Emerging Lessons from Innovation in Catastrophic Weather Insurance to Improve the Livelihoods of Rural Households

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Presentation
Bill and Melinda Gates Foundation
Seattle, Washington
September 21, 2009

Recasting the Farm Household Risk Problem

Brian Wright raises the following question:

Why is government so heavily involved with agricultural insurance?

Wright argues that the literature on agricultural insurance has focused on smoothing income from a single crop in a single crop year with strong assumptions about risk aversion

One gets different policy prescriptions when the problem is recast as smoothing consumption over time. Protection of assets that can be used to generate future income and risk models that are more focused on safety first become more critical in developing countries

Key Themes

1. Weather index insurance should be about *ex ante* financing and improving the way stakeholders pay for catastrophic losses (this can include market and gov't solutions)
2. Index insurance is best suited for consequential losses
3. One-off weather insurance for small households may not be a scalable model
4. Insurance that addresses weather risk of firms that serve the poor (risk aggregators) should provide the most opportunity given limitations of providing weather insurance directly to small holders
5. Solutions that involve public-private partnerships must clearly distinguish the role for markets and the role for government; understanding cognitive failure for extreme risk can help

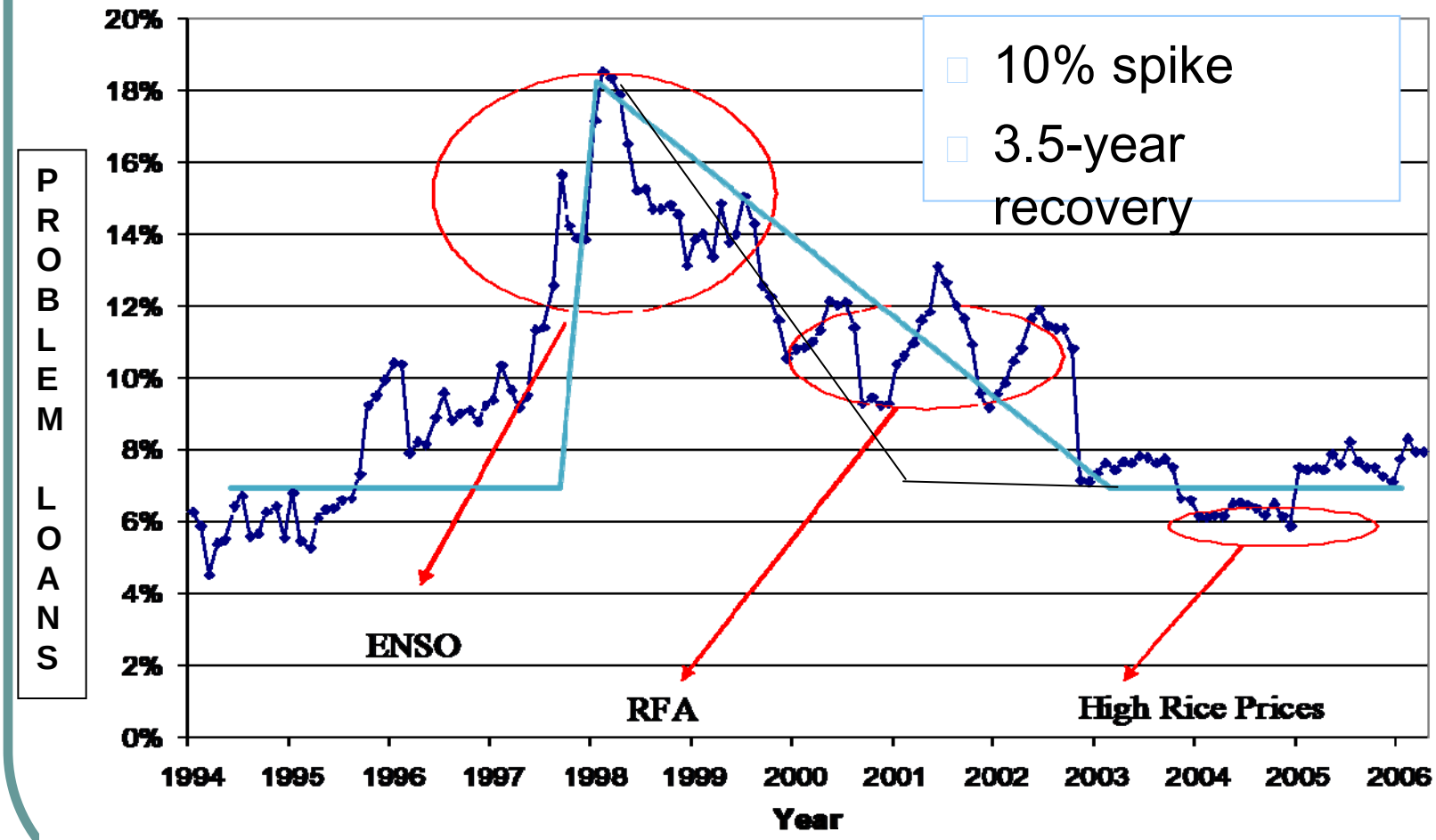
Somebody Pays for Catastrophic Natural Disaster Risk
Who? How?

- The poor pay
- Financial institutions restrict services as they learn that the correlated losses of many of their borrowers and savers create significant banking problems
- Governments seek solutions — disaster assistance, infrastructure investments, subsidized agricultural insurance
- Donors forgive debt and provide funds for recovery

The Poor Pay
Poverty Traps Created by Severe Events

- Rapid onset shocks can knock households below a minimum asset threshold, and result in locking them into a poverty trap
- Slow onset shocks can also result in poverty traps depending on the coping strategies available to and chosen by households
- Households sell assets to maintain minimum levels of consumption — This in turn reduces future streams of income
- Households reduce consumption to protect assets — This can impact the human capital needed to generate future income streams

Lenders Pay
1997–1998 El Niño Spike and Recovery



With this event every 1 in 15 years, 300 basis points must be added

Lenders Pay
Default Risk Significantly Affects Interest Rates!

$$\pi = p(1+i)L - (1+r)L \qquad i = \frac{1+r}{p} - 1$$

π – Expected profits
p – Exogenous probability of non-default
i – Interest rate
r – Lender's opportunity costs
L – Amount of funds loaned

Example (No default risk)
r = 10%
p = 100%

$$i = \frac{1+0.10}{1} - 1 = 0.10$$

Example (10% default risk)
r = 10%
p = 90%

$$i = \frac{1+0.10}{0.90} - 1 = 0.22$$

Governments Pay

- Disaster relief
- Infrastructure repairs
- Debt forgiveness
- Global discussion and actions on subsidized agricultural insurance complicate every attempt to make progress with weather insurance markets in developing countries
- A larger public policy discussion must frame every effort that attempts to create markets for weather risk catastrophes

Donors Pay
Development Banks, NGOs, Private Donors

- Debt forgiveness from donor banks
- NGO responses
- Private donor responses

Impossible to coordinate the myriad of responses

Highly likely that these institutions and responses will work at cross purposes

Index Insurance Is about Weather Risk, not Crop Risk

- More critical thinking is needed about how small holders pay for extreme weather risk. What are the consequential losses?
- Recasting weather index insurance as insurance against consequential losses rather than crop insurance has many positive dimensions
- Weather insurance is about a disruptive weather event

More on Consequences of Catastrophic Natural Disaster Risk for the Poor

- Catastrophic weather disrupts livelihoods (*Ex post* impacts)
  - Crops
  - Livestock (distressed sales / lower prices)
  - Off-farm income (E.g., working on another farm, etc.)
  - Local food costs may increase
- Risk of catastrophic weather (*Ex ante* impacts)
  - Low-risk, low-return livelihood strategies
  - Limited access to credit
  - Reduced investment
    - Durable productive assets
    - Less fertilizer use
    - Failure to adopt new technology
    - Less likely to use enhanced seed varieties

Consequential Losses from Natural Disaster
Data Come via Risk Assessment

- Ethiopia (Dercon, 2005)
- Mongolia — Livestock mortality
- Early flooding in the Mekong Delta
- Drought for coffee growers in Vietnam
- El Niño flooding for MFIs
- El Niño flooding for communities
- El Niño flooding for farmer associations
- Livelihoods insurance for small households?

Setting Index Insurance into a New Legal and Regulatory Framework

- Valued policies — Pre-agreed value and losses (Insurable interest — Proxy for loss)
- A form of business interruption insurance
- Creates a better frame for risk assessment and pre-agreed losses that will be tied to index insurance
- Mitigates legal risk
- Opens the way to sell catastrophic insurance?
- Lessens the importance of basis risk
- Stop presenting index insurance as a replacement for crop insurance

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How Do We Work to Improve Access to Catastrophic Weather Insurance?

- Improving access to financial services for the rural poor through innovative approaches for transferring weather risk.
- Risk layering…Putting catastrophic insurance into a broader conceptual framework
- Our model for advancing market development for weather risk transfer

Our Experience Suggests…

- Many one-off experiments that are working on innovations in index-based weather insurance
- One-off experiments are costly, and it has proven difficult and time-consuming to build a market for micro products
- More critical thinking and research are needed to integrate these products into the financial sector and to create long-term sustainable products that remain after donor interest has waned

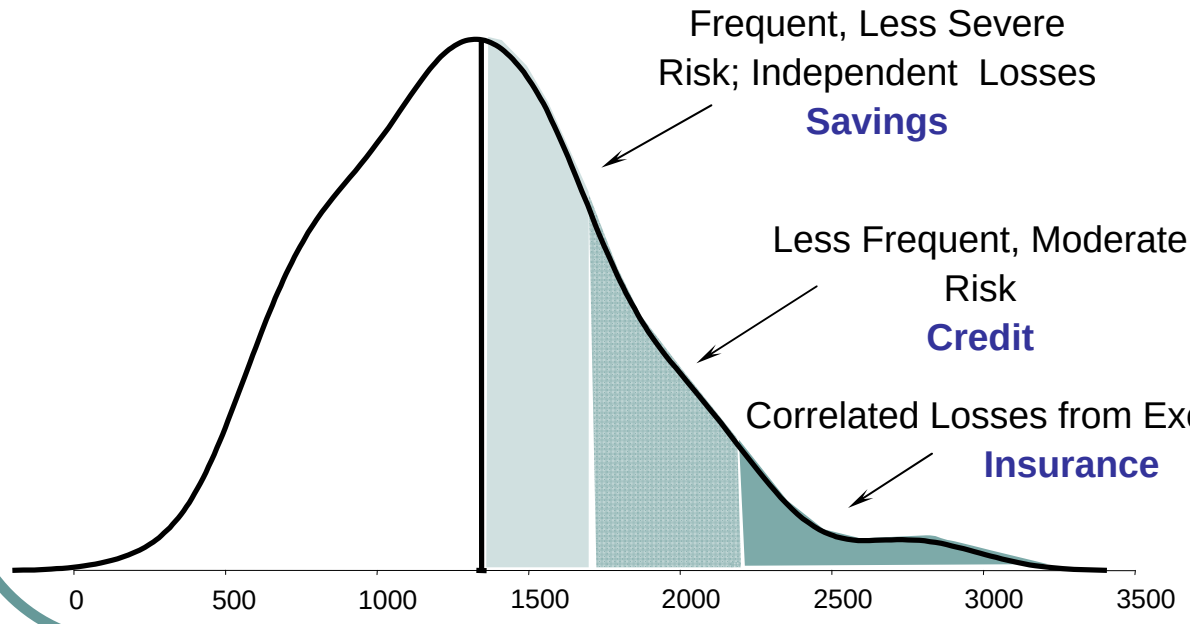
Select GlobalAgRisk Projects

- Peru — ENSO Insurance/ Global Research and Outreach Program
  Bill and Melinda Gates Foundation 4/09 to 4/12
- Vietnam — Floods in Mekong Delta/ Drought in Central Highlands
  Ford Foundation 7/09 to 12/10 and ADB 7/05 to 5/08
- Mongolia — Index-based Livestock Insurance
  World Bank and government of Mongolia since 7/01
- Mali — Prefeasibility Study on Potential for Index Insurance
  Save the Children 8/08 to 4/09
- Ethiopia — Drought Insurance for Emergency Food Aid
  World Bank 8/03 to 8/04
- Mexico — Irrigation Insurance in the Rio Mayo
  InterAmerican Development Bank 5/03 to 9/04

Financial Services and Correlated Weather Risk Management

Financial services are complementary — A blend of savings, credit, and insurance is likely most effective for risk management

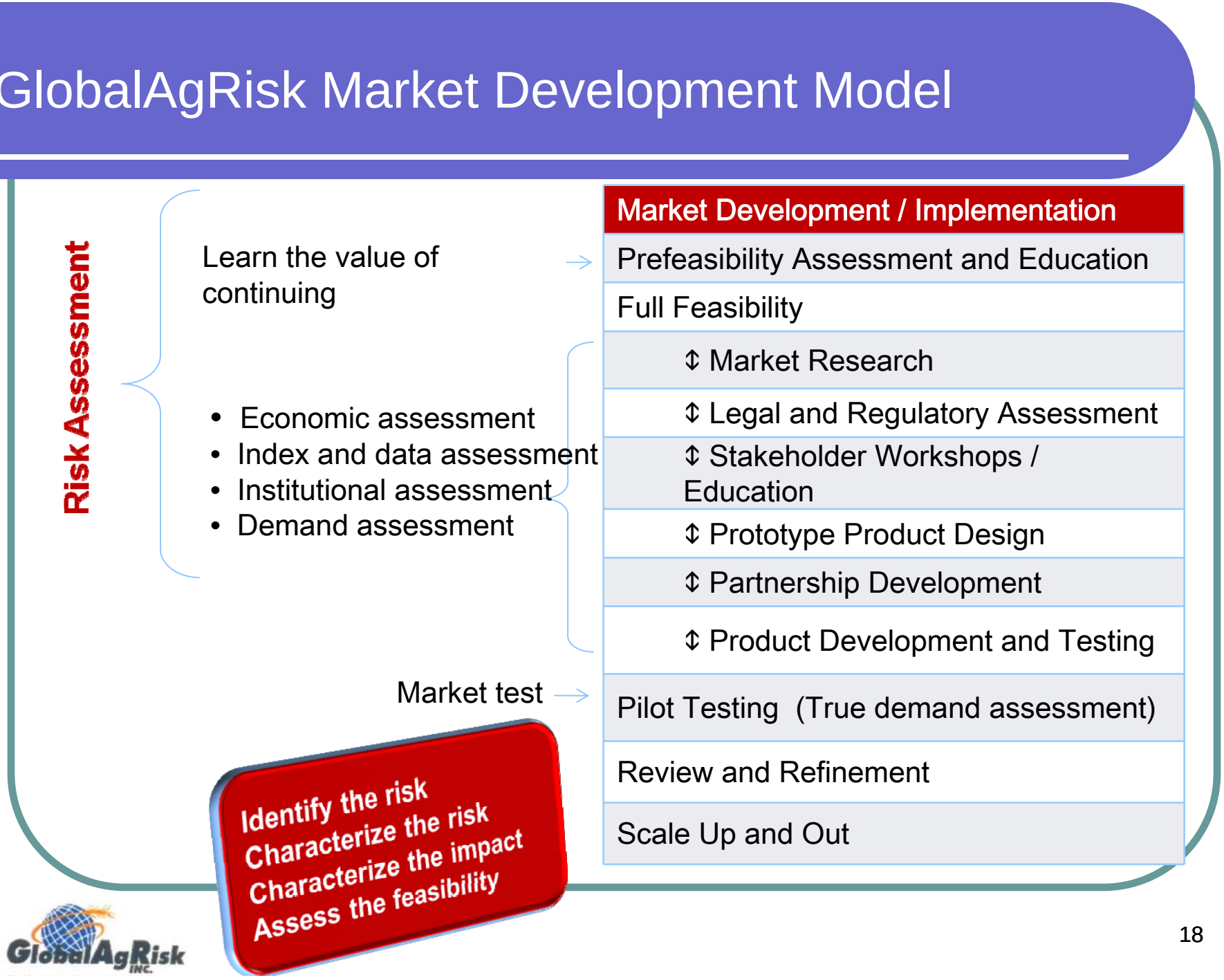
- Savings and credit best for small to moderate losses
- Insurance is best for catastrophic losses



Economies with banking *and* insurance markets grow faster than those with only banking services

Insurance is expensive — Focus must be catastrophic risk

GlobalAgRisk Market Development Model



Finding New Models for Public-Private Partnerships
Innovation in Mongolia

- Work follows Skees and Barnett (1999)
- Motivated by
  - Desire to structure public-private partnership that mitigates undue rent seeking
  - Desire to clearly separate the role of the market versus the social role
  - What we know about cognitive failure and natural disaster and pricing extreme tail risk

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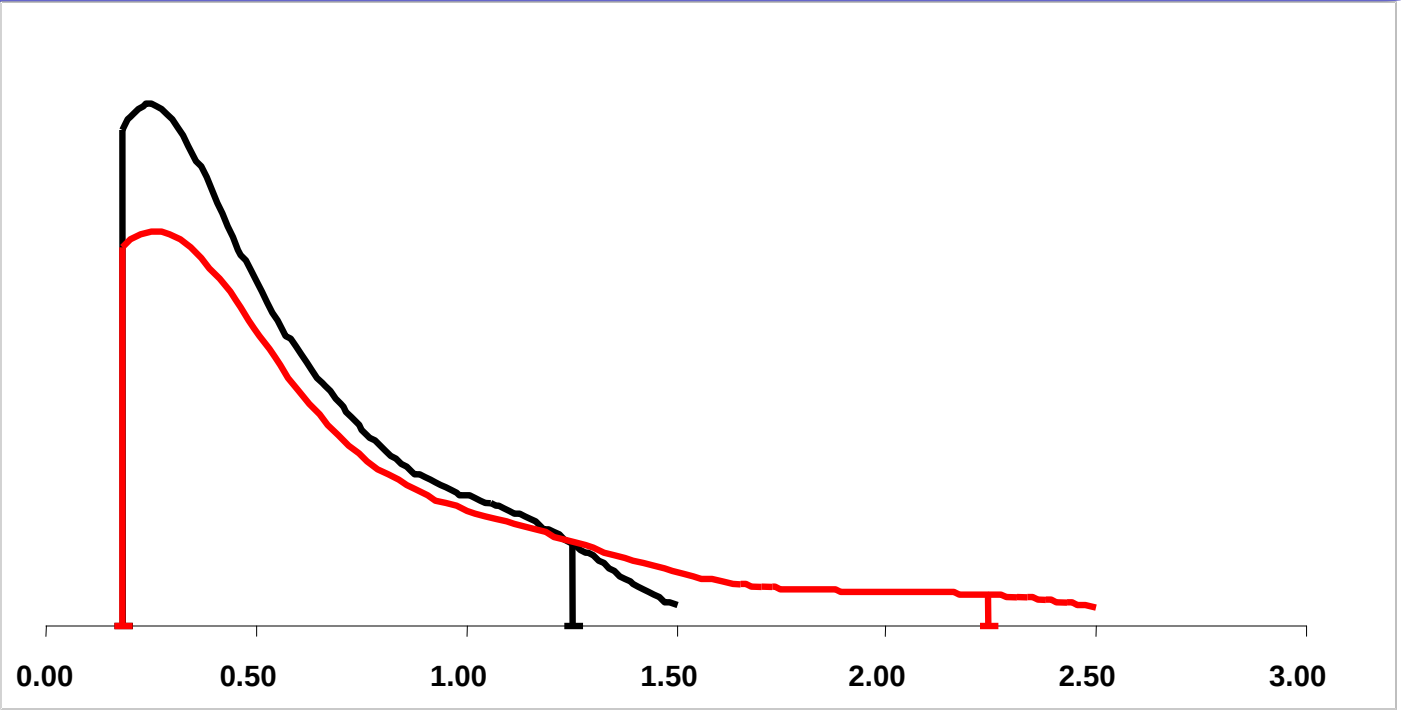
Cognitive Problems for Risk Decisions

- Difficulty in interpreting and reacting to probabilities
  (Morgan and Henrion, 1990; Kunreuther and Pauly, 2001)
- Aversion to ambiguous risk and loss estimates
  (Schade, et al., 2002; Kunreuther, et al., 1995)
- Decision makers tend to spend too much time on small but common losses that, while unpleasant, can be coped with
- But the same decision makers don't pay enough attention to protecting against large, truly disastrous, low-probability events

Differences in Expectations about the Loss Function



Classic problem in pricing — Both buyers and sellers of risk management instruments must agree about underlying risk for a market to evolve

Addressing Cognitive Failure — Focus Tail Risk

Leads to decision errors in risk management and creates a wedge between supply and demand for insurance and insurance-type products, especially for risks that are infrequent

Parametric disaster assistance for low-probability events

- Reduce/remove ambiguity
- Lower load over the remaining distribution
- Larger probabilities are easier for consumers to grasp
- Lower search cost

Mongolia — Massive Deaths of Animals

- Mongolia has some 45 million animals
- Sheep, goats, cattle and yak, horses, camel
- Value of animals = US $1.5 Billion
- Some 11 million animals were lost in 2001–2002 due to dzud (harsh winter weather)
- Animal husbandry in Mongolia is 20+% of the GDP and over 85% of all agriculture
- Census is done every year — Mortality data are available by soum (county) from 1970 onwards

Mongolia — Index-based Livestock Insurance

The Risk

Severe livestock losses due to dzud
(harsh winter weather)

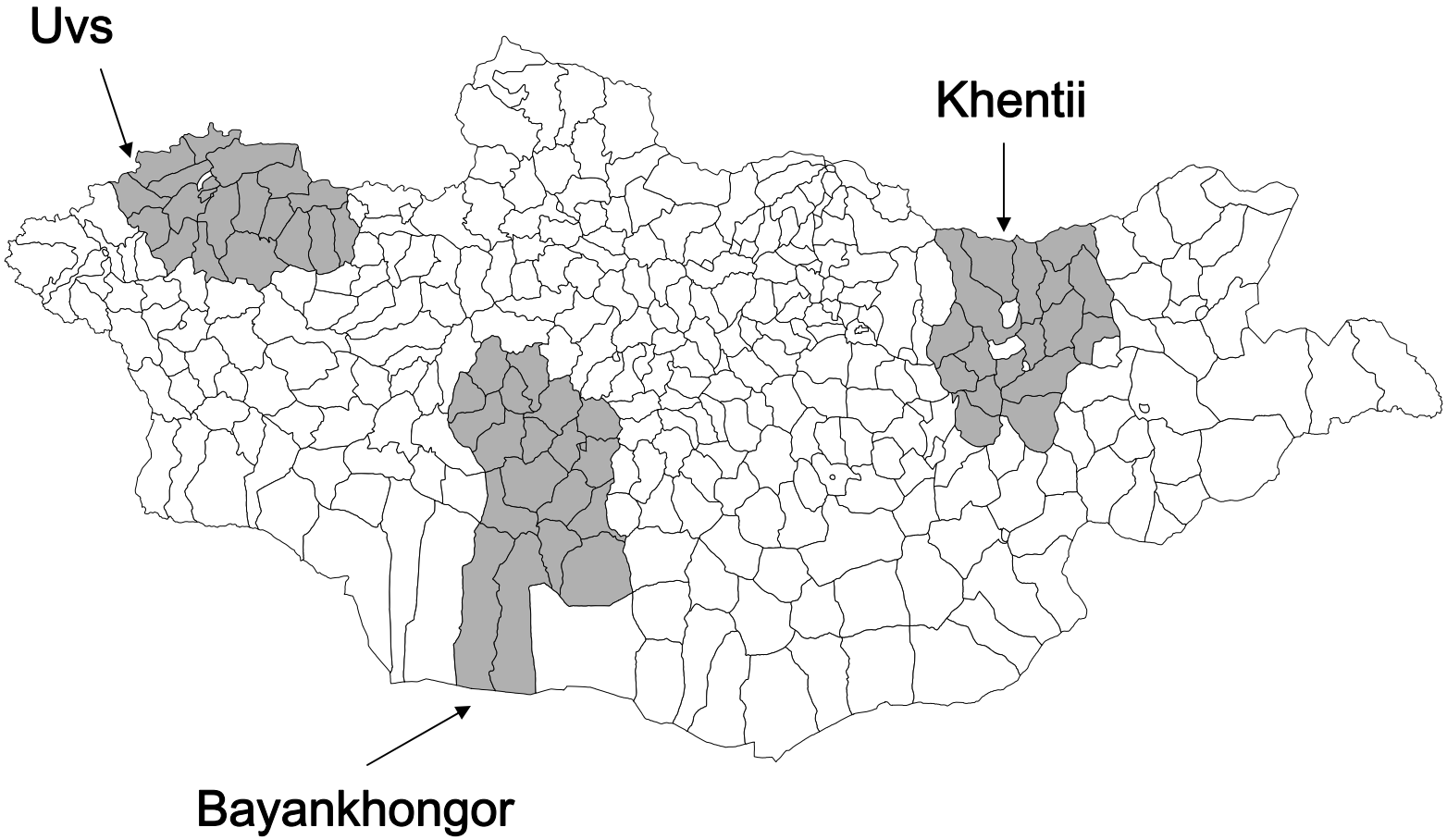
Target Users

Herders

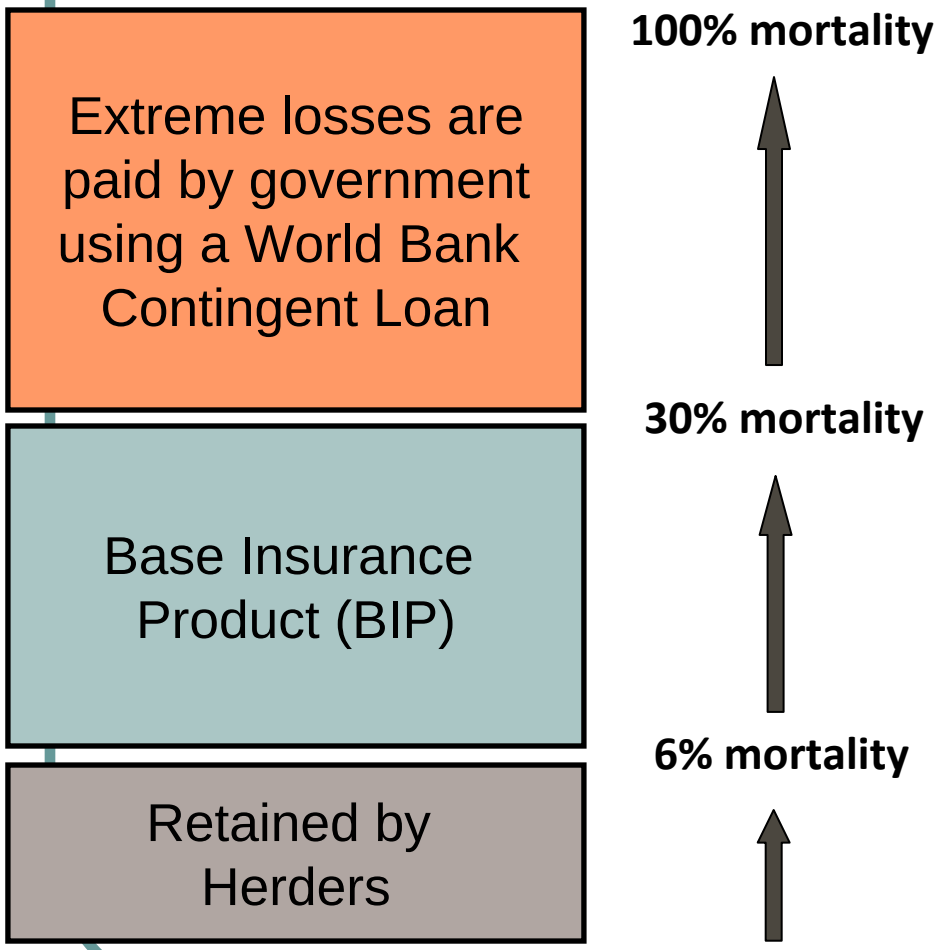
Contract Structure

Payments based on livestock mortality rates at the soum (county) level

Pilot Project, 2005–2009
3 Aimags — Soum-Level Mortality



Index-based Livestock Insurance



DRP — Social Insurance

A layer of very infrequent risk where decision makers may have a cognitive failure problem

BIP — Commercial Insurance

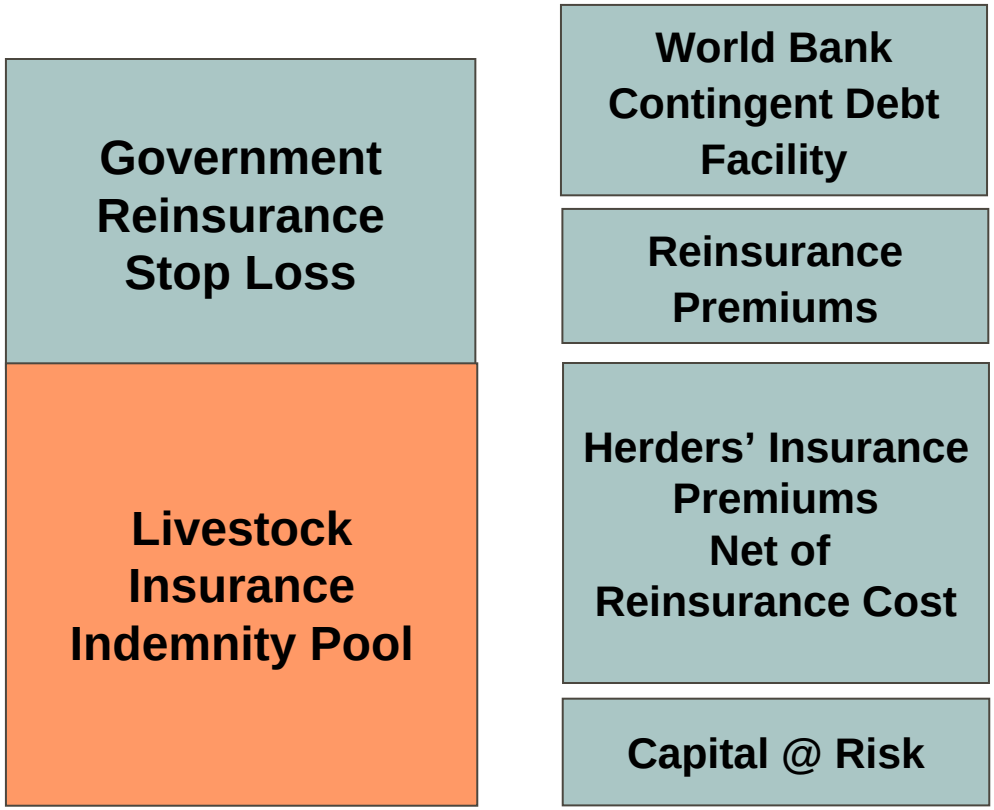
Offered by private companies with reinsurance from government in the pilot

If the government can't continue to pay for extreme losses, the commercial layer can continue

Objectives of Setting Regulations for Participating Insurance Companies

1. Protect and reassure herders
2. Ring-fence premiums
3. Protect and give confidence to participating insurers
4. Protect government as reinsurer
5. Provide confidence to the new Mongolian regulator
6. Provide confidence to international reinsurers
7. Transparency

Regulations Are Set inside the Project
Livestock Insurance Indemnity Pool



Mongolia Experience
Based on 4 Years of Sales and 3 Years of Payments

- Participation has grown from under 8% of eligible herders to about 20%
- Losses were paid in 2008 and 2009 due to strong storms and difficult winters in pilot areas
- Insurance companies understand and, now, support the pooling arrangement and regulations
- Herders fully understand the project and have adopted a view of solidarity regarding premium payments
- Banks offer discounted herder loans and now special purpose loan to purchase the insurance
- Herders are saving to pay premium
- Government is ready to expand to national program

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ENSO Insurance for Extreme Flooding in Piura, Peru

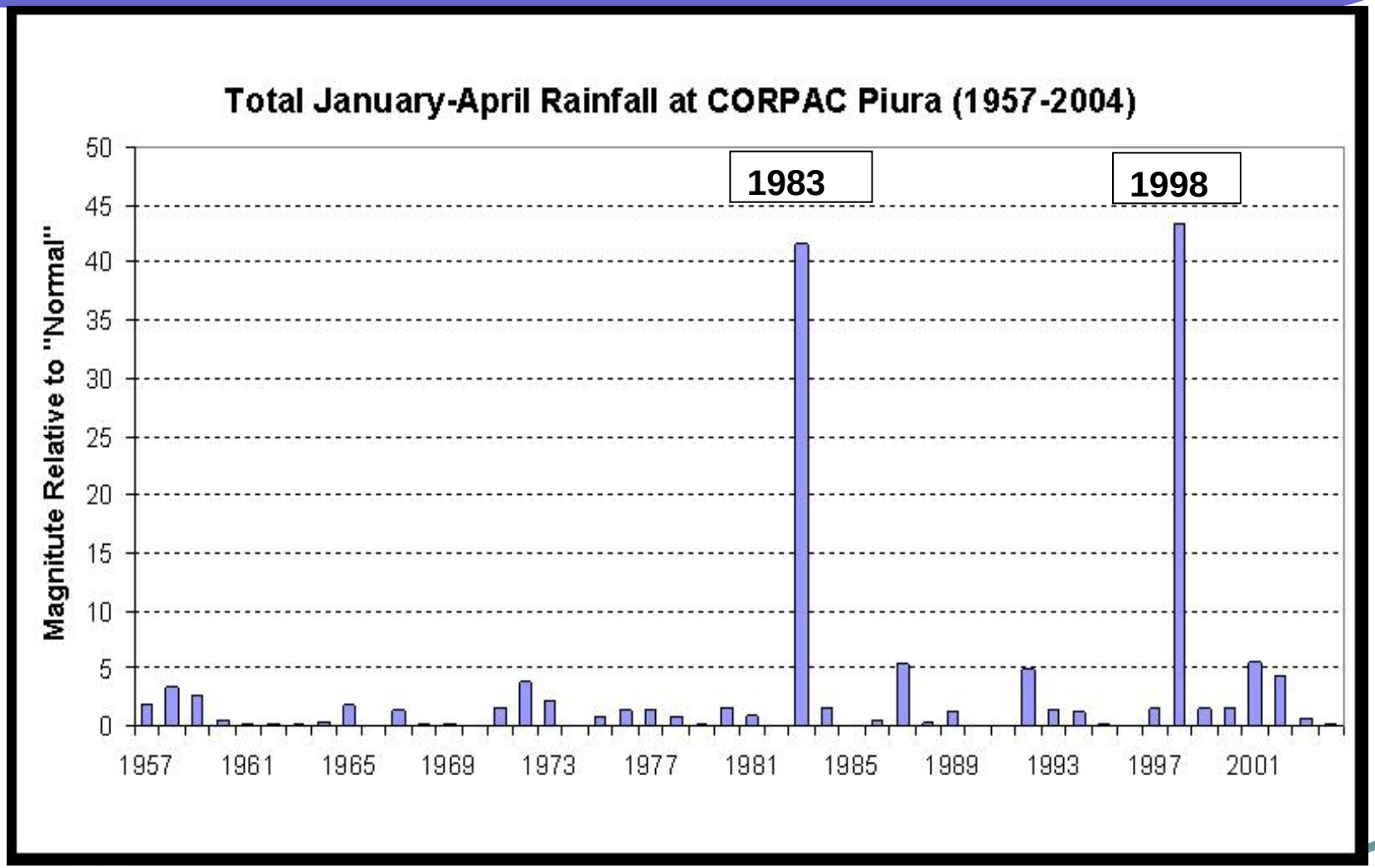
- Regulator has approved the a product that will pay in January whereas extreme flooding occurs in Feb–May
- MoU to work with LaPositiva Insurance Company of Peru to offer ENSO Insurance
- PartnerRE will provide reinsurance
- Strong and growing interest among many stakeholders in Peru
- Detailed risk assessment to advance the understanding of how to use an ENSO Insurance payment by lenders to reduce their consequential losses during El Niño

Extreme Flooding and El Niño

- Extreme flooding in Piura is directly tied to El Niño
  - Warm Pacific trade winds meet cold air coming down Andes Mountains
  - Result — Extreme, prolonged rainfall
  - Severe El Niño occurs roughly 1 in 15 years
- Most recent severe El Niño events: 1982/83 and 1997/98
  - Rainfall was 40x normal from January to April
  - For 1997/98, volume of Piura River was 41x median value
  - For 1982/83, volume of Piura River was 36x median value
- El Niño is the biggest risk event for agriculture, also affects many other sectors due to infrastructure breakdowns

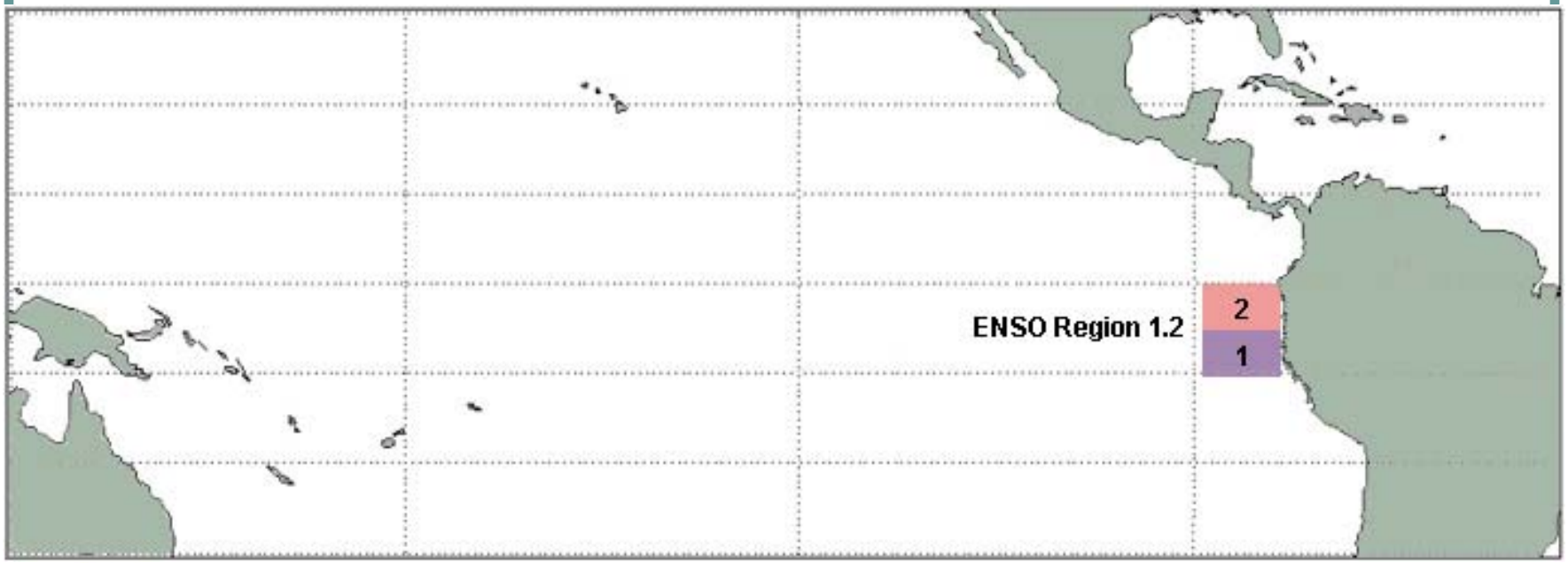
Historical Pattern of Agricultural Lending in Piura 1994–2006

Extreme El Niño Events of 1982/83 : 1997/98

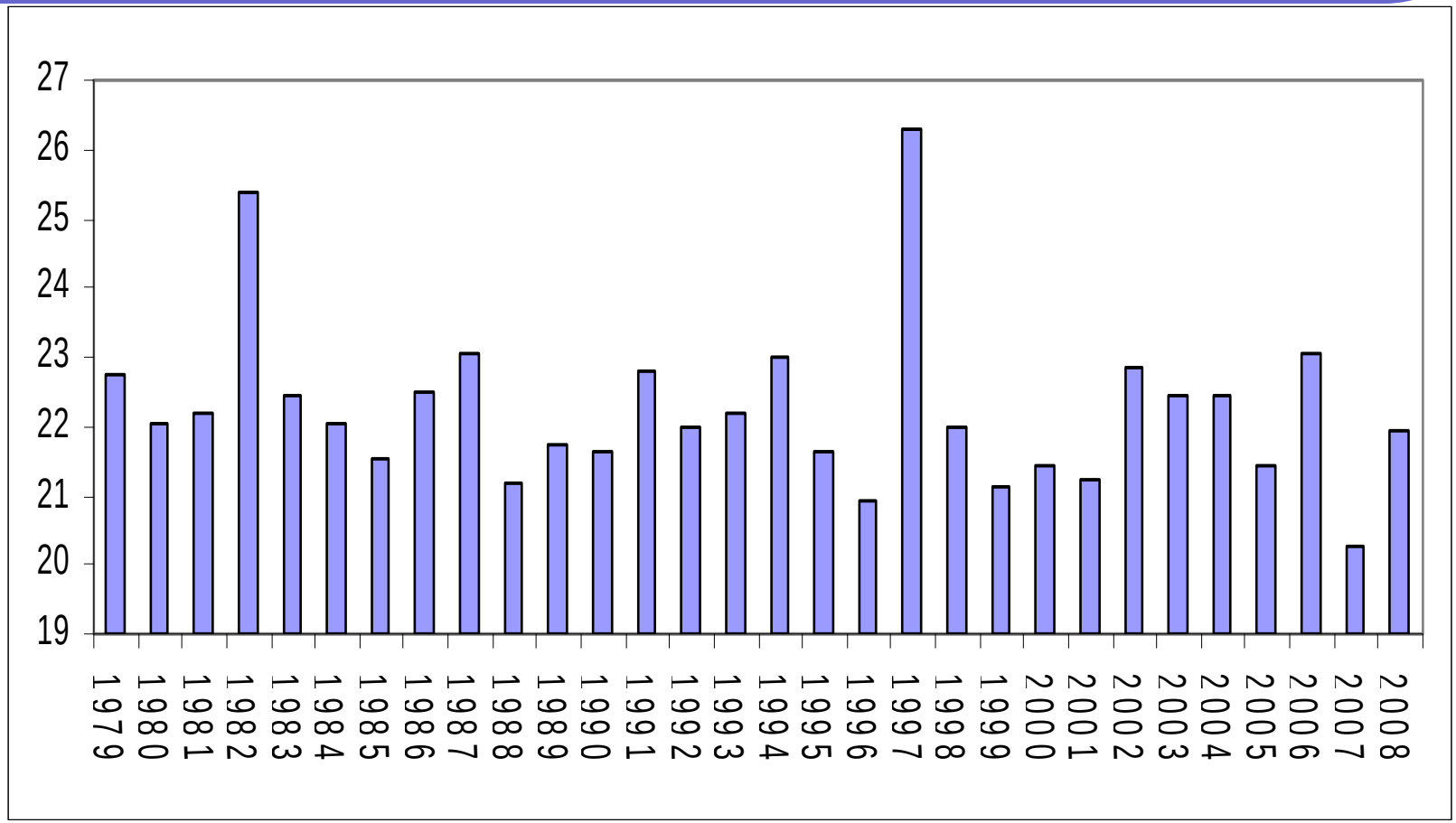


ENSO 1.2

- Measured and reported by the NOAA Climate Prediction Center for over 50 years
- ENSO Region 1.2
  - (0°-5°S, 90°W-80°W and 5°S-10°S, 90°W-80°W)



ENSO Index from 1979 to 2008 (Nov–Dec)



1983 Payment Rate = 34%; 1998 Payment Rate = 71%
Start Threshold = 24.5; Exit Threshold = 27

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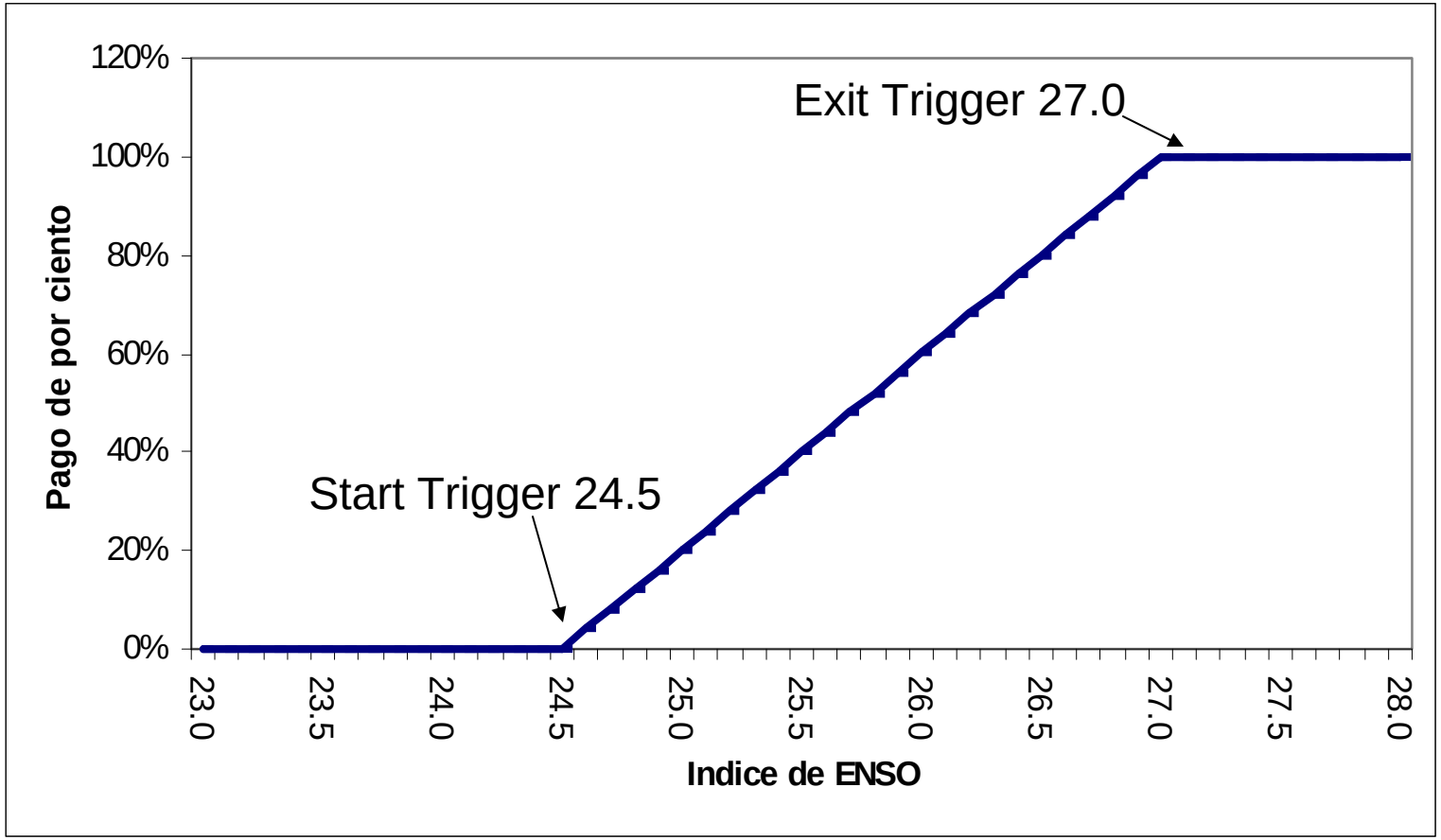
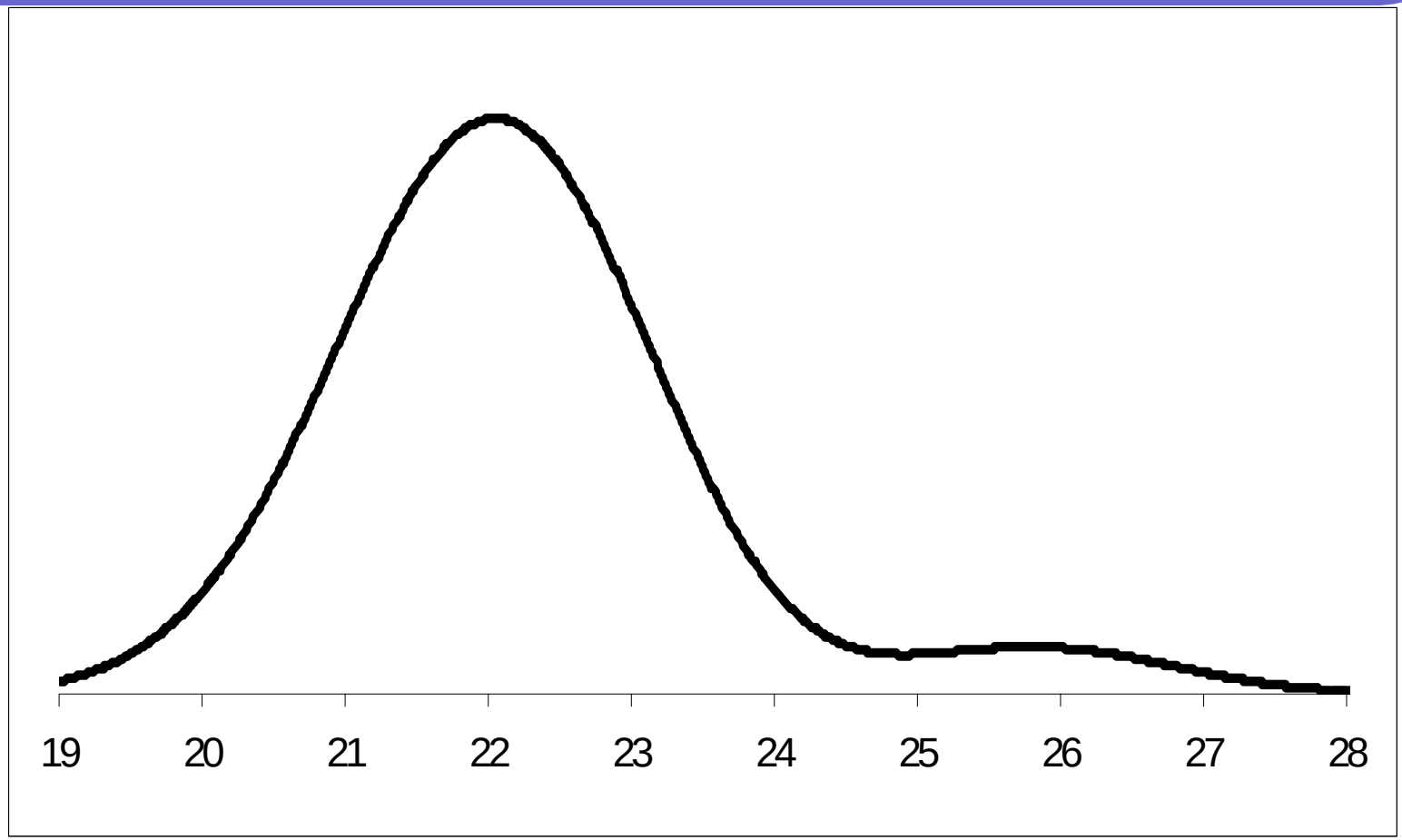
Payout Structure



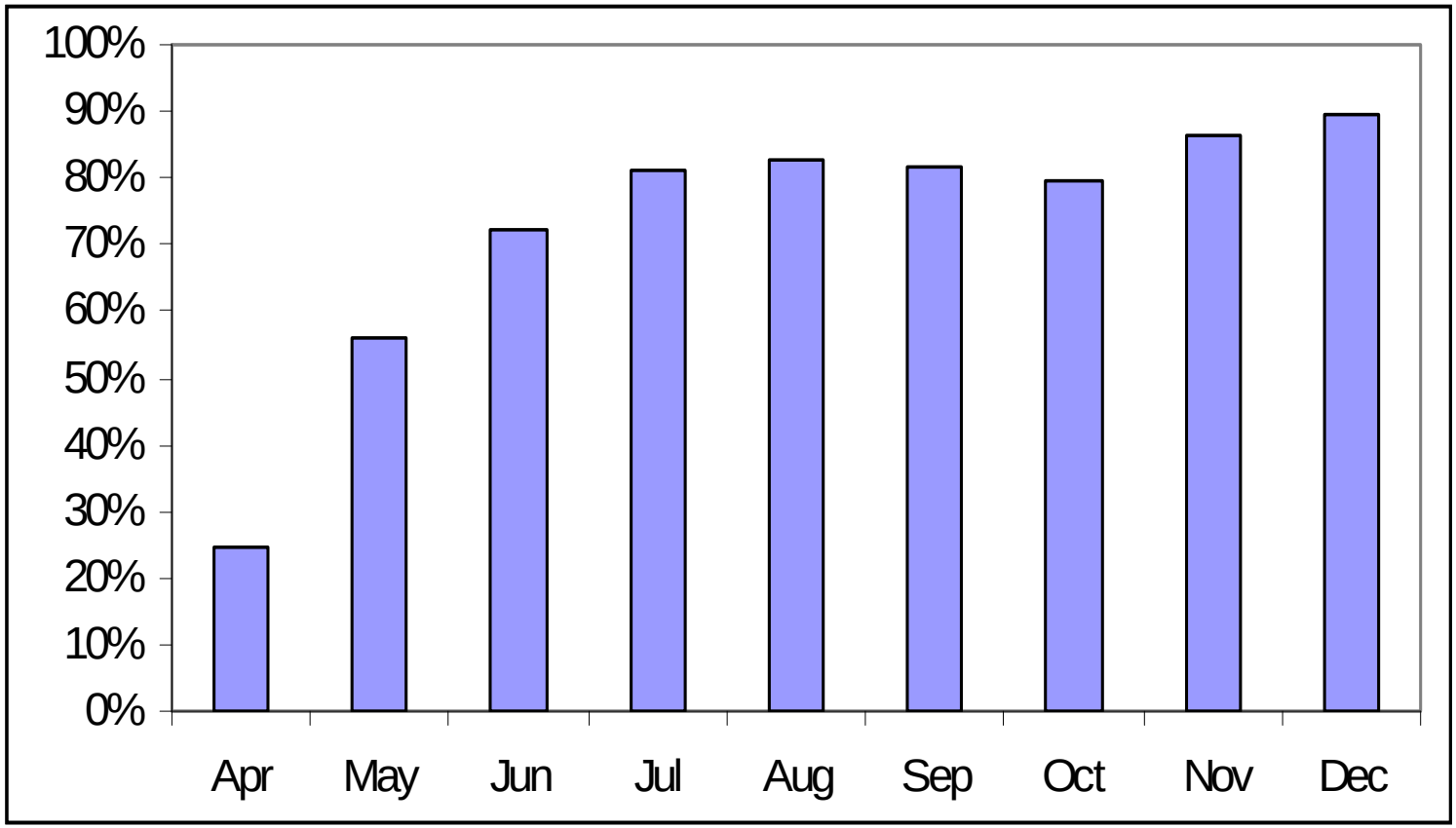
Linear payout so that if temperature is halfway between 24.5 and 27, or 25.75, the payout rate is 50%

Estimated Probability Density Function for ENSO Index Using Data 1979 to 2007



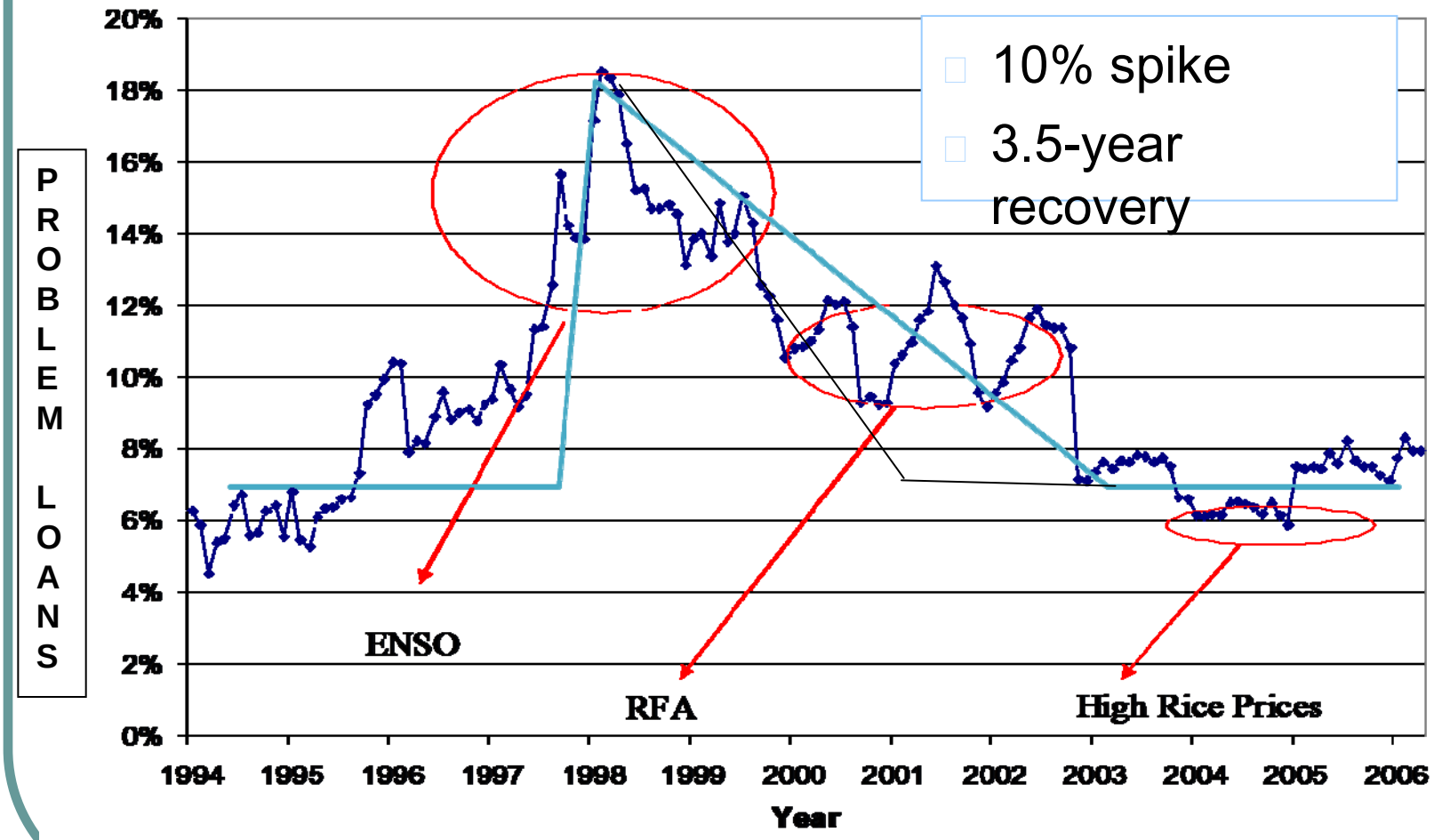
Events in excess of 24 may occur as frequently as 1 in 11 years

ENSO Forecast Can Be Made as Early as April



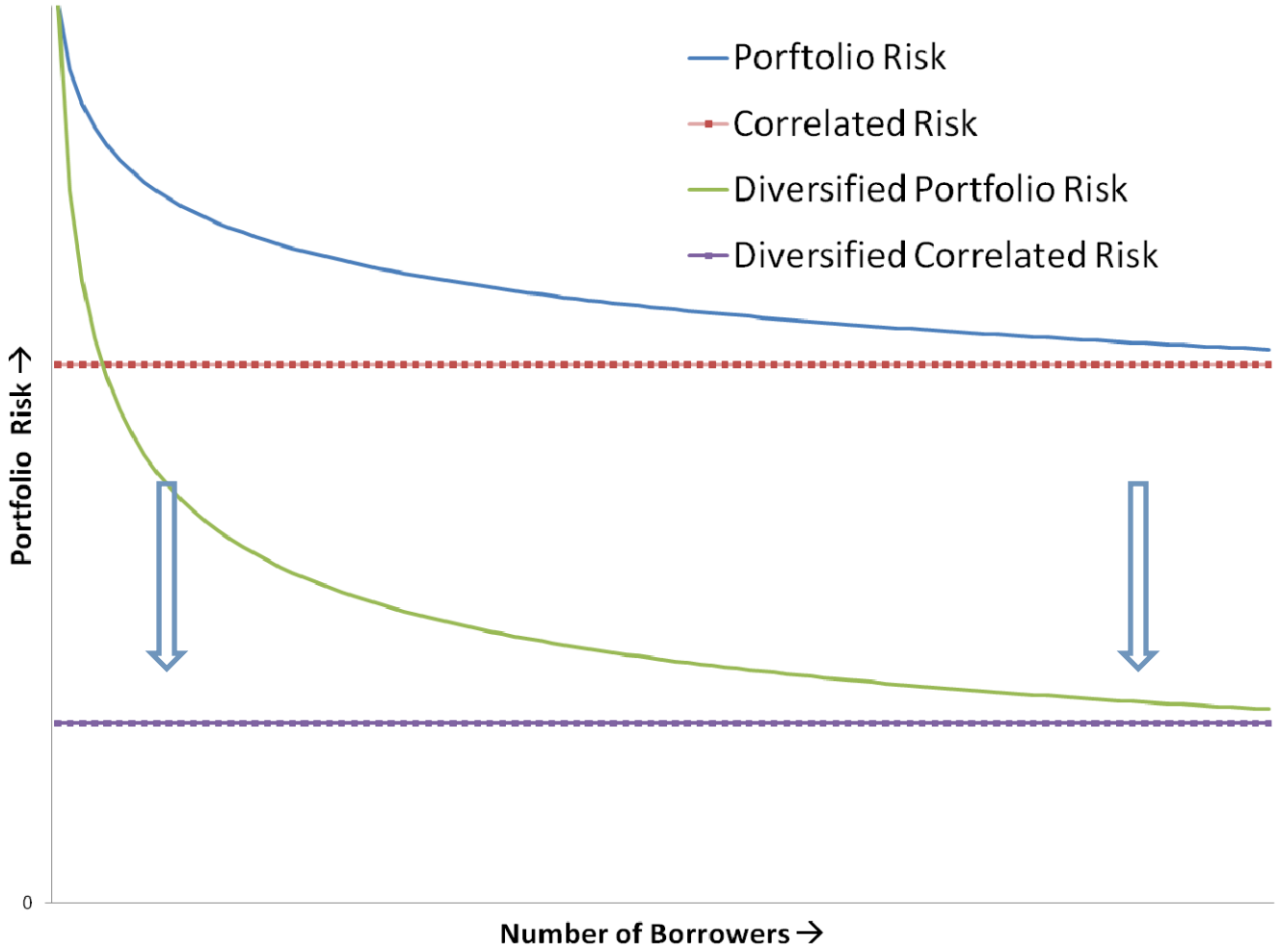
Simple correlation between Jan–March ENSO 1.2 and previous year by month, using only Jan–March ENSO 1.2 average values above the median

Lenders Pay
1997–1998 El Niño Spike and Recovery



With this event every 1 in 15 years, 300 basis points must be added

Diversification Can Reduce Correlated Risk in the Portfolio



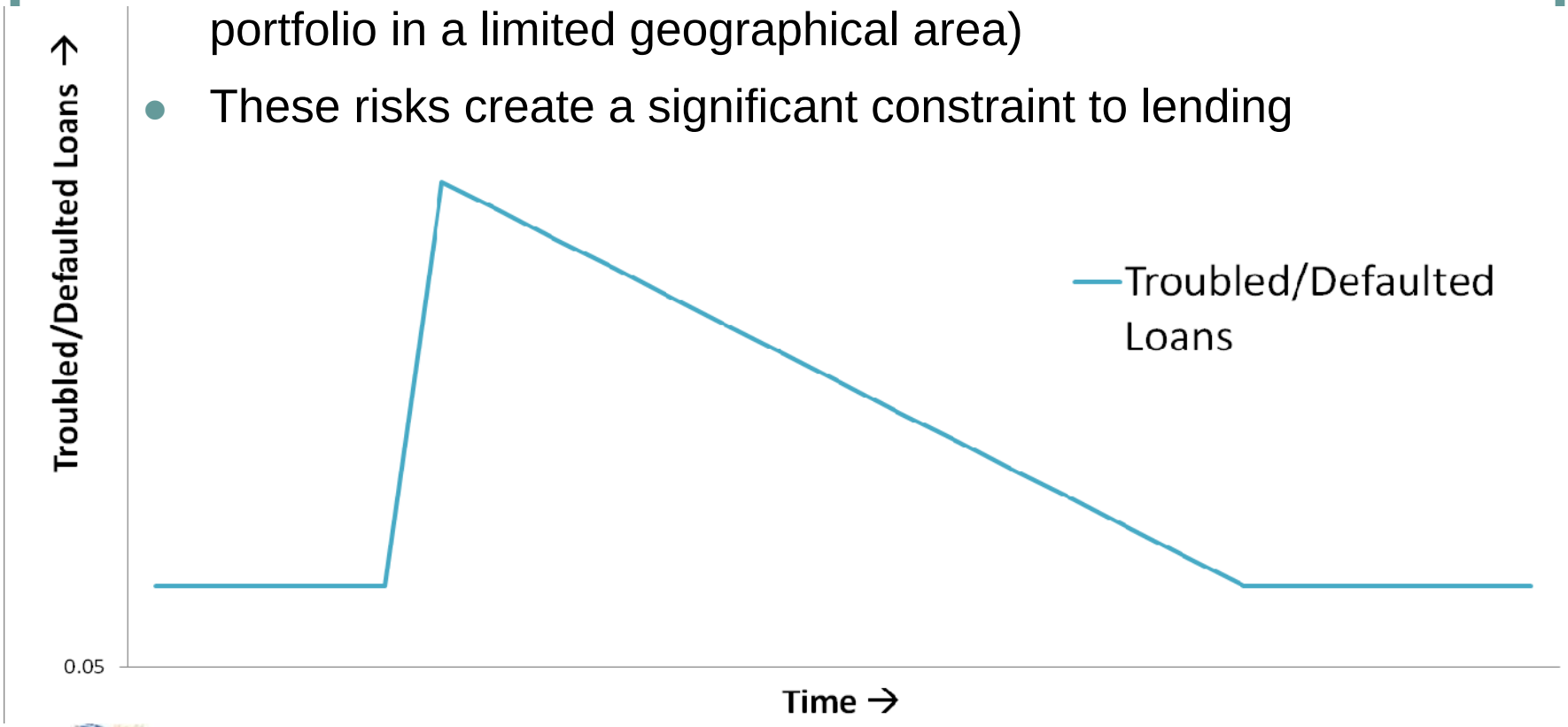
Risk Aggregator Strategy — Addressing the Spike in Defaults Created by Extreme Weather Event

- Perform risk assessment to learn the maximum probable loss
- Lending institutions have many ways of managing these risks (E.g., provisions, restructuring loans, etc.)
- For simplicity, assume that the initial position should be using an index insurance that protects 50% of the maximum probable loss

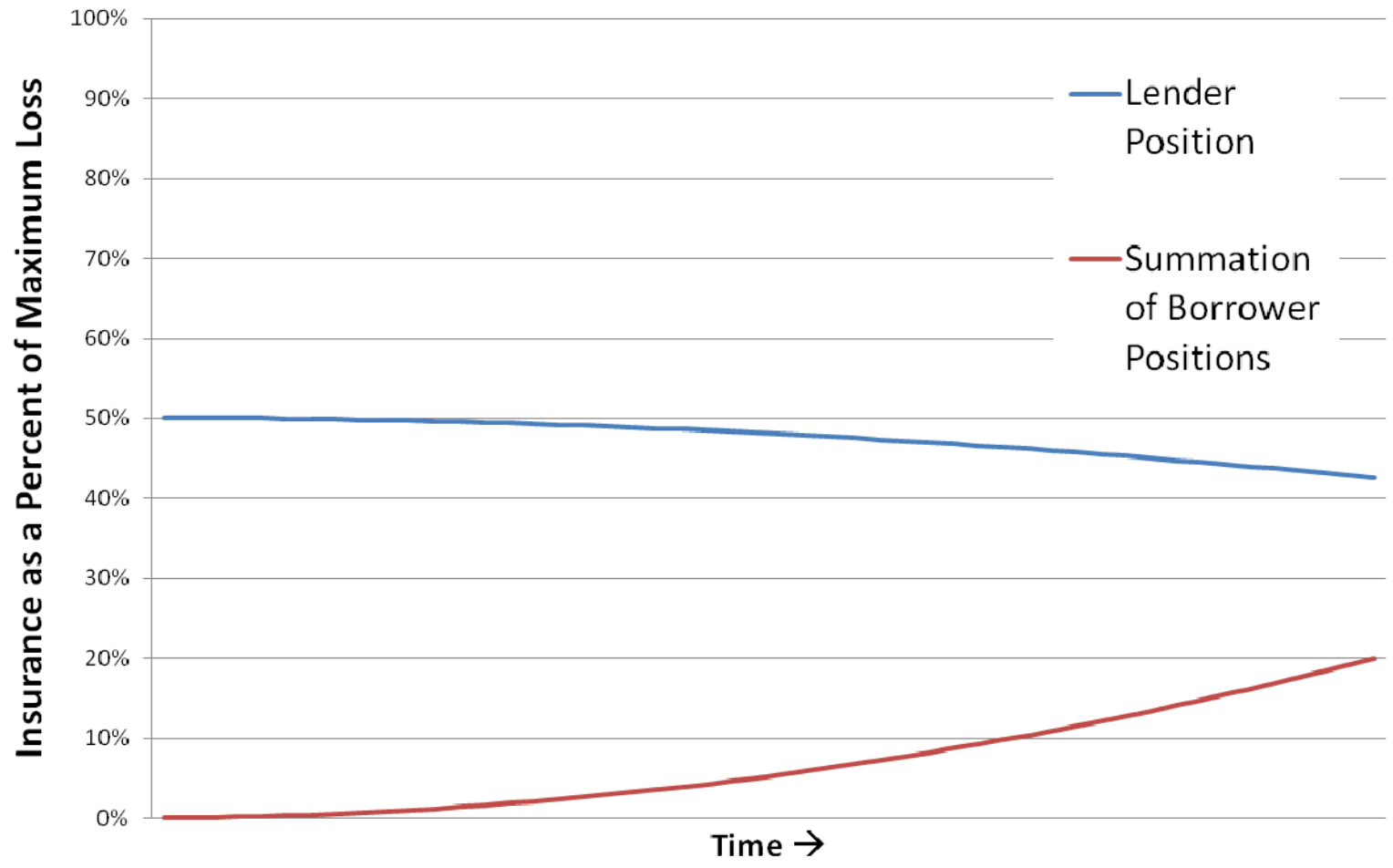
Managing a Catastrophic Weather Risk

Risk Assessment

- Weather risk event is expected to cause default risk to spike by 10 percentage points (Common problem for an agricultural portfolio in a limited geographical area)
- These risks create a significant constraint to lending



The Market Development Process *Intermediate Timeframe*
Insurance as a Percent of Maximum Probable Loss



ENSO Business Interruption Index Insurance (EBIII)

Covers lost profits or extra costs due to extreme flooding as indicated by high average sea surface temperatures in November–December

- Liquidity risk
- Savings are being withdrawn
- Decrease in certificates of deposits
- Loans are being refinanced
- Cost of capital will increase
- Defaults will follow
- Increased need for more capital for provisioning

Timing of the Contract

Year 1			Year 2	
Feb–April	**May–October**	**Nov–Dec**	**Early January**	**Feb–April**
Marketing period with a sales closing date of April 30	The EBIII is in force for possible upcoming severe event	SST data from ENSO 1.2 is used to calculate payments	Payments can be made *before* flooding as lenders begin to incur costs	Catastrophic flooding in the region

- Sales closing date must occur before buyers can predict an El Niño — Target April 30
- Insurance contract covers ENSO 1.2 (Nov–Dec)
- Payments will be made in early January as business interruptions are occurring

ENSO Insurance for Risk Aggregators

- In the next months, GlobalAgRisk will work with
  - 4 Financial institutions
  - Businesses in the value chain (Bananas, mangos)
  - 3–4 Farmer associations
- Next steps
  - Perform risk assessment to inform risk aggregators about the potential value of the ENSO Insurance
  - Continue working with Peruvian banking and insurance regulator to understand more about how this fits as a warranty-like instrument
  - Begin working with credit risk agencies in Peru to assess how this insurance can change the credit risk rating of financial institutions

Is There a Future for Insurance for Small Households? Potential of Livelihoods Insurance

- Household purchases insurance for a level of liability that pays whenever the insured CAT weather risk occurs
- Over-insuring is unlikely to be a problem — Experience has shown that households are more likely to under-insure
- How might the loss function change in the tails?
- Benefits over index insurance for a specific crop
  - Inclusive of households with diverse income sources
  - More inclusive of the landless poor
  - Straightforward, simple contract structure
  - Gives households more flexibility to adjust production strategies to changing conditions

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Challenges and Conclusions

- Focus should be on risk aggregators and consequential losses
  - Rural lenders
  - Value Chain
  - Farmer Associations
- Carefully moving to small households with concept of livelihoods insurance for consequential losses suffered by small households; challenges will remain for demand and delivery
- Solutions that involve public-private partnerships must clearly distinguish the role for markets and the role for government; understanding cognitive failure for extreme risk can help