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# Learning from Lemons: The Role of Government in Index Insurance for Individuals*

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## Abstract

This paper considers the potential role of government in aiding the scale-up of high quality index insurance products in developing countries. In particular, we analyse optimal public policy in light of the fact that index insurance policies are typically credence goods - that is, the basis risk of a given policy cannot be distinguished by consumers before purchase and only to a limited extent after purchase. We discuss two potential market failures that stem from this property that governments may seek to correct: low take-up and low investment in reducing basis risk. In each case, we consider the costs and benefits of various alternative government policies. We show that policies aimed to improve take-up may improve or worsen incentives for investment, and that the precise nature of these effects will depend on the government's ability to commit, the marginal cost of funds, and their potential to identify the inputs necessary for constructing a high quality index.

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## 1. Index insurance products as a market for lemons

Insurance indices have enormous potential as a tool for affordable protection against catastrophic, covariate shocks for hundreds of millions of poor households in developing countries. However, recent attempts to sell index insurance in developing countries solely through the private sector have generally not scaled up (World Bank, 2011). One potential explanation for this low take-up is that, in many instances, the quality of the index insurance polices sold has been poor. In particular, after purchasing such products, farmers are frequently still left with a large amount of 'basis risk' – that is, the risk of a mismatch between an indexed claim payment and an incurred loss.

The issue of basis risk has been shown to have a significant impact on the welfare benefits of index insurance (see, for example, Clarke (2011)) and hence it is not surprising that we find evidence that in practice it is an important factor explaining non-purchase (see, for example, Mobarak and Rosenzweig (2013) or Dercon et al. (2012)). Although basis risk is often not explicitly calculated, existing evidence suggests it is frequently very high, with extremely weak correlations between the indices used to calculate payouts and farmer's output (see, for example, Clarke et al. (2012)). This low correlation comes about due to several reasons. In the case of weather insurance, for example, it may be that the index is constructed based on a weather station which experiences different weather to the farmer's plots (since weather stations are spaced over a large area). Furthermore, even in the case where the weather observed in the two locations is similar, it may be that the farmer experiences a different type of catastrophic shock, such as pests or disease, that is not covered by the insurance product. Farmer behaviour is also often difficult to estimate, and proper calibration may require many years of data. Hence by purchasing a policy with basis risk, the farmer is reducing their utility in the worst state of the world -where they experience a shock, but do not receive a payment.

When it comes to basis risk, not all index insurance products are created equally. Most of the previously piloted index insurance products have been based on indices that rely solely on data from weather stations. In recent years, a number of methods have been suggested for producing higher quality indices with lower basis risk. New technology can play a key role here, with satellite data being able to detect proxies of weather and yield, and cell phones with GPS technology being useful in providing audits for representative samples of crop cutting experiments. Moreover, basis risk can be reduced by increasing the number of datapoints used, both in terms of a single technology (e.g. building a denser grid of weather stations) and in terms of combining technologies. Insurance indices that are likely to be most effective at reducing basis risk might use some combination of video recorded crop cutting experiments conducted in the fortnight before harvest, weather data used for early trigger of claims, and satellite data for designing the sample and for auditing.

Producing a high quality, low basis risk, index insurance product however comes at a price. Collecting data from multiple sources will necessarily involve greater expense than using just a single source. Even if in the long term new technologies are no more expensive than existing ones, high costs will have to be borne in the initial stages to experiment with these technologies and research how the data evolves. Reinsurance is also likely to be more expensive (or impossible) until several years of data are collected, and during this time reinsurance companies are likely to be particularly onerous on ensuring there is sufficient auditing and validation of the index. At least in terms of initial costs, producing a high quality index will be substantially more expensive than producing a low quality one. This high cost will mean that it is likely to be inefficient to 'double up' on data collection, and hence there will be a significant part of the index construction that is a natural monopoly.

The quality of a given index insurance product is also likely to be very difficult for a potential customer to detect. For many types of insurance product it is possible to appraise the quality of a product by reading the policy terms and conditions, or to learn quickly about whether the product can be relied upon in extreme years. This is not the case for index insurance products. First, appraisal before purchase is particularly challenging because the claim payments from an index insurance contract are based solely on the realization of an index, and such an index may be poorly understood by the policyholder. For example, a smallholder farmer may have a very good understanding of her recurrent production risk, and even the weather as experienced on her land, but little idea of how this relates to millimeters of rainfall at a nearby contractual weather station, or whether a contract based only on weather data can be relied on in catastrophic years. Secondly, the covariate, catastrophic nature of shocks means that the potential to learn from experience is likely to be weak. It may be possible to learn quickly from experience for some insurance products, such as life and health insurance products, as one can learn from other policyholder's experience. However, index insurance claims are typically paid to all policyholders within a given area at the same time (triggered by the index), and so learning from others is slower.

We can therefore categorise index insurance as a credence good in the sense of Darby and Karni (1973). A credence good is a good whose quality is not observable before purchase and at best only partially observable after purchase. For the case of index insurance, particularly catastrophe index insurance, this observation is natural yet underexplored. Whilst reputation may be relied upon to prevent market failures for experience goods (where quality is always observed after purchase), this mechanism may not be sufficiently strong when it comes to credence goods. There is thus a risk of arriving at a 'market for lemons', where insurers do not invest in costly but low basis-risk indices because there is no market incentive for them to do so. This can lead to serious market failures if index insurance is left purely to private actors.

## 2. The potential role of government

The potential market failures that arrive in producing credence goods suggest that there may be an important role for government intervention in the index insurance sector. Indeed, the index insurance programs that have achieved the greatest scale, such as the mNAIS in India or IBLIP in Mongolia, have been public-private partnerships, with wide-ranging contributions from the public sector. Moreover, some sort of government involvement in agricultural insurance in general is extremely widespread. Governments frequently provide formal or informal safety nets to farmers in the case of large scale catastrophes. Moreover, the public sector often subsidises agricultural insurance products, with the total public cost of agricultural insurance programs estimated at 68 percent of the 2007 global premium volume (Mahul and Stutley, 2010).

The aim of our analysis is therefore to develop a theoretical model that provides a framework to analyze potential roles that governments could play in combatting market failures. We therefore wish to explore how public policy can improve the take-up of high quality index insurance products and how government programmes may improve or worsen the private sector's incentive to invest in quality indices. We also aim to explore how optimal public policy may depend on the country context, since we do not believe there is likely to be a 'one-size-fits-all' solution.

The analysis is based on a theoretical model with two periods. There are a continuum of consumers whose income is taken from a random distribution in each period, and a single firm selling insurance indices. There are then two potential indices, one of high quality and one of low quality. We assume that the firm maximises expected profit. At the beginning of period 1, the firm decides on the quality of product it will sell. In order to sell the high quality product, the firm has to make an investment that is significantly higher than that required for the low quality product. We assume that the cost of this investment is sufficiently low that it is in the interests of society for the investment to be made.

Both indices payout a fixed claim with a the same probability, and no claim otherwise, and in both cases the probability of payout is correlated negatively with income. The only difference between the two indices is that the higher quality index is more negatively correlated. In particular, if income is below a particular level, the high quality index is more likely to pay out than the low quality index, and this difference is larger the lower the income of the consumer. We assume that the firm faces a marginal administrative cost in selling an index insurance policy, and hence the total expected marginal cost is strictly greater than the expected payout.

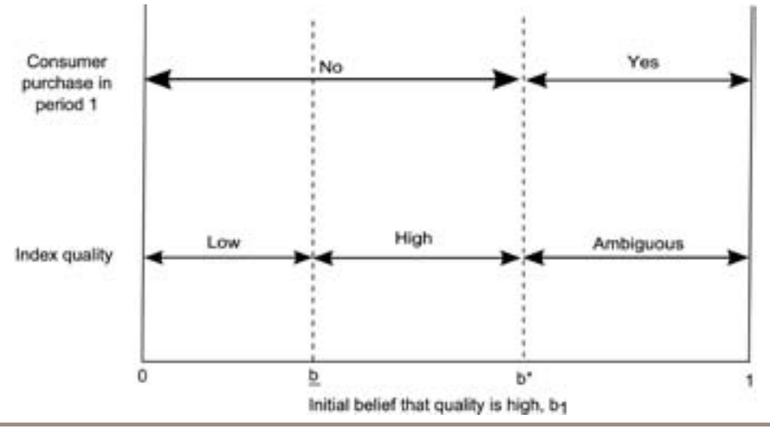
In terms of consumers, we assume that a certain share is risk averse and another part risk neutral. In this framework therefore it is never first-best for the risk neutral consumers to be insured using either product. For the risk averse consumers, we assume that buying the high quality product at cost price would increase their expected utility, but buying the low quality product would decrease their utility. Consumers observe only their own income and whether the index would have paid out, but cannot observe directly the quality of any index insurance product sold. In period one, they believe that with probability $b_1$ that the firm is selling a high quality product. In period 2, their beliefs are then updated using Bayes' rule. Consumers that experience a low income in period 1 and a payout will grow more confident that the product is of high quality, whilst those that experience a low income and no payout will become less confident the product is of high quality. Since consumers' expected utility is increasing in $b_1$, there will be a critical value $b^*$ above which consumers purchase the product when sold at cost, but below which they do not.

In this model, the firm does have some incentive to invest in a high quality index. Since a higher quality product is more likely to pay out when a consumer suffers low income, observing this ex post will make the consumer more willing to pay for the product in period 2. If consumers are not purchasing in period 1 (because $b_1 < b^*$), then this incentive to invest is increasing in $b_1$. This is because, in general, only consumers that are fairly confident to begin with will be able to move their beliefs enough to then purchase the product in period 2. Hence, if the cost of investing in the high quality index is not too large, there will be some critical value $\underline{b}$ where the incentive to invest is just enough to incentivise the firm to invest in the high quality product. This is displayed in Figure 1.[1]

In this situation, there are two potential market failures that the government may try to solve. First, when the insurance index is of high quality, the uptake is at times inefficiently low (in Figure 1, this corresponds to the portion where $\underline{b} \leq b_1 < b^*$). Welfare would increase if consumers bought the product at cost, but they do not do so because they believe it is too likely to be a low quality index (which it is not). Second, there are times when the firm may not invest in building the high quality index, even though it may be in society's interest for it to do so (even if this is only to improve the quality of policies sold in period 2). In the analysis that follows, we will focus on the scenario when there is no purchase in period 1 without government action (i.e. $b_1 < b^*$) since this appears to be the scenario that corresponds most closely to reality. We assume that the government maximises joint welfare – summing consumers' utilities and the firm's profit – and that it faces a marginal cost of raising public funds, $\lambda$. This cost represents the inefficiencies caused by the extra taxation required to raise funds.

1. Above $b^*$, the firm's incentive to invest may increase or decrease in $b_1$, depending on the distribution of income.

**Figure 1.** Firm investment and consumer purchase decision




We consider three ways in which the government may increase take-up. First, the government may subsidise premiums such that consumers only pay a fraction of the cost. This type of subsidy is extremely common for other agricultural insurance products, with the World Bank estimating that the overall government cost of upfront premium subsidies is estimated at 44 percent of original gross premiums (Mahul and Stutley, 2010). Second, the government may simply pay for all risk averse consumers to receive the policy for free. We label this policy social insurance, as it may be provided through a government social protection programme. Third, the government may regulate the price the firm can charge for the product. This policy is not so relevant in period 1 (where a lack of demand means the firm cannot exploit its monopoly power), but regulation will increase take-up in period 2 where the firm would otherwise charge an inefficiently high profit maximising price.

In terms of increasing investment, we consider two possibilities. First, the government may pay for part of the investment itself - in other words, subsidise the inputs into the index. This could be, for example, through providing the data necessary to construct the index. Second, the government may produce a licensing regime whereby the firm is only permitted to sell index insurance if it makes the investment required to produce a high quality index. It seems reasonable to believe that there is a limit on the share of the investment which the government can pay for or license - the government could oblige companies to use a certain data source, for example, but would have difficulty knowing whether they had used the time and skill required to understand how to make best use of this data.

The optimal policy mix for period 1, treating period 2 policy as exogenous, is presented in Figure 2. We can see that premium subsidies should certainly be used when consumers' confidence in the index being of high quality ($b_1$) is very close to the level whereby they would purchase at cost price, $b^*$, since in this case the subsidy required to achieve take-up is very



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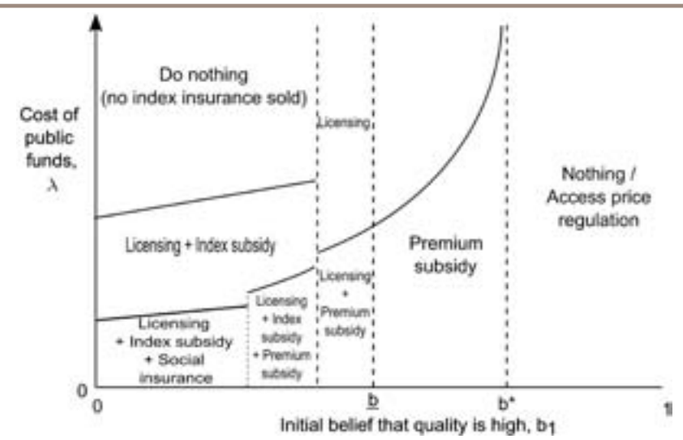
small. As consumers become less confident in the product however, the required subsidy becomes larger, and hence subsidies should only be recommended when the cost of public funds is relatively low. In other cases, it is not worth the extra distortive effect of the taxation required to ensure risk averse consumers purchase the product. When consumers have very low confidence in the index being high quality, targeted social insurance is preferable to premium subsidies. This is because the premium subsidy required would be so large that the expected payout of the policy would be greater than the effective price, and hence even risk neutral consumers would purchase.

**Figure 2.** Firm investment and consumer purchase decision




The marginal cost of public funds and consumers' initial beliefs also play a role when it comes to the optimal policy to encourage investment in a high quality index. When initial beliefs are just below the value $\underline{b}$, the firm does not need much encouragement to invest in high quality. In this zone, the government can simply use a licensing scheme to ensure that the firm no longer has the option of selling a low quality index. However, if consumers' beliefs are much lower, than the profits involved in selling index insurance will not be enough to stimulate investment, and the firm will prefer not to sell any index insurance at all. In this case, the government will need to help the firm by providing input subsidies, and whether or not this is welfare increasing will depend on the cost of public funds. Note that, in some scenarios (such as the case represented in Figure 2), it will be worthwhile the government subsidising the index inputs even when there is no take-up in period 1, in order to ensure that there is a high quality index in period 2.

The firm's investment decision will also depend on expected government policy in period 2. The impact of expected policy on the firm's investment decision depends crucially on whether or not the government licenses index insurance. Let us first consider the case where licensing is not possible. If the firm expects small premium subsidies in period 2, then they will be more likely to invest. This is because these subsidies will encourage more consumers who experience low income and a payout to purchase insurance. The firm hence has a greater incentive to ensure these consumers will indeed receive a payout. On the other hand, if the subsidies are large (to the extent they would succeed in getting consumers to buy in period 1) then the expectation of subsidies may reduce firm investment. Indeed, if period 2 subsidies are expected to be very large (or the government is expected to implement social insurance) then the amount of insurance the firm sells in period 2 will not be related to its payouts in period 1. As a result, it will have no incentive to invest in reducing basis risk. Similarly, anticipated price regulation will reduce the firm's incentives to increase demand, and hence reduce investment.

If licensing is possible, then the firm's investment decision is simply a function of their total expected profit from selling index insurance. Hence, in this case, subsidies, social insurance and a lack of price reduction will all increase the firm's investment incentives.

Clearly therefore, if a government can commit to the policy it will implement in period 2 it will have a greater number of tools at its disposal for encouraging the firm to invest. In reality, commitment to future policy is likely to be difficult, and the more likely scenario is that there exists policy inertia. This means that, if the government is implementing a particular policy in period 1, there is a greater probability that it will be implementing such a policy in period 2. If this is the case, then a more long-term view needs to be taken when designing period 1 policy. This inertia effect will push against price regulation and towards at least small premium subsidies, and depending on the licensing possibilities will either encourage or discourage the government to adopt large premium subsidies or social insurance.

## 3. Conclusions

Overall, we have shown that the need for investment in high quality index insurance products has important implications for government policy. The 'credence good' nature of index insurance policies means that firm reputation cannot be relied upon for making this investment without government support, and even when the investment has been made consumers may still not purchase. Public policy may correct these market failures through a mixture of premium subsidies, social insurance, input subsidies and licensing. The optimal policy mix will depend, amongst other factors, on the marginal cost of funds in the country and the government's ability to commit.

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