



INSURING THE NEVER BEFORE INSURED: EXPLAINING INDEX INSURANCE THROUGH FINANCIAL EDUCATION GAMES

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Risk and insurance in low-income agriculture

THE COSTS OF UNINSURED RISK for low-wealth agricultural and pastoral households are well documented. Risk makes people poor when it leads them to shy away from higher-return but riskier activities. Risk also keeps people poor when it leads them to pursue defensive savings strategies that cut off pathways from poverty that they could traverse via sustained accumulation of productive assets. Finally, risk depresses the development of the deep agricultural finance markets in a region that can be important to the growth and development of the small-farm sector.

Insurance is a potential solution to these problems of pervasive and costly risk. Yet, insurance is most notable for its absence in low-income rural areas. While there are many reasons why insurance contracts are not offered in these areas, the innovation of a new generation of financial technologies built around the concept of parametric or index insurance raises the prospect that insurance instruments could be made to sustainably work in low-income environments. It remains to be seen if these index insurance products can resolve the problems of poverty and thin financial markets, yet the first challenge is to innovate and pilot effective, livelihood-focused index insurance contracts for which there is effective demand.

Unfortunately, the complexity of index insurance contracts stands as a potential barrier to creating effective demand. These contracts present particular problems for populations that have little experience with formal insurance, much less complex index-based contracts. Progress requires innovative efforts to enhance the understanding and financial literacy of the people that might purchase and benefit from index insurance. This *BASIS Brief* details one strategy that aims to solve this problem of financial literacy for those who have never been insured.

Index insurance basics

The idea of index insurance is straightforward. In contrast to conventional insurance contracts, which separately calculate losses and pay indemnities for each insured individual, payouts under an index contract are not based on individual outcomes. Instead, they are based on the outcome of an aggregate index. Because an individual's outcome does not often perfectly match this aggregate index, index insurance covers only a fraction of the risk the producer faces. The risk that is not covered is referred to as "basis risk."

Using a data source that is promptly, reliably, and inexpensively available (and cannot be manipulated by either the insurer or the insured), an index insurance

contract makes the agreed indemnity compensation payment to insured beneficiaries whenever the data source indicates that the index reaches the “strike point,” or insurance activation level.

Consider the case of an area yield contract in which the index is determined by a reliable measure of average yields in a valley. If the long-term average yield is 40 quintals of cotton per hectare, then the insurance might be activated at a strike point of 35 quintals (that is, when the average yield index falls below 87.5% of its long-term average). If the average yield index fell to 30 quintals, then individual farmers would receive a payment equal to the contractually stipulated value of 5 quintals per hectare insured (the strike point level minus the realized average yield). Because it is not necessary to verify individual losses, transactions costs with index insurance are modest, a feature that is especially important if coverage is to be offered to small farmers and other low-wealth agents.

For agricultural contracts, index insurance can be based on measures of average area valley yields (as in the example above), climatic information, or satellite information on ground cover and plant growth. For livestock contracts, possible indices include those based on average mortality, forage availability or rainfall measures, and satellite measures of vegetative cover.

An important advantage of index insurance is that it preserves effort incentives for producers. No individual farmer can increase the probability of an insurance payout by working less hard. In other words, index insurance does not suffer from the problem of moral hazard. Index insurance also is unaffected by the problem of adverse selection, which occurs when only the individuals most likely to suffer a loss purchase insurance. In the case of index insurance, it does not matter who purchases the insurance, as payouts do not depend on the personal characteristics of those who actually purchase the insurance. Together with the low transactions costs, the absence of moral hazard and adverse selection problems suggests that the market should be able to sustainably provide index insurance to the small farmer and pastoralist sectors in the developing world.

Why comprehension is important —and challenging

Index insurance can only reduce risk and deepen agricultural financial markets if there is sustained and

informed demand for it. However, effective demand for insurance may be weak among a population unfamiliar with insurance. Insurance is an intangible good that offers stochastic benefits: sometimes insurance offers a benefit and sometimes it does not.

If farmers misunderstand or underestimate the value of the stochastic benefits of a well-designed insurance contract, then there will be little demand for the contract and little or no impact on farmer behavior. Conversely, if farmers overestimate the value of the benefits (especially with index insurance, which offers only incomplete coverage of losses), then they are likely to be disappointed and fail to purchase insurance again in the future. Without training potential buyers in financial literacy, it is unlikely that index insurance contracts will solve the problem of agricultural risk.

Recent efforts to implement index insurance have struggled with making it easily comprehensible. In India, a microfinance institution had to redesign and restart an index insurance program based on a rainfall contract after there were massive cancellations of contracts by farmers disappointed by the lack of payments in a normal year. Clearly, these farmers did not fully understand the stochastic nature of the benefits provided by insurance.

In a Malawi project, farmers were offered insurance bundled with a loan to see if including insurance would increase loan take-up to finance higher-risk, higher-return strategies by eliminating some of the risk. Counter intuitively, take-up rates were substantially lower among farmers offered the insurance than those offered a basic loan (Giné and Yang 2008). Statistical analysis showed that there were significant differences in education between farmers who took up loans with insurance and those who did not, but this difference is not there in the case of basic loans. It is possible that the complexity of the insurance meant that those farmers with lower levels of education who were offered the bundled product simply were not comfortable enough with their understanding to want to purchase the product.

As a cautionary tale on educating farmers about risk, however, the researchers Giné and Yang discuss the possibility that farmers who were offered the insurance were also presented information on weather risk, which may have increased their perception of risk and decreased take-up. The importance of good financial literacy training is likely to be a key to successful agricultural insurance products.

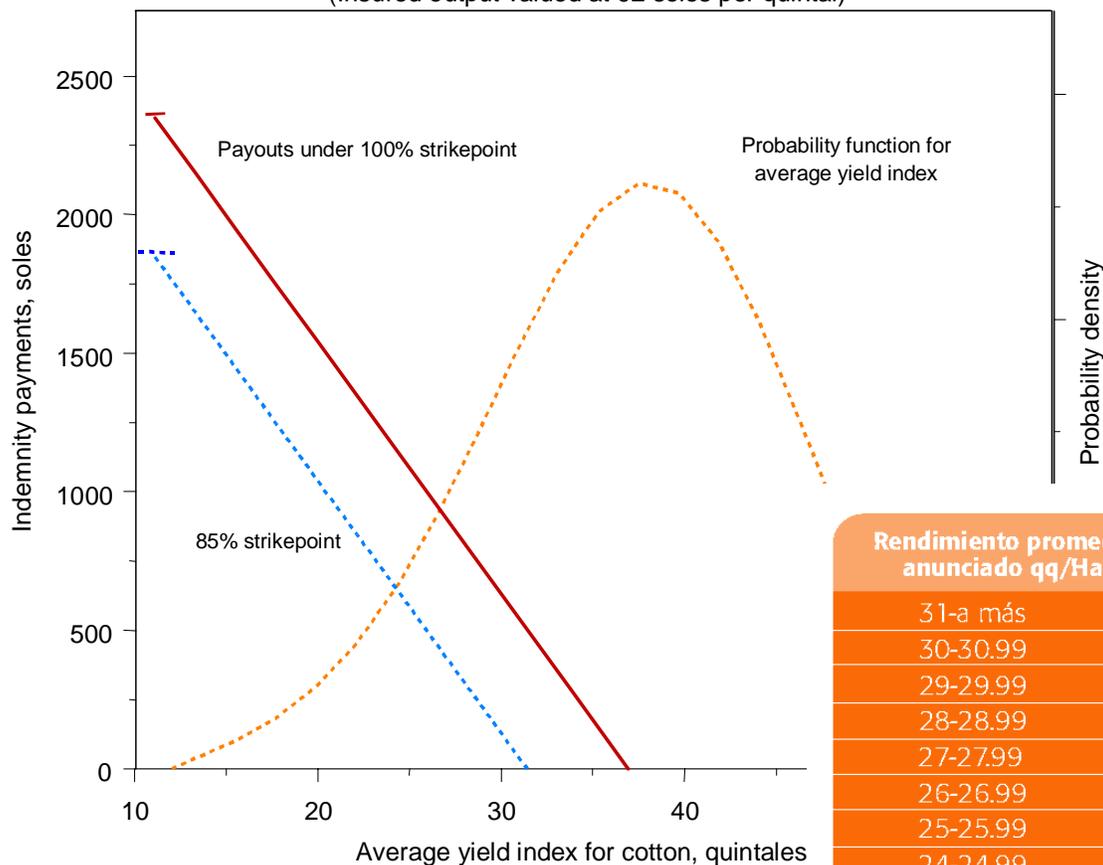
Figure 1 shows two ways of looking at the index insurance contract for cotton producers that BASIS researchers are implementing in the Pisco Valley in Peru, in conjunction with a local insurance company, a local microfinance institution, and an international reinsurance company. The contract is based on an average area yield index, with payouts made when average yields in the Pisco Valley fall below a specified strike point. Individual farmer outcomes are highly but imperfectly correlated with average valley yields—in other words, farmers individually can do better or worse than the average.

The smooth curve in Figure 1 shows the estimated probability distribution of the Pisco cotton yield index,

while the lines show the payoffs received by farmers when the index reaches the indicated strike point. While perhaps adequate for communicating the nature of the index contract to individuals with statistical training, the figure is somewhat opaque for most of us. Somewhat more easily comprehensible is the payout table to the right of the figure, which is from the publicity flyer distributed to advertise the program. While this table more clearly shows the payouts to farmers when the index reaches certain levels, it does not fully communicate the benefits to the farmer when compared to an uninsured situation. Communication of the stochastic benefits of insurance clearly requires a more comprehensive approach.

Figure 1. Index insurance contracts for Pisco Valley cotton

(Insured output valued at 92 soles per quintal)



Rendimiento promedio anunciado qq/Ha.	Indemnización por hectárea cultivada en S/.
31-a más	0
30-30.99	61
29-29.99	186
28-28.99	311
27-27.99	436
26-26.99	561
25-25.99	686
24-24.99	811
23-23.99	935
22-22.99	1,060
21-21.99	1,185
20-20.99	1,310
19-19.99	1,435
Menos de 19.99	1,435

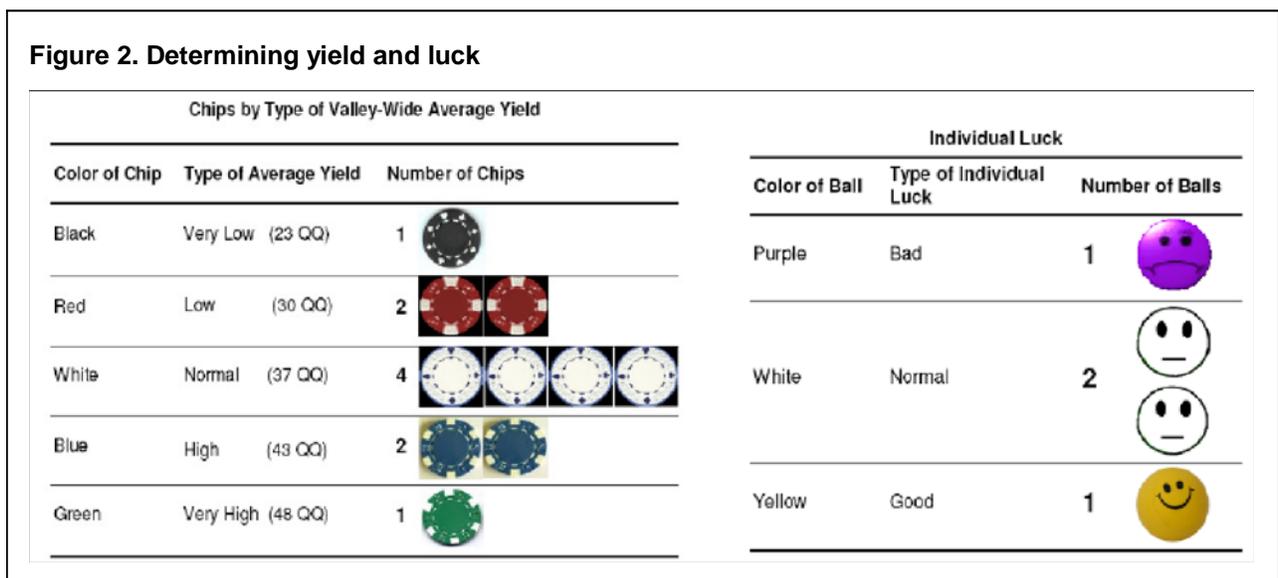
Experimental economics games for financial education

Experimental economics is a relatively new branch of economics whose methods can help individuals understand the complexities of index insurance and evaluate its value. Economic experiments can be designed to reliably elicit people’s behavior in complex circumstances that involve strategic considerations and uncertainty.

These experiments often employ real economic incentives, where participants receive financial payments based on their performance and outcomes in the experimental setting. They also often exploit the ability to repeat games multiple times so that individuals can understand the complexities of the situation they face and learn the behavior that best suits them.

comes. One challenge of designing an experimental economics game is to make sure that the game incentives closely match those of the real world.

A second challenge is to minimize the cognitive leap from the game to the real world. Much of the classic experimental economics research has been designed to uncover general patterns of behavior that are context free. The goal of experimental economics games for financial literacy is somewhat different, as a primary motive of the game is to assist learning about an unknown insurance product. In contrast to context-free experimental economic research, the games described below are carefully framed to correspond closely to reality so that what the individual learns in the game can be easily transferred to their real economic lives.



For index insurance, which offers a stochastic benefit that only appears from time to time, experimental economic methods offer the prospect of letting individuals play and replay their lives and farming decisions, with and without insurance, over a short period of time so that the benefits of the insurance can be understood and evaluated.

Much of the remainder of this brief will discuss an experimental economics game based on the Peruvian cotton insurance project described above. A key feature of this game is that participants receive a payout based on their financial outcomes in the game and their decision whether or not to purchase insurance. As in the real world, insurance comes at a cost, but it also lessens the likelihood of unfavorable out-

Minimizing the cognitive leap from game to reality

Figure 1 illustrated the index insurance contract being made available to cotton farmers in Peru’s Pisco Valley. In an effort to create informed understanding of this contract, BASIS researchers designed an experimental economics game that duplicates the precise structure of the Pisco index insurance contract. Doing so requires a game that faithfully replicates the workings of the insurance, the workings of uninsured basis risk, and the impacts of both on farmer incomes.

As a first step in designing the game, the continuous probability distribution for average Pisco yields shown in Figure 1 was broken into five discrete chunks. The result of this “discretization” is shown in the lefthand table in Figure 2. When the average yield index is very

low (as happens one year in ten), the average yield index will be about 23 quintals of cotton. In the game, this outcome is represented by one black poker chip that is put into an “average yield sack” that contained a total of 10 poker chips of differing colors.

Similarly, in the middle part of the distribution (which happens 40% of the time), yields are expected to be 37 quintals. In the game, this outcome is represented by four white poker chips that were included in the average yield sack. Similar calculations were carried out for the other chunks of the true probability distribution, and the lefthand table in Figure 2 represents the full contents of the average yield sack.

As in the real world, an individual farmer’s yield outcome not only depends on averages in his or her area, but also on individual luck or variation around that average. As part of the *ex ante* analysis of the insurance design, farm level yield data were used to estimate the degree of basis risk, which is simply yield variation that is not explained by the average yield index. Analogous to the probability distribution shown in Figure 1, a probability distribution for basis risk was also estimated.

The resulting distribution of basis risk was again discretized and broken into the three pieces shown in the righthand table in Figure 2. An “individual luck sack” was formed, containing one purple ball representing bad luck (individual yields below average), two white balls representing average luck (individual yields equivalent to average), and one orange ball representing good luck (individual yields better than average).

Once these two sacks were assembled, the participants were trained in understanding the forces that would determine their yields in the game. Each participant was given a fictive land endowment of two hectares and was assigned to a “valley.” At the beginning of each round of the game (representing a year), one farmer from the valley would pick a chip from the average yield sack, which determined the valley’s average yield result in that year. Each individual within that valley then picked an individual luck ball that determined whether his or her outcome would be below, equal to, or above the average yield for the valley in that game year.

Once the basic mechanics of yield determination were understood and practiced by everyone, individuals were presented with different production strategies. Initially, individuals were presented with two options. The first was a high yielding commercial cotton produc-



Choosing a chip from the “yield sack.” The color of the chip determines the average yield for the valley that game year.

Photo by Julio Cesar Casma. Used by permission from La Positiva Seguros y Reaseguros Peru.

tion strategy in which the farmer allocated all his or her fictive land endowment to the production of cotton. To undertake this strategy, individuals were told that they had to borrow funds to purchase inputs.

Using accurate information on input costs, interest rates, and the value of cotton, a net farmer income was calculated for each possible cotton yield generated by the combination of poker chips and individual luck draws. The payout table (see Figure 3, next page) shows the various possibilities under the commercial cotton production option. Notice that in valleys with very low averaged yields (as happened one year in ten, or when a black chip was drawn) farmers had insufficient earnings to even repay their bank loan, and they were left in debt and with zero earnings to keep for themselves.

Participants also were offered a second option for cultivating their fictive land endowment. Instead of borrowing money and putting all land into cotton, individuals could choose a safer, lower returning alternative calibrated on what a farmer could expect with minimal input purchases and dividing his or her land between cotton and food crops. A similar financial payoff matrix was constructed for this option.

With these two options explained, farmers played a sequence of low stakes, or learning, rounds. At the beginning of each round, each farmer chose his or her

production option. Farmers were told that they would receive a real monetary payment based on their results from one of the later rounds of the game. (In addition, farmers received a payout based on the value of their land, as is explained below.)

During the low stakes round, an unfavorable rate of exchange was established between game payoffs (shown in the payout table) and real money. These low stake rounds were established so that the farmers could experiment and learn the mechanics of risk as captured in the game. After the low stakes rounds, a set of high stakes rounds was then played. A more favorable exchange rate was established for these rounds, giving the farmer sharp incentives to make his or her game choices carefully.

strategy. In most cases, farmers settled on a preferred strategy by the time of the high stakes rounds, consistently choosing one of the three options across all rounds of the high stakes game.

Capturing the benefits of insurance

Crop yield insurance is designed to help farmers smooth out the rough spots. Payments received in bad years substitute for lost income, allowing individuals to smooth their consumption over time. In many situations, insurance offers a second important advantage. An uninsured farmer who borrows to pursue a commercial strategy risks losing his or her land if a drought leaves him or her unable to repay a loan in which his or her land was used as collateral. Empirical work on risk rationing reveals that some 20% of small farmers may

Figure 3. Payout table

		PROJECT A: COTTON WITH LOAN											
		Valley-Wide Average Yield											
		Very Low (23 QQ)		Low (30 QQ)		Normal (37 QQ)				High (43 QQ)		Very High (48 QQ)	
LUCK		0 (Debt)		250		800		1350		2000			
		0 (Debt)		600		1400		2100		2700			
		0 (Debt)		900		1900		2800		3400			
		0 (Debt)											

Finally, farmers were introduced to a third option based on the Pisco index insurance contract. Under this option, farmers dedicated all their land to cotton, borrowed money to finance a complete set of inputs, and paid the market price for an index insurance contract. Payouts were determined only by average valley outcomes (determined by poker chips) and not by individual luck. A small payment was made to insured farmers when a red chip (low yield) was drawn, and a larger payment was made when a black chip (very low yield) was drawn. Insurance premiums and payouts were based on the actual Pisco cotton insurance contract illustrated in Figure 1. Under the payoff structure, farmer returns were lower in good years, but higher in bad years. In addition, insurance eliminated the possibility of default.

Low and high stakes rounds were again used to allow farmers to first experiment with insurance and then (motivated by the high stakes) settle on a desired

refuse to take out loans precisely because they fear losing the assets on which their future livelihood depends (Boucher, Carter and Guirkingner 2008).

In this context, insurance can offer an important second benefit. It allows people to preserve their asset base for use in the future. Realistically capturing this inter-temporal benefit is important in any game designed to allow individuals to fully understand how insurance works.

In the design of the Pisco cotton game, BASIS researchers originally gave each player land title certificates for each of the two hectares they had available for production in the game. Any player unable to repay a loan used to finance a high-return production strategy had to forfeit one unit of land and its corresponding land title certificate. Analogous to the real world, the player's future earning prospects

were thus diminished by this land loss. In addition, as final player payoffs included payments for land in their possession (to represent the value of passing land on to their heirs), lost land further diminished earnings.

While game design pre-testing revealed that farmers readily understood this default mechanism, it proved to be a too-powerful incentive for insurance purchase in the game. It also made the game quite competitive as individuals enjoying teasing fellow players who lost their land. While it is true that Peruvian lenders threaten to seize land in the event of default, such threats are rarely implemented. In order to better capture the real world incentives, the game was modified such that defaulting individuals (1) lost access to the credit system for future rounds, and (2) were paid a lower value at the end of the game for land against which a credit lien was still held.

Other types of agricultural or livestock systems may present distinctive types of inter-temporal incentives. The photograph to the right shows women in the arid northern region of Kenya playing an index insurance game framed on the reality of their pastoral economy. Research from this region has indicated the presence of poverty traps: herds that fall below a critical threshold tend to collapse back toward a small herd size (a poverty trap equilibrium), while herds above that threshold tend to exhibit positive growth over time towards a higher-level equilibrium (see Lybbert et al. 2004 and Barrett et al. 2006).

To capture this complex reality, BASIS researchers designed a game in which each player is given chips to represent a stock of animals. The color of the chip represents either a large animal (for example, a cow or camel) or a small ruminant (for example, a sheep or goat). In the game, ten small ruminants are equivalent to one large animal. During each time period of the game, a net herd growth rate (which becomes negative in bad conditions when mortality is high) is randomly determined by drawing balls from two different sacks. In one sack, the color of the ball drawn determines the average growth or mortality rate. In the second sack, the type of face marked on the ball determines the individual-specific idiosyncratic variation around that average.

Each round represents a six-month period consisting of a rainy season and a dry season. To capture the growth dynamics implied by a poverty trap threshold, each player had to give up five small stock animals (equivalent

to half of a large stock animal) during each time period to cover consumption needs for his or her family. The effect of this fixed cost was to create an expected growth rate that is negative for herd sizes of fewer than seven livestock units, and positive for larger herds.

While not entirely faithful to the processes that seem to create poverty traps, this simplified approach was easy to explain and understand and could be implemented in the field where rudimentary conditions prohibit complex designs. By playing multiple rounds of the game, participants could begin to understand the impact of insurance on herd size and stability.



Kenyan farmers play the index insurance game with BASIS researchers.

Photo by John McPeak.

Two-way learning

The games just described offer two-way learning. First and foremost, the games were designed as a learning opportunity for the potentially insured. Ongoing research in Peru is probing the effectiveness of the games as a learning tool. Given findings in other studies that insurance uptake is enhanced when trusted local leaders recommend it (see Cole et al. 2008 for India), a long-term strategy may be to focus the games on a local cadre of respected farmers who can understand and then share their knowledge and recommendations with their broader communities.



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In addition to this primary type of learning, the experimental economics games discussed here also provide important lessons for the design of insurance contracts and their likely impacts. In the case of the Pisco cotton insurance project, variants of the game (with different contractual parameters) were played with local leaders, including heads of irrigation commissions and the cotton farmers' association. Their play revealed greater uptake for insurance with an intermediate strike point (payoffs begin when yields fall below 85% of their long-term average) than for either a lower (65%) or a higher (90%) strike point. After a debriefing discussion with this group, the final insurance contract was set with an 85% strike point.

The games can provide information on the effective demand for insurance contracts. Unlike abstract questions about whether people might "like" to have insurance, the games put the actual product on the table with its market price attached. In Peru, the game was played with a random sample of almost 500 cotton farmers in Pisco. Almost 60% of them purchased insurance in the game.

The Pisco game also provided some information on what the behavioral effects of index insurance might be. In the early rounds of the game, when farmers could choose only between the safe, low returning activity and the uninsured, debt-financed commercial activity, roughly 25% chose the former. These "risk-rationed" farmers kept themselves poorer on average than they needed to be given the options offered to them. Interestingly, when the index insurance contract was added to the options, more than half of these risk-rationed farmers shifted to the high-return activity, both borrowing money and purchasing insurance. It is this kind of behavioral change that index insurance is meant to induce.

To date, the game in Kenya has been played in only five communities in a pre-testing mode. Yet, 100% of the pastoralists playing the game purchased at least some

insurance. Those that built up larger levels of livestock in the game tended to insure only a portion of their herd, while those with fewer livestock tend to insure their entire herd.

It remains to be seen if these game results translate into actual purchases of insurance. BASIS researchers are carefully tracking this, so stay tuned for results in future *BASIS Briefs!*



Related reading

BASIS project webpage available at
<[www.basis.wisc.edu/projects_ama/
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