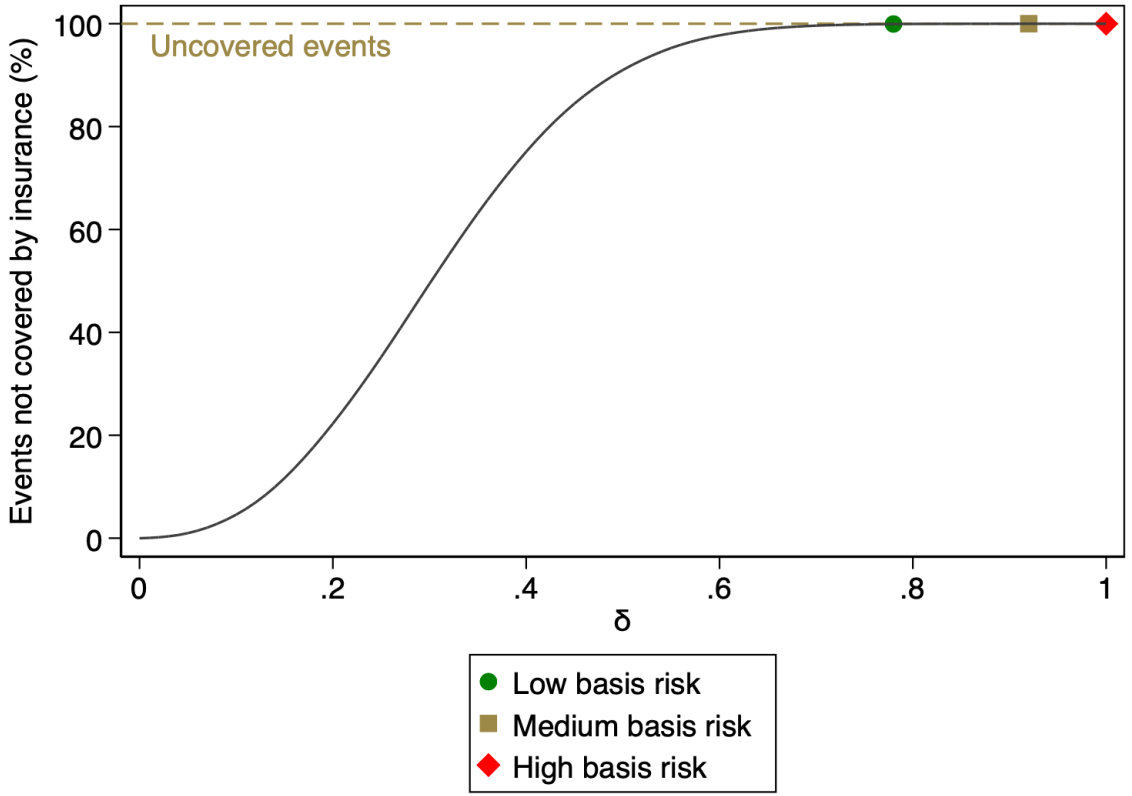


25% markup

Events not covered by insurance under alternative markups



No markup



25% markup

Summary of results

Markup	Basis risk level	Optimal δ	Social welfare	CE	$\frac{CE}{\bar{y}}$	Uncovered events (%)
0%	Low	0.22	-7.2618165	1.8963	0.9980	27.11
	Medium	0.32	-7.26442	1.8950	0.9973	55.08
	High	0.43	-7.2661085	1.8941	0.9968	81.19
10%	Low	0.45	-7.267313	1.8934	0.9965	84.61
	Medium	0.56	-7.267806	1.8932	0.9964	96.01
	High	0.68	-7.2680485	1.8931	0.9963	99.46
25%	Low	0.78	-7.2682415	1.8930	0.9963	99.94
	Medium	0.92	-7.2682485	1.8930	0.9963	100
	High	1	-7.268249	1.8930	0.9963	100

Final remarks

- Given the government's goal to maximize the economic well-being of the target population subject to its fiscal constraint, we use a metric to show that sovereign index insurance can offer value over a government self-financing strategy
  - Reliance on this product depends on the reliability of the underlying parametric index
  - Government's financing strategy can be highly sensitive to markup rates
  - We are investigating how results may change when the government considers further instruments such as lines of contingent credit
- Finance is only part of the picture, but it is an important one to think about
  - Well-functioning disaster risk management systems also depend on the quality of program design, delivery, data and information, and institutional arrangements
  - Still, many low- and middle-income countries lack established funding mechanisms for reliable and predictable disaster response via social protection
  - Macro- and micro-level insurance instruments can be linked to offer customizable support to the target population

Thank you!

marcosms@ucdavis.edu