COVERSHEET

RISK ATTITUDES IN THE 'VICIOUS CIRCLE OF POVERTY' *

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Abstract

This paper examines attitudes to risk and the ability to manage risk as two separate stages in the vicious circle of poverty – a process that both causes and is caused by chronic poverty. We have investigated attitudes to risk employing an incentive-compatible research design among small-scale farmers in Ethiopia, Uganda and Andhra Pradesh (India). The evidence presented in this paper suggests that the vicious circle of poverty should be represented as follows. Due to the precarious conditions in which asset-poor small-scale farmers operate in poor countries, and in the absence of insurance markets, adequate risk management requires diverse livelihoods with low covariate risk between the factors that cause the uncertainty of income streams associated with each activity. Failing risk management strategies are bound to lead to a depletion of the (small) physical, human and social capital buffer, thereby increase the likelihood of income poverty in any given year, and thereby increase the likelihood of chronic poverty. A state of mind brought about by chronic poverty, which we measure with an index of perceived vulnerability, reduces one's willingness to undertake the risky investment that may offer an escape from poverty, which completes the circle. A research focus on risk attitudes allows one to see that the conservative or even inert entrepreneurship that traps its practitioners into low risk/low return activities is not necessarily evidence of their irrationality, incompetence or backwardness, but may well be a manifestation of a finely balanced survival algorithm. Testing for the presence of such a survival algorithm requires that one abandons the axioms of the dominant theory in economics of risky choice (expected utility theory) and enters the realms of decision-weighting models. We find strong evidence in favour of the descriptive superiority of such models in our data of precisely the kind that the survival algorithm implies; which is all the more remarkable, since risk experiments until date (in high-income countries) confirm decision-weighting models as we do, but find at the same time that the mirror image of the kind of weights we find describes their data best.

I. Introduction

A commonsense explanation of the persistence of poverty – and therefore of chronic poverty – in developing countries rests in the idea of the 'vicious circle of poverty': people are unable to take the actions which will extract them from poverty because they are poor. The idea of the vicious circle of poverty takes many forms, since the attribute of poverty which makes escape difficult may be poor health, lack of skill, lack of self-confidence or support mechanisms, remoteness from markets and institutions, lack of physical assets or borrowing power, or combinations of the above. But one key element in many versions of the spiral, in any country or environment, is *risk aversion*: if poor people are risk-averse to the extent that they are unwilling to invest in the acquisition of modern assets because that involves taking risks, they will remain poor, with willingness to climb the 'ladders out of poverty' – processes of investment in physical, human and even social capital – being confined to those who are economically secure and in possession of sufficient defences against risk.

Having been originally visualised by the founding fathers of development economics, and in particular Nurkse (1959) and Myrdal (1964), as a metaphor for the stickiness of poverty and underdevelopment, and taken up with altered language by the 'underdevelopment school' deriving inspiration from the Marxist tradition, the concept of the vicious circle disappeared underground, but has recently and eloquently been reinvented by the World Bank in its latest (2000) *World Development Report* on poverty.

> 'Extreme poverty deprives people of almost all means of managing risk by themselves. With few or no assets, self-insurance is impossible. With poor health and bad nutrition, working more or sending more household members to work is difficult. And with high default risks, group insurance mechanisms are often closed off. When a shock occurs, they must obtain immediate increases in income or cut spending, but in so doing they incur a high long-term cost by jeopardising their economic and human development prospects. These are the situations that lead to child labour and malnourishment, with lasting damage to children, and the breakdown of families'. World Bank 2000, page 146.

The emphasis in this quotation is on people's *ability to manage risk* rather than their *attitudes to risk*. In this paper, we address risk attitudes as a separate stage in the process of impoverishment (Figure 1). If true, the idea of a vicious circle 'driven' by

risk aversion has obvious distributional implications (Weeks 1972): for if the poor do not invest and the rich do, gains in enterprise income will be restricted to the rich, with the implication of growing inequality over time. Thus, if we are to understand the dynamics of poverty and inequality, we need to understand attitudes to risk, how they are distributed between individuals and if possible what influences, policy and other, have a bearing on those attitudes.

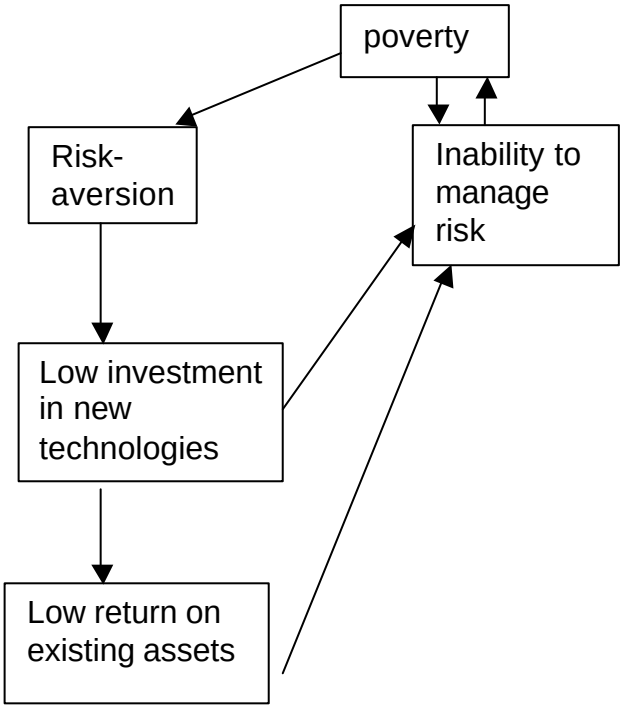

Figure 1. 'Vicious circles of poverty' based on risk-aversion and inability to manage risk

We report on a number of experimental tests of individual decision-making behaviour under risk conducted among small farmers in rural Ethiopia, rural Uganda and rural Andhra Pradesh (India) that employ an incentive-compatible design where participants in the experiment were paid according to the outcome of one of their choices. An accompanying household survey collected information on relevant socio-economic characteristics. To the best of our knowledge, since the pioneering studies by Binswanger (1980, 1981), no such experiments using techniques developed in laboratories in high-income countries have been conducted in low-income countries. Perhaps surprisingly, risk aversion measures derived from our experimentally obtained data are largely unresponsive to income and wealth in a regression analysis, echoing the results of the studies by Binswanger.

A natural conclusion at this stage would be that a methodology that fails to detect a pattern confirming a commonsense explanation of chronic poverty must be at fault. The 'fault' (such as it is) is known as the problem of doubtful external validity of behavioural data obtained in laboratory-type settings[1]. The intuition that lies behind the external validity critique on experimental economics is that even incentive-compatible research designs fail to capture aspects of people's *ordinary* behaviour since the experiment places them in an *extraordinary* situation. Our other findings prevent us from jumping to this conclusion. First of all, as may be seen from the way we have stated the argument in the first paragraph of this introduction, the vicious circle of poverty is not caused by poverty itself but by the psychological repercussions of chronic poverty. A life-history marked by material hardship and defencelessness, marked by finding oneself at the mercy of circumstances, contributes to an outlook on life that psychologists call an 'external locus of control', which is well-known to hinder a predisposition to entrepreneurship. The statistical significance in our risk aversion regressions of an index summarising respondents' perceptions of their vulnerability suggests the appropriateness of stating the vicious circle of poverty argument in this way.

Second, when we explore in-depth in two of our research locations (Sironko and Bufumbo in East Uganda) the relationships between small farmers' income poverty, their (human, physical and social) capital buffer, and their ability to defend themselves against idiosyncratic shocks, we find that the vicious circle of poverty argument should be stated in terms of probabilities (which also helps explain statistically insignificant coefficients in a regression analysis): income-poor farmers are more likely to be vulnerable in the double sense of being both asset poor and deriving income from sources exposed to a large degree of covariate risk; and would therefore be less likely to take the risks associated with the acquisition of assets.

Third, conventional risk aversion measures may be a red herring: utility maximising strategies in farm management models are remarkably insensitive to even unrealistically large variations in the Arrow-Pratt risk aversion coefficient (Pannell et al. 2000). We consider therefore that the proper empirical focus when analysing the

[1] See the symposium on experimental economics in the *Economic Journal* of February 1999.

influence of risk on small farmers' strategic plans may be on decision algorithms governing large discrete choices, and propose that a design for survival would cause asset-poor small farmers to discard an innovation with a non-negligible probability of failure, however attractive this innovation may be in terms of its certainty equivalent value, and even when the certainty equivalent value has been calculated using a value of the risk premium obtained with state-of-the-art research techniques from those same farmers. We find evidence of the presence of such a survival algorithm in the form of statistically significant deviations from axioms of subjective expected utility theory of precisely the kind that the algorithm implies in each of our research locations; which is remarkable, since these deviations are found in a direction diametrically opposed to the one normally found in experiments conducted in high-income countries.

The remainder of the paper is organised as follows. Section II traces the genesis of the notion of a vicious circle of poverty among small farmers; remarkably and perhaps significantly, theoretical and empirical interest faded once measurement began and no evidence of a relationship between poverty and risk aversion was found – ours is an attempt to revive such research interest. Section III describes the experiments on which the statistical analysis in the subsequent sections is based. Section IV presents measures of risk aversion and analyses their responsiveness to income, wealth (i.e. objective vulnerability) and perceived vulnerability; Section V examines the relationship between poverty and the ability to manage risk; and Section VI tests for a survival algorithm among the small farmers in our sample. Section VII restates the vicious circle of poverty argument in conformity with the tendencies evident in our data, and points to the potential for micro-insurance both as a means of escape for those trapped in the vicious circle and as a safety net that may protect others from falling prey to it.

II. Early literature

In principle vicious circles of poverty may occur within any sector of the economy, but the focus of most early research was on the attitudes and behaviour of small farmers. Throughout its 'years of high theory'[2], lasting from Rosenstein-Rodan's (1943) essay on the industrialisation of Eastern and South-Eastern Europe to the middle 1960s, development economics worked with the assumption that traditional agriculture operated with a surplus of unproductive labour, contrary to the neo-classical premise (see for example Schultz 1964) that all workers and other factors of production were paid, as their wage, the value of their marginal product. The controversy between these two approaches became particularly sharp at the end of the 1960s, and in the process risk aversion came to be emphasised as not only a reason for low levels of yield, but also as one reason why labour, and other factors of production, might not be hired up to the level of their marginal product[3].

Lipton in his essay on 'The Theory of the Optimising Peasant', argued that small farmers, rather than seeking to equalise the value of expected marginal products of factors of production, would practise a 'survival algorithm' (1968:337) – a decision rule which has a high chance of keeping the livelihood of the farm household intact – in the process sacrificing efficiency in resource allocation. The poorer the household, Lipton speculated, the more urgent the need to protect against risk in this way and the higher one's 'risk premium', or the subjective value attached to protection against risk:

> The risk premium is an increasing function of risk and a decreasing function of assets (Lipton 1968:335).

In other words, the arrow going from poverty to risk aversion in Figure 1 denotes an orthodox direct relationship – the poorer you are, the more you seek to avoid risk. The commonsense basis for this relationship is clear both from Lipton's paper and from the surrounding literature – the poorer you are, the less will be the *assets* which are

[2] Krugman's term (1993).
[3] Bliss and Stern (1982) based on research done in Palanpur, North India conclude that risk aversion was probably the reason lying behind some of their findings in the field – for example, might be the reason why ploughing labour and other factors of production were hired to less than the value of their marginal product.

available to protect you against catastrophe, and hence the more risk-averse your *attitudes* are likely to be[4]. Lipton presented this approach as a challenge to the standard rationality professed by neo-classical microeconomics :

> 'Compared with a lower-mean, lower-variance policy, MVPE [marginal value product equalisation] substantially reduces its practitioners' prospects of surviving to complete the sequence. *The more 'underdeveloped' the peasant, the stronger are [the] objections to the logic of MVPE*[5].'

In most writing of the 1960s and 1970s this is the manner in which the argument is presented: a chain of reasoning based on common sense, rather than on empirical observation. The copious evidence produced at this time in support of or in opposition to the hypothesis of surplus labour or 'disguised unemployment' did not directly examine the issue of attitudes towards risk: the various stages of the 'vicious circle of poverty', as depicted in Figure 1, were elided into one another rather than being regarded as separate stages of a process of impoverishment, and the idea that risk-aversion would increase with the level of poverty was assumed rather than measured. Once measurement began, it exposed the unexpected.

The studies by Binswanger (1980, 1981) represent some of the outstanding early applications of experimental economics, and as far as we are aware the only ones of their kind in a low-income country context until our own experiments. Working in semi-arid, risky-rainfall areas of Andhra Pradesh (India), Binswanger according to his own account (1981:867), 'chose an experimental approach when it became clear that we could not obtain reliable estimates of risk aversion by the usual interview techniques of eliciting certainty equivalents' and applied the now standard approach that attitudes to risk cannot be inferred from hypothetical questions about behaviour in face of such risk (e.g. 'would you prefer (a) £1000 now or (b) an equal probability of £2000 or zero determined by the toss of a coin?'), but rather must be derived from observation of actual behaviour under experimental conditions with real money being paid to the subjects of the experiments if the gambles made in the laboratory turn out successful.

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[4] As support for this view Lipton cites the 1954 book by Kalecki, *Theory of Economic Dynamics* (London 1954), which also presents the proposition in axiomatic form.

[5] Lipton 1968, page 330; italics ours. This statement is presented in terms of MVPE (marginal value product equalisation), which represents conventional 'optimising' behaviour under certainty. Under *uncertainty*, the corresponding optimising postulate becomes MEVPE (marginal *expected* value product equalisation). Later in his article, however, Lipton makes clear that his strictures apply to MEVPE as well.

In contradiction of the intuition of Lipton and many others, embodied in Figure 1, that risk aversion would increase with the level of poverty, Binswanger found that experimentally obtained measures of risk aversion are unresponsive to income and wealth[6]. On this view, there is no behavioural rationale for a vicious circle – if risk aversion is indeed unconnected with well-being and randomly spread across a large range of incomes, there is no presumption for believing that the poorest are less disposed to incur the gamble involved in entrepreneurship and investment, either in physical or in human capital or in social capital[7]. Binswanger's results are of course twenty years old and confined to one region of one country. Theory has moved on since the early eighties, but rather surprisingly not its testing within low-income countries. The 'commonsense theory' of Figure 1 and previous empirical evidence are thus in conflict, and an initial task confronting any researcher in this area is to bring them into some sort of relationship. With the help of our own experimentally obtained data for five research locations in three poor countries (described in Section III), we therefore examine a number of plausible explanations in Sections IV, V and VI why even experimentally obtained risk aversion measures might not register risk-avoiding behaviour of 'the' poor.

To begin with, the vicious circle of poverty argument as we have stated it in the introduction to this paper implies not necessarily that all poor people are especially risk averse (we like Binswanger find that risk aversion measures are largely unresponsive to income and wealth) but only those whose life-history is marked by chronic poverty and therefore perceive themselves to be vulnerable (Section IV) and find themselves unable to manage risk (Section V). Moreover, Binswanger interpreted his findings within the context of expected utility (EU) theory (von Neumann and Morgenstern 1944). However, since Binswanger many experimental economists in high-income countries (and some in middle-income countries) have discovered behaviours in face of risk which depart altogether from the standard EU axioms. We examine in Section VI whether a design for survival, which can be specified as a violation of the EU independence axiom, manifests itself in our data obtained for low-income countries.

[6] The only variables to which risk aversion was responsive were experimental rather than environmental ones – luck with the experiment and the size of the gamble.
[7] Binswanger inferred that differences in behaviour – in particular, reluctance to invest in modern inputs – were due rather to 'limitations on credit or on access to modern inputs' (1980:395).

III. Conducting the experiments

With the help of gambles involving coloured marbles and coloured bags, we have investigated attitudes to risk among semi-subsistence small farmers (median plot size ranging from two to three acres) in two areas in rural Uganda, two areas in rural Andhra Pradesh, India[8], and one area in rural Ethiopia. Table 1 summarises the research locations and sample characteristics. In an accompanying survey we collected relevant background information. Adopting official poverty lines (from the sources mentioned underneath Table 1), we calculate that 43.1% of the respondents are income-poor in the Ugandan survey areas, 45.1% in the Ethiopian one, and 50.5% in the Indian ones. They mainly grow maize (Uganda), rice (India), and coffee (Ethiopia). Price fluctuations are cited as the main threat to livelihoods by the Ugandan and Ethiopian respondents, drought by the Ethiopian and Indian ones, and health hazards are cited as a major threat by all.

The original research design was precarious: the experiment had to be simple because many participants are illiterate; and yet it remained important to choose a procedure that allowed a non-banal characterisation of small farmers' risk preferences. Participants were presented with various pairs of lotteries (Table 2), one with a higher expected value but riskier than the other, and were asked to state their preferred lottery out of each pair. In addition to these lotteries, the risk of which could in principle be resolved within the experiment, two hypothetical questions were added that elicited certainty equivalents (see Section IV). The pilot experiment took place in Uganda, and when we found that the methodology yielded promising results (Humphrey and Verschoor, 2002), we proceeded to replicate it in Ethiopia and India.[9]

[8] Interestingly, Vepur, one of the Indian research locations, is only 40 miles from ICRISAT headquarters at Patancheru from which Binswanger launched his surveys in 1980.
[9] For a detailed analysis of all our experimentally obtained data see Humphrey and Verschoor (2003).

Table 1. Research locations and sample characteristics

Location	Uganda Sironko (township), Sironko (district), East Uganda	 Bufumbo (sub-county), Mbale (district), East Uganda	Ethiopia Afeta Peasant Association (PA), Mana wereda (district), in the Jimma Administrative Zone of Oromiya region	India Vepur (village), Mahabubnagar (district) of the State of Andhra Pradesh	 Guddimalakapura (village), Mahabubnagar (district) of the State of Andhra Pradesh
Date	**October 2001 and February 2003**	**October 2001**	**February 2002**	**April 2002**	**April 2002**
Exchange rate (per 1 UK pound)	**2500 Ugandan Shillings (UGS)**		**12.5 Ethiopian Birr (ETB)**	**71.9 Indian Rupees (INR)**	
GDPpc as % of UK GDPpc	**1.6**		**0.53**	**2.12**	
Gini (Source: WDI) UK: 36.8 Brazil: 60.7 Netherlands: 32.6	**37.4**		**40.0**	**37.8**	
Average income per day per household (standard deviation)	**3750 UGS (3007)**	**1720 UGS (1479)**	**2.5 ETB (1.85)**	**30 INR (22.5)**	**38 INR (16.0)**
Average household size	**7**	**7.1**	**5.8**	**6.0**	**6.0**
Average daily wage (female/male)	**1000/1500**	**1000/1500**	**2.5/4**	**15/30**[2]	**15/30**[2]
Daily poverty threshold[3]	**852 UGS**	**852 UGS**	**2.7 ETB**	**40.6 INR**	**40.6 INR**
Average age	**38.2**	**40.6**	**45.0**	**36.4**	**36.4**
<20 (%)	**0.9**	**2.1**	**-**	**-**	**-**
20-30 (%)	**22.9**	**22.9**	**17.0**	**22.0**	**17.0**
30-40 (%)	**38.5**	**25.0**	**17.0**	**34.9**	**33.9**
40-50 (%)	**20.2**	**21.9**	**20.0**	**34.9**	**27.1**
50-60 (%)	**7.3**	**16.7**	**25.0**	**7.3**	**22.0**
60-70 (%)	**6.4**	**10.4**	**18.0**	**0.9**	**-**
>70 (%)	**3.6**	**1.0**	**3.0**	**-**	**-**
Sample size	**109**	**96**	**100**	**109**	**118**
Female (%)	**63 (57.8)**	**38 (39.6)**	**35 (35.0)**	**56 (51.4)**	**61 (51.7)**
Male (%)	**46 (42.2)**	**58 (60.4)**	**65 (65.0)**	**53 (48.6)**	**57 (48.3)**

1. *Participants were either the main income-earner or their spouse.*
2. *During the survey in Andhra Pradesh, the area was suffering from a drought, which triggered a general wage collapse – it was common to find women working for as low as Rs.2 and men for as low as Rs.8.*
3. *Sources:*
   Uganda: Appleton, Simon, 2001, 'Changes in Poverty and Inequality,' pp. 81-122 in: Ritva Reinikka and Paul Collier (eds.), Uganda's Recovery – The Role of Farms, Firms, and Governments, Washington: The World Bank.
   Ethiopia: World Bank Report: Ethiopia: Focusing Public Expenditures on Poverty Reduction Vol.III: Public Expenditure Review of Oromiya Region, World Bank, Dec.20, 2001:3.
   India: Planning Commission, Press Release, February 22, 2001.

The representation of risky prospects took place in essentially the same way in all five locations. When explaining problem [1] in Uganda, for example, prospect *R1* was represented as a red bag containing four coloured marbles. The experiment organiser, standing on a stage, placed one yellow marble into the bag and explained that, should this bag be selected and the yellow marble subsequently drawn, it would be worth 5000 Ugandan shillings (UGS). Two green marbles (each worth UGS 2000 and one blue marble (worth nothing) were added to the red bag. Prospect *S1* was represented by a (blue) bag containing four green marbles, each worth UGS 2000.

Table 2. The lotteries

	Option1			P(1)	Option2			P(2)	Option3			P(3)
	UGS	**ETB**	**INR**		**UGS**	**ETB**	**INR**		**UGS**	**ETB**	**INR**	
R1	**5000**	**20**	**25**	**0.25**	**0**	**0**	**0**	**0.25**	**2000**	**8**	**10**	**0.5**
S1	**2000**	**8**	**10**	**1**								
R2	**5000**	**20**	**25**	**0.25**	**0**	**0**	**0**	**0.75**				
S2	**2000**	**8**	**10**	**0.5**	**0**	**0**	**0**	**0.5**				
R3	**5000**	**20**	**25**	**0.75**	**0**	**0**	**0**	**0.25**				
S3	**5000**	**20**	**25**	**0.5**	**2000**	**8**	**10**	**0.5**				
R4	**10000**	**44**	**55**	**0.5**	**0**	**0**	**0**	**0.5**				
S4	**4500**	**20**	**25**	**0.75**	**0**	**0**	**0**	**0.25**				
R5	**4500**	**20**	**25**	**0.75**	**0**	**0**	**0**	**0.25**				
S5	**4500**	**20**	**25**	**0.5**	**3500**	**16**	**20**	**0.25**	**0**	**0**	**0**	**0.25**
R6	**10000**	**44**	**55**	**0.5**	**0**	**0**	**0**	**0.5**				
S6	**4500**	**20**	**25**	**0.5**	**3500**	**16**	**20**	**0.25**	**0**	**0**	**0**	**0.25**
R7	**10000**	**40**	**50**	**0.25**	**0**	**0**	**0**	**0.75**				
S7	**3000**	**12**	**15**	**0.75**	**0**	**0**	**0**	**0.25**				

Each of the problems was also presented in the form of a coloured illustration that participants had in front of them on a sheet of paper (Ethiopia and Uganda), or that were large and on display (India). These illustrations showed the contents of the red and blue bags, with appropriate values attached to each differently coloured marble. Participants then pointed to the bag they preferred and a helper recorded their choice.[10] We did not let any of the participants write anything themselves, because as mentioned before, many of them are illiterate or semi-literate and may well have felt awkward holding a pen. We started the experiments with a dummy question that was explained till participants grasped what was expected of them.

[10] In India participants were asked to step into a booth when their name was called, where they were asked to point to the bag of their choice. Our enumerators suggested this device, because it would ensure anonymity of choice, and because frequent periodic elections in this part of the world mean that participants are very used to pooling booths.

Next participants were told: 'When you have finished the questions that we are about to put to you, we will randomly select one by drawing a number from this bag which contains pieces of paper numbered consecutively.[11] We will then look at how you chose in this problem and play out your chosen alternative by selecting a coloured marble from this bag, which contains (marbles as appropriate). If you win you will be paid in cash on the spot.[12] Because you will not know which of these problems will be played for real money until all problems have been answered you should consider each of them carefully and as if they are all for real money.' Both beforehand and again and again throughout the experiment, it was emphasised that because the real payment problem would not be known until all problems had been completed, any problem could be for real money. Participants were thus motivated to consider all problems as if they were being played for real money.

Half our sample got the questions in one order, the other half in the reverse order. We disguised what we were testing by having a problem order (not the order presented in Table 2) that does not place similar questions next to each other. We worked with groups of approximately 10 participants at a time, and one helper per participant. They were spatially separated to discourage conferring, and were told that any talking, apart from asking questions of clarification, would lead to their exclusion from the prize-winning part of the experiment. A session with one group typically lasted between three and three-and-a-half hours, with often at least 60% of the time spent explaining the experiment (introductory examples, playing a real gamble with volunteers, playing the dummy question, and so forth). Locations were school or community halls, and in one case (Ethiopia) a field under the shade of trees.

[11] In the Ethiopian and Indian experiments, question numbers were written on pieces of paper and put in a bag (or box in India) only after participants had stated all their preferences, and one of the participants was invited to draw a number; enumerators found that this way of doing it enhanced the experiment's transparency and credibility in the eyes of the participants.

[12] In India winnings were paid in vouchers, redeemable at the local bank (with no transaction costs to the participants).

IV. Measures of risk aversion

In expected utility theory, risk aversion is related to the concavity of the agent's utility function, and can be expressed as a combination of some or all of: its first and second-order derivatives, initial wealth, and the stochastic variable that determines increments to wealth (e.g. Laffont 1989). If we assume that the utility function is twice differentiable, Arrow-Pratt's approximation allows us to disentangle the respective effect on welfare of risk and preferences, as follows. Let U (W) be a suitably behaved concave utility function in wealth, and let Z be the prize of the lottery, a the probability of winning the prize, and ? the reservation price. A measure of risk aversion ? equal to minus the second divided by the first-order derivative of the utility function can then be deduced by developing a Taylor expansion of U (W– ?) and U (W+Z– ?) around U (W) and solving for ? (for details see Gollier, 2002)[13].

$$? = (aZ - ?) / (?^2 / 2 + aZ^2 / 2 - a\,?Z)$$

Putting a number to an individual's attitude to risk with the help of such a measure becomes possible once he or she has stated the certainty equivalent of a stochastic variable. We have elicited certainty equivalents with the help of these two questions:

Imagine you own the lottery and are about to play it for real money. What is the minimum amount I would have to give you so that you forego playing?

8. \$5 with p=1/4; 0 with p=3/4
9. \$1.5 with p=3/4; 0 with p=1/4

Following Hartog et al. (2002) we calculate risk attitudes from these Willingness To Accept (WTA) questions with the help of the Arrow-Pratt measure of absolute risk aversion developed above: we call risk aversion measured from responses to question 8, AP8, and from question 9, AP9.

[13] Multiplying ? by wealth gives a measure of relative risk aversion (that is, a dimension-free measure of an individual's willingness to accept a gamble when wealth and the size of the prospect both increase by the same proportion). Although tempting, we stop short of doing this, because, as a result, the measurement error of risk aversion would be compounded by that of wealth (cf. Hartog et al., 2002).

Table 3. Risk aversion and income and wealth etc. (a)

	Uganda	Ethiopia	India	Uganda	Ethiopia	India
Region = 1 (b)		-	AP8** AP9***		-	AP8** AP9***
Female = 1 (c)			RA2** RA3**			RA2** RA3**
Age (c)		RA5*	AP8* AP9*			AP8* AP9*
Literate = 1						
Income pc (d)		RA2*		-	-	-
Wealth pc (d)	-	-	-	RA2** RA5* RA6*		
Dependency ratio						

(a) Dependent variables are AP8, AP9, RA2, RA3, RA4, RA5 and RA6, and are inserted in the table when a coefficient on an independent variable is statistically significant (* at 10%, ** at 5%, *** at 1%)
(b) Bufumbo = 1 in Uganda; Gudi = 1 in India. Significant coefficients are positive
(c) Significant coefficients are negative
(d) Significant coefficients are positive

The Arrow-Pratt measure of risk aversion assumes the validity of Expected Utility (EU) theory. Given the extent to which EU is violated in our sample (Humphrey and Verschoor 2003 and Section VI below), a measure of risk aversion that does not hinge on its validity would be preferable. We therefore develop a simple, theory-free, intuitively plausible measure of risk aversion based on the number of times that participants in our experiment, when given the choice between two lotteries, say they preferred the risky to the safe lottery. Participants were in effect faced with two kinds of probability when asked to state a preference for a lottery: the probability that this lottery would be the one played 'for real' (one over the number of pairs of lotteries) and the probability of winning a prize of a certain size within this lottery (listed in Table 2). By sometimes choosing a safe lottery and sometimes a risky, they could therefore manipulate the probabilities of winning various prizes in ways that would not be open to them when presented with only one lottery. It should in principle be possible to infer both an overall risk premium and probability preferences from the patterns of responses participants exhibited. As a first cut, we simply count the number of times they indicated a preference for the risky lottery. Our risk aversion measures take the value one (1) for participants who preferred risky lotteries least frequently (so, for instance, RA3 = 1 for participants who state a preference for a risky lottery less than three times) and zero (0) otherwise.

When we replicate Binswanger's regressions we find results broadly similar to his. Table 3 summarises thirty six risk aversion regressions (binary logistic regressions in the case of the RA measures) on income, wealth and other household and personal characteristics. Although income and wealth (and some of the other explanatory variables) are in some specifications associated with some of the risk aversion measures, significance is obviously not robust to specification and may well be spurious. However, the vicious circle of poverty argument as we have stated it in the introduction to this paper implies not necessarily that all poor people are especially risk averse but only those whose life-history is marked by chronic poverty and therefore perceive themselves to be vulnerable. For Sironko, Uganda, we are able to test this: we asked 82 out of the 109 participants in the risk experiment to indicate their degree of agreement with a number of statements that capture various aspects of perceived vulnerability, on the basis of which we constructed an index (Box 1). The coefficient on the index appears with the expected sign and is significant in binary logistic regressions of the RA measures (but its coefficient in regressions of the 'less true to life' AP measures is insignificant – tried but not reported on here).

Table 4. Risk aversion and perceived vulnerability etc.

	RA2	RA3	RA4	RA5
Constant	-2.038* (2.924)	0.248 (0.043)	0.354 (0.059)	1.409 (0.502)
Age	0.003 (0.020)	-0.017 (0.573)	0.004 (0.021)	-0.024 (0.367)
Gender	0.534 (1.246)	-0.620 (1.328)	-0.414 (0.421)	-1.118 (1.387)
Education	-0.093 (0.843)	0.352 (0.458)	0.548 (0.751)	0.619 (0.480)
Dependency ratio	1.622 (2.031)	0.663 (0.307)	-0.112 (0.006)	-1.057 (0.262)
Perceived vulnerability	0.033* (3.435)	0.041** (4.464)	0.038* (2.812)	0.103*** (7.104)
Nagelkerke R^2	0.127	0.123	0.082	0.289
N	82	82	82	82

Wald-statistics in parentheses. * Significant at 10%, ** at 5%, *** at 1%

Box 1. Perceived vulnerability

Constructing a perceived vulnerability index

The index uses scores that reflect respondents' degree of agreement with a number of statements about themselves that fall into four broad categories: memories and expectations of poverty throughout their and their children's lifetime; short-term income dynamics expectations; perceived risk of potentially high return farm activities; and self-respect and perceived own status. The higher the index, the higher is someone's perceived vulnerability (range: 0 – 100).

1. Memories and expectations of poverty (range: 0 – 30)

Respondents were asked to think of poverty as having an income inadequate to cover expenditures on food, clothes, housing, medical care, schooling and important ceremonies (circumcision, burial, marriage and so forth). [Possible scores]

- ?? I will be poor next year [0, 1, 3, 5, 6]
- ?? I have been poor for most of my life [0, 1, 3, 5, 6]
- ?? My children have been poor for most of their lives [0, 1, 3, 5, 6]
- ?? I will be poor for most of the rest of my life [0, 1, 3, 5, 6]
- ?? My children will be poor for most of the rest of their lives [0, 1, 3, 5, 6]

2. Expectations of short-term income dynamics (range: 0 – 20)

Scores are based on the degree of confidence respondents expressed that their income would be higher in, respectively, one and five years' time. [Possible scores]

- ?? My income will be higher/lower next year [0, 2, 5, 8, 10]
- ?? My income will be higher/lower in five years' time [0, 2, 5, 8, 10]

3. Perceived risk of entrepreneurial behaviour (range: 0 – 20)

Scores are based on respondents' degree of agreement with the following statements. [Possible scores]

- ?? If I were to buy more hybrid seeds, I might get into financial difficulties [0, 1, 2, 4, 5]
- ?? If I were to hire more workers, I might get into financial difficulties [0, 1, 2, 4, 5]
- ?? If I were to improve my land, I might get into financial difficulties [0, 1, 2, 4, 5]
- ?? If I were to buy more land, I might get into financial difficulties [0, 1, 2, 4, 5]

4. Self-respect and perceived own status (range: 0 – 30)

Scores are based on respondents' degree of agreement with the following statements. [Possible scores]

- ?? I am an important person in my community [0, 2, 4, 8, 10]
- ?? I am an important person in my family [0, 2, 4, 8, 10]
- ?? I am an important person in my own eyes [0, 2, 4, 8, 10]

V. Poverty and risk management

Effective risk management requires protection against idiosyncratic shocks. In the absence of insurance markets, reducing exposure to external shocks usually takes the form of livelihood diversification among small farmers in developing countries (Ellis 2000). The uncertainty in income streams associated with one type of capital or productive activity is offset by that of others within the household economic portfolio to the extent that risk correlations between livelihood components are low. In this section, we explore for two of our research areas, Sironko and Bufumbo in East Uganda, the extent to which income-poor and asset-poor households (are able to) diversify assets and productive activities, as a measure of exposure to shocks affecting single income sources.

Reported income figures in our sample are unreliable, usually underestimating actual income. First, respondents tended to focus on income sources that generated a regular cash flow, ignoring other sources. Second, they did not include production for own consumption. Third, some respondents assumed that their participation in the survey would make them eligible for future government support, and were therefore inclined to understate their income. We therefore impute total household income using data obtained separately for a number of income sources (Table 5).

Table 5. Household income by source (in UGS; all sample; n = 297)

Income sources	Mean	Percent of households	Conditional mean	Conditional min.	Conditional max.	Conditional median	Conditional Standard deviation
Crops	100,544	96.0	104,778	2,400	1,920,000	57,600	191,045
Livestock	41,003	83.5	50,115	160	590,080	38,720	69,440
Waged labour	20,651	33.7	57,322	3,200	681,600	32,000	87,136
Other	88,018	42.8	244,313	12	2,912,000	166,400	356,642
Total imputed income	201,682	-	201,682	4,480	4,104,480	95,424	365,950
Income per adult equivalent	61,613	-	61,613	1,056	1,093,241	32,305	104,886

(a) Net income from crops. Calculated as total yield times the actual selling price if some of the harvest was sold (times the local farm gate price if none was sold) minus the costs of all inputs used for production (apart from household labour): pesticides, fertiliser, seeds, draught power, land (if rented), outside labour and credit.
(b) Net income from livestock. Calculated as income from selling produce plus potential income from selling the livestock itself, imputed on the basis of locally obtained estimates of the costs of raising, selling price when mature and average lifetime.
(c) Income from waged labour (as reported by respondents).
(d) Income from various other sources, including own business, rental of farm equipment, and remittances (as reported by respondents).

The last row of the table reports income figures adjusted for household composition and size: by using equivalence scales appropriate for rural East Uganda (as reported in Appleton, 2001b), and by making a conventional adjustment for economies of scale in group consumption (a set at 0.22; cf. White and Masset, 2002). Appleton (2001a) calculates a poverty line for East Uganda in 1993 prices of 15,446 UGS per adult equivalent household member per month. Adjusting this line for inflation using the composite national CPI (consumer price index) sets it at 25,563 UGS (almost exactly half a dollar a day) for our survey period. A household with a monthly income per adult equivalent below this line will be said to be income-poor.

Table 6: Poverty headcount (P_0) statistics

	P_0	Significant at (1-tailed) [a]	Contribution to sample P_0	N
All sample	43.1	-	100.0	297
Female-headed	60.0	0.067	11.7	25
Sironko	37.6	0.006	43.0	146
Bufumbo	48.3	0.000	57.0	151
Below median:				
Physical capital [b]	72.5	0.000	84.4	149
Human capital [c]	53.0	0.009	61.7	149
Social capital [d]	44.7	0.369	56.2	161
Low coping ability [e]	64.1	0.000	64.0	128

(a) Based on a binomial test that compares the distribution of poor and non-poor in each sub-group with a specified probability of being poor. The alternative hypothesis is that this probability is at most equal to 0.431 (the sample poverty headcount ratio), apart from for Sironko and Bufumbo, where the alternative hypothesis is that this probability is at least (most) equal to the poverty headcount ratio in the other region.

(b) Physical capital has been calculated as the monetary value per adult equivalent of a household's land, house, livestock, farm equipment and farm buildings.

(c) Human capital has been calculated as total discounted expected future income per adult equivalent that can be attributed to the levels of education achieved by a household's members, using the private rates of return currently prevailing in Uganda on primary, secondary and tertiary education, reported in Appleton (2001b).

(d) Social capital is measured using an index that captures a household's reciprocal bonds with outsiders (bonding), its perceived degree of community support (bridging) and its benefits from government programmes (linking social capital), giving equal weight to each type of social capital with weights based on relative median values.

(e) Coping ability is the weighted sum of physical capital (converted to standard units), human capital (converted to standard units) and social capital, with weights determined by the relative median values. The cut-off line has been set at the cumulative percentage of 43.1, deliberately equal to the sample P_0.

Table 6, column 1, presents poverty headcount (P_0) statistics for various groups, column 2 significance levels for a test that compares binomial distributions across groups, and column 3 each group's contribution to the sample P_0. The probability of being poor is significantly higher for female-headed households (at the 7% level) and for Bufumbo compared to Sironko (at the 1% level). Single-year income poverty

measures may not accurately represent farm households' medium to long-term welfare; they shoot up when, say, crops fail even though a capital buffer may be in place to mitigate the impact of negative shocks.[14] The second panel of Table 6 reports P_0 for groups of asset-poor households, with asset-poverty defined as values of physical, human and social capital, respectively, below the sample median (cf. notes b, c and d). A measure of coping ability (the inverse of asset-poverty) has been constructed that summarises a household's asset portfolio (note e). The probability of being income-poor is significantly higher for each asset-poor group (at the 1% level) apart from for the low social capital group.

Table 7 presents the results of t-tests for the equality of sample mean numbers of crops, livestock and income sources and analogous mean values for each income-poor group identified in Table 6. Out of a total of twenty-four possible inequalities sixteen mean values for poor groups are significantly lower, and two are higher. There are plausible explanations for the two minority findings. In Bufumbo the regional effect appears to dominate the effect due to poverty on number of crops grown. The higher mean number of crops grown by less educated households may be explained by the observation that low levels of education tend to block access to non-agricultural income sources (cf. footnote 14) and lead to a dependence on agriculture alone. These two exceptions confirm the rule that income poverty and asset poverty are associated with a greater exposure to idiosyncratic shocks.

Table 7: Diversification among income-poor and vulnerable household groups

Income-poor:	Number of crops	Number of livestock	Number of income sources	N
All sample		Lower ***	Lower ***	128
Female-headed	Lower *	Lower **		15
Sironko	Lower ***	Lower ***	Lower **	55
Bufumbo	Higher **		Lower ***	73
Below median:				
Physical capital		Lower ***	Lower ***	108
Human capital	Higher *	Lower *	Lower ***	79
Social capital		Lower ***	Lower ***	72
Low coping ability		Lower ***	Lower ***	82

**** Denotes significance at 10%, ** at 5%, *** at 1% for a one sample t-test (2-tailed) for equality of means. Test values are the sample mean number of crops, livestock and income sources, respectively.***

[14] Physical and social capital may be converted into liquid assets in times of hardship; human capital not only raises permanent income but also increases access to non-agricultural income sources (quantified for Uganda in Appleton, 2001c).

VI. EU violation and a design for survival

At this point we should hark back to Binswanger's and our own risk aversion regressions that failed to register a response to income and wealth (Sections II and IV, respectively). Income poverty is associated with asset poverty and both types of poverty are associated with vulnerability in the sense of less diversified livelihoods (Section V). Although the strength of the association is strong, the mere fact that *some* of the poor not *all* of the poor are vulnerable, combined with significant coefficients on a perceived vulnerability index in risk aversion regressions (Section IV), suggests that grouping all poor people together in a wholesale analysis fails to detect a vicious circle of poverty that can be detected through a different approach. In this section we examine the possibility that the risk aversion measures themselves may be a red herring, by conceptualising the concept differently.

Binswanger interpreted his findings within the context of expected utility (EU) theory, under which individuals choose between options on the basis of the utility of the certainty equivalent value of the future outcomes which might result from each option, with risk aversion inherent in the shape of the utility function, and measured by the Arrow-Pratt coefficient: an axiomatically derived approximation of its degree of concavity (see Section IV above). However, since Binswanger many experimental economists in high-income countries (and some in middle-income countries) have discovered behaviours in face of risk which depart altogether from the standard EU axioms. We examine in this section whether a design for survival on the part of asset-poor small farmers, which can be formally expressed as a violation of the EU independence axiom[15], manifests itself in our data obtained for low-income countries.

[15] Expected utility (EU) theory rests on a set of axiomatic principles of rational choice: *Ordering:* individuals are willing to state preferences across all pairs of alternatives, and these preferences are transitive, in other words, having once preferred A to B, and B to C, they do not then prefer C to A. *Continuity*: there are no kinks in indifference curves. *Independence*: for any three prospects A, B and C, if A is preferred to B then an x per cent probability of A combined with a (1-x) per cent probability of C will always be preferred to an x per cent probability of B combined with a (1-x) per cent probability of C, *whatever the probability x may be*; in other words, once third options are introduced, they do not, however they are presented, alter the structure of an individual's preference between any two basic options.

Although EU theory is the dominant theory of decision-making under risk in economics, the axioms it rests on are not robust to testing under experimental conditions (see Camerer 1995 and Starmer 2000 for recent surveys of the evidence). Debate continues not only about the descriptive accuracy of EU axioms, but also about which of several non-EU theories is best[16]. The experiments on which we report in this paper have been specifically designed to be able to discriminate between some of the most prominent theories of rational choice that are now on the market. We explore elsewhere in-depth the appropriate characterisation of risk preferences suggested by our experimentally obtained data (Humphrey and Verschoor 2002, 2003). Here we focus on the decision-weighting, and the specific type of EU violation, suggested by a reinterpretation of Lipton's (1968) survival algorithm. As will be recalled from Section II above, Lipton intuited that asset-poor small farmers may discard prospects with attractive expected values when the probability of failure is substantial, as part of a rational long-term survival strategy.

A convenient and frequently deployed test to discriminate between EU theory and decision-weighting models is the common consequence effect. Common consequence effects are violations of the independence axiom of EU theory observed over decision problems of the type described in Figure 2 (based on Figure 2 in Humphrey and Verschoor 2002).

Figure 2. *Common Consequence Effect Problems* [a]

Problem [1]	*R1*:	5000, 0.25;	2000, 0.5;	zero, 0.25	[2250]
	S1:		2000, 1.0		[2000]
Problem [2]	*R2*:	5000, 0.25;		zero, 0.75	[1250]
	S2:		2000, 0.5;	zero, 0.5	[1000]

[a] Each decision problem is a choice between a relatively safe and a relative risky alternative. All outcomes are in Ugandan Shillings (UGS). In problem [1], for example, the choice is between *R1* and *S1*. The numbers in square brackets show the expected value of each lottery.

Problem [2] is generated from problem [1] by deleting from the intermediate outcome in both the relatively safe and the relatively risky alternative a 0.5 probability of 2,000

[16] Starmer, in his recent review (2000:1) claims that these models 'now number well into double figures'.

UGS. Formally stated, the independence axiom requires that for any two prospects where $x \succ y$ ('?' denotes strict preference) the introduction of a third prospect z and probability $0<p<1$ does not disrupt the original preference relation between x and y, so that $[x, p; z, (1-p)] \succ [y, p; z, (1-p)]$. Therefore, in this context, it requires that, having once preferred R1 (S1), an individual should then prefer R2 (S2). The specific violation of the independence axiom commonly observed in laboratories in high-income countries over problems [1] and [2] is that R2 ? S2 is significantly more frequent than R1 ? S1. By contrast, in Lipton's survival algorithm, asset-poor small farmers avoid prospects in which a probability of failure looms large, which tendency, if sufficiently strong, would cause R1 ? S1 to be significantly more frequent. This is precisely what we find in the second panel of Table 8 in each of our research locations, echoing in a more formal way Lipton's claim that expected marginal value product equalisation may 'substantially reduce its practitioners' prospects of surviving to complete the sequence'.

The third panel of Table 8 shows that the violation rate of EU axioms as manifested by the common consequence effect ranges from 32 to 40% in our research locations. These rates are broadly similar to those observed in experimental laboratories in European and North American universities (Starmer 2000) and slightly higher than the 26% violation rate reported in Finkelshtain and Feinerman (1997) on the behaviour of agriculturists from a middle-income country (Israel). An implication of our findings is that if we were to calculate a (lower bound on) the risk premium from respondents' revealed preferences in problem [1], and use it to calculate certainty equivalent values of the prospects represented in problem [2], we would overstate the attractiveness to our respondents of prospect R2. Lipton stated his argument in terms of a higher risk premium for asset-poor small farmers but this requires careful application: they may well discard prospects with high certainty equivalent values, even when these have been calculated using a value of the risk premium obtained from the concerned farmers themselves. So, although for a majority of small farmers EU axioms *are* descriptively accurate, the crux is that any inference about the likelihood of a 'vicious circle' driven by a high risk premium needs to take into account the possibility that for some farmers at least, risk aversion may not manifest

itself primarily in the risk premium as conventionally measured, but in the weighting of probabilities associated with failure and loss.

Table 8. Common consequence effect and EU violation

Location: / Pattern of choices:	Uganda	Ethiopia	Andhra Pradesh
R1 ? S1 then R2 ? S2	33	20	50
R1 ? S1 then S2 ? R2	44	25	58
S1 ? R1 then R2 ? S2	21	12	33
S1 ? R1 then S2 ? R2	107	43	86
N	205	100	227
((R1 ? S1)/ (R2 ? S2)) * 100 (Chi-square statistic) (a)	142.6*** (16.7)	140.6*** (9.0)	130.1*** (13.3)
((R1 ? S1 then R2 ? S2) + (S1 ? R1 then R2 ? S2)) / (N/100)	31.7	37.0	40.1

*** Denotes significance at 1%.

(a) Significance based on a chi-square test of H_0: P(R1 ? S1)/ (R2 ? S2)) < 1

VII. Conclusion

Farming everywhere is a risky business, and for no one and nowhere more so than for small-scale farmers who operate in precarious conditions in poor countries. When evaluating promising investment opportunities (say a superior technology) they must implicitly attach probabilities to the possibility of an improved livelihood, and to the possibility that the promise fails to deliver and that the required investment outlay (perhaps financed by 'micro-debt') locks them firmer into poverty. Since they are in it for the long haul, they must tread carefully, and may not bite when presented with the bait of innovations doctored by agricultural extension workers or globe-trotting agricultural 'specialists'. As Lipton (1968:327) saw, 'the farmer is no fool': things are not always what they seem, and observed conservative or even inert entrepreneurial behaviour *may* just be a manifestation of a finely balanced design for survival rather than of laziness, incompetence, or 'cultural values'.

To jump and maybe fall, or not to jump at all, that is the question. The expected value of the jump may get one over the ravine, but the variation in possible outcomes may prevent one from jumping – that is the logic behind Lipton's critique of marginal expected value product equalisation. Detecting it in the data requires careful application. An analysis of the responsiveness of risk aversion measures to income and wealth fails to register it convincingly, but a similar analysis applied to a state of mind induced by chronic poverty does not. Moreover, risk aversion may manifest itself primarily in the over-weighting of probabilities associated with failure and loss, which requires an analysis outside the box of the dominant theory in economics of risky choice.

The evidence presented in this paper is suggestive of a vicious circle of poverty of the following kind. The root cause of an insurance market failure requires that the agricultural household's economic portfolio consists of components with low covariate risk, which in developing countries is commonly achieved through a diversification of livelihood sources. When such risk management strategies fail – and given enough time and the stochastic nature of idiosyncratic shocks over time – hit

after hit after hit will lead to a depletion of the (physical, human and social) capital buffer and thereby to an increased probability of income poverty in any given year, and thereby to an increased probability of chronic poverty. Chronic poverty itself, through its reign of terror on health and strength, self-esteem and optimism, reinforces the risk avoidance that is prescribed at any rate by a long-term survival strategy. Avoidance of risky investment opportunities that offer an escape from poverty completes the circle.

'Micro-insurance' (against drought, crop, animal and human disease, and so forth) promises to tackle the moral hazard and asymmetric information problems that have previously plagued efforts to deliver insurance services to clients below and just above the poverty line, through ingenious delivery mechanisms that make use of local information and/or externalities of existing (micro-finance) groups[17]. If it lives up to its promise, micro-insurance against the most pertinent risks associated with the acquisition of assets may prevent those at risk from being sucked into the vicious circle of poverty by reducing the demands on the household economic portfolio to protect against idiosyncratic shocks, which then allows the household to specialise in its highest-return activities; and it may break the circle for those already trapped in it by offering a sure (although more costly!) escape from poverty.

[17] See the theme issue on micro-insurance of *Small Enterprise Development*, Volume 12, Number 1, March 2001.

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