Experimental evidence for time preference among Mikea foragers and farmers: Implications for subsistence and development

Bram Tucker (Corresponding author)
Ohio State University
Department of Anthropology
244 Lord Hall
124 W. 17th Ave.
Columbus, OH 43210
bram@bramtucker.us

Daniel A. Steck
University of Oregon
Oregon Center for Optics and
Department of Physics
Eugene, OR 97403-1274
dan@steck.us

DRAFT (21 Dec 2004): Do not cite without authors’ permission

Keywords: Economic anthropology; time preference; Madagascar; mixed economies

A recurring theme in economic anthropology is that people with different subsistence regimes have dissimilar concepts of economic value (Sahlins 1972). Woodburn (1980, 1988) has suggested that some hunter-gatherers value time, manifested in the delay preceding an economic payoff, differently than do other foragers and all farmers and herders. Hunter-gatherers such as the Hadza of Tanzania or the Kalahari San practice an “immediate return” economic system in which each day’s work digging tubers, collecting nuts, or hunting game is rewarded that day or soon after with food (assuming the work is successful). Other groups practice a “delayed return” economic system, in which they must wait weeks or months for the rewards of their labor. Delayed return foragers spend time preparing nets and traps and tinkering with the growth and reproduction of wild plants, enjoying the payoffs weeks or months later. Cultivators wait several months from planting until harvest. Herders may care for animals for years until slaughter or sale. Woodburn’s distinction between immediate and delayed return economic systems has been influential, yet no one has tested empirically whether foragers and farmers have different time preferences. In this paper we confirm Woodburn’s basic premise with choice experiment data collected among Mikea forager-farmers of Madagascar in 2003 and 2004.
When a decision-maker decides between a smaller reward available immediately versus a larger, delayed reward, she makes a judgment about the commensurability of quantity and time. Ever since the late 19th century, economists have used the concept of marginal substitution to relate dissimilar forms of value (Blaug 1997; Hunt 2002). Two dissimilar options have equivalent value when a decision-maker is indifferent between them. Otherwise, the choice of one option or the other indicates a “preference” for whatever dimensions of value distinguishes the superior choice. Since the 1940s economists have employed experimental methods to directly measure individual’s indifference values and preferences (Davis and Holt 1993:5; Roth 1995:5-20). In choice experiments, human and bird subjects frequently prefer smaller, immediate rewards to larger, delayed ones, which suggests that the value of future rewards is discounted in the present, a phenomenon called future discounting (Green et al. 1981; Mazur 1984, 1987; Rachlin, Raineri, and Cross 1991; Green, Fristoe, and Myerson 1994; Kirby and Hernnstein 1995; Myerson and Green 1995; Green and Myerson 1996).

Why decision-makers discount the future, and why individuals discount future rewards at different rates, remains largely unexplained. “Expected utility theory” has long asserted that risk preferences, and presumably time preferences as well, are a function of wealth (Von Neumann and Morgenstern 1944; Friedman and Savage 1948; see Mongin 1997 for a review). Yet there is compelling evidence that decision-makers do not use their wealth status as a reference point in economic judgments (Kahneman and Tversky 1979; Rabin 2000). Becker and Mulligan (1997) argue that some people are more habituated to investing in “future oriented capital,” such as the wealthy, students, and people of intermediate ages; but they do not explain why these differences exist. Other explanations include the inherent uncertainty of delayed rewards (Myerson and Green 1995:263), and immediacy of needs such as hunger (Snyderman 1983; Tucker in prep).
Mikea of Madagascar are an interesting population in which to explore time preference, for nearly everyone practices a combination of immediate and delayed reward activities. To most Malagasy, the word “Mikea” connotes a forest-dwelling hunter-gatherer, with all the associated primitive and mystical stereotypes (Poyer and Kelly 2000). Yet most self-described Mikea living in the dry forests north of Toliara combine foraging for wild tubers, honey, and small game with maize and manioc cultivation, cattle and goat herding, wage labor, and petty commerce (Tucker 2001). Mikea have probably always practiced a diversified economy. Oral history reveals that Mikea are not stone-age relicts, but are the descendants of herders and farmers who sought refuge in the forest during the past four or more centuries to escape raids and tribute demands by local kings, and later, to escape French colonial policies of forced relocation, mandatory public labor, and taxation (Yount, Tsiazonera, and Tucker 2001; Tucker 2003). Mikea oral histories are replete with references to pasture territories, livestock sacrifice, slash-and-burn agriculture, lakebed gardening, and trade with neighboring peoples. Mikea have a long history of future discounting decisions (Tucker in press).

Since the 1980s, outside politico-economic pressures have strongly influenced Mikea households’ investment in delayed return activities. The mid 1980s saw a maize boom. Merchants, many with family origins in southwest Asia, purchased maize in bulk from Mikea and resold it to exporters, who then shipped it to the Seychelles to be used as pig feed. Mikea cultivate maize in low-input slash-and-burn fields called batsake, which are generally planted for two to three years and then abandoned.

The Mikea Forest hosts a diversity of endemic and endangered species (Seddon et al. 2000). Rapid deforestation for batsake attracted the attention of the World Wildlife Fund (WWF) and Conservation International (CI). In 2002 they encouraged the formation of a Commission Mixte whose mission was to stop batsake. The Commission Mixte included such organizations as a league of local township mayors FiMaMi, Madagascar’s Organization Nationale pour L’Environnement (ONE) and
three of its constituent organizations; as well as the national military, gendarmerie, and tribunal system, with some material support from the United Nations Development Project (UNDP). The Commission began with a series of town meetings, which established that ending *hatsake* was indeed the will of the local people. The Commission enforced this mandate, and by 2003 had nearly completed eliminated *hatsake*. Few actual arrests have been made, mostly of gross offenders. Then in 2003 the World Bank announced plans to create a protected area National Park within the Mikea Forest.

As an alternative to *hatsake*, some members of the *Commission Mixte*, the World Bank, and other involved organizations have encouraged Mikea to practice labor-intensive manioc cultivation in the anthropogenic savannas left over from previous clearing. A key difference between *hatsake* maize cropping and savanna manioc cultivation is in the delay from planting to harvest. Maize matures three months after planting (six months after fields are initially cleared), while manioc farmers typically wait 12 to 16 months from planting to harvest. In 2003 Mikea opinion on their future options is divided. Many had abandoned their forest camps and resettled in the villages such as Vorehe, where they planned to become more-or-less full-time savanna manioc farmers. Others, particularly people with historical ties to remote villages such as Namonte and Ankililale, stated that they were planning to become more-or-less full-time hunter-gatherers.

In this paper we document evidence for significant differences in time preference for those who plan to pursue a future of foraging versus those who plan a future of agriculture. As predicted by Woodburn, future foragers discount future rewards at a significantly higher rate.

**Choice experiment**

Behavioral researchers debate the most effective features of an experimental design (Hertwig and Ortmann 2001). Economists generally insist that real reward payoffs are necessary to encourage
actualistic decision-making (Hertwig and Ortmann 2001; but see Camerer and Hogarth 1999), while
many psychologists accept hypothetical rewards as a cheaper and faster alternative with minor
effects on data quality (Thaler 1987). With real rewards, it is more difficult to perform repeated
questions, for the amount gained on a previous choice may affect subsequent decisions; but in “one-
shot” questions participants cannot learn from previous trials (Hertwig and Ortmann 2001). The
scale of rewards and delays are important, for decision-makers appear to have different time and risk
preferences for smaller versus larger rewards (Kirby and Marakovic 1996; Holt and Laury 2002).

The design of the experiment should be congruent with the research objectives. To this end,
one of us (B.T.) and field assistant Jaovola Tombo conducted two different time preference
experiments in the Mikea Forest during 2003 and 2004. The first experiment offered a one-shot
choice between one quarter-liter cup of cooking oil now versus three cups after trial-specific delays
of 21, 7, or 3 days (results reported in Tucker in prep). The results of this experiment were useful
for cross-cultural comparison with other experimental studies that offered real rewards on the scale
of a fraction of a day’s wage (Kirby et al. 2002; Godoy et al. 2004).

The decision to allocate labor to foraging or farming involves large-scale payoffs and long
delays (Tucker in press). This paper presents results from our second experiment, the objective of
which is to mimic the actual scale of rewards and delays in the foraging versus farming decision.
Payoffs are expressed as 100 kg gunnysacks of maize, which for logistical reasons are hypothetical.
Hypothetical rewards permitted repeated questions and trials, revealing multiple indifference values
for each participant.

While economists generally disapprove of hypothetical rewards, Camerer and Hogarth
(1999) conclude from a comparison of 74 studies that the benefits of real incentives are somewhat
ambiguous. Real rewards may encourage participants to take decisions more seriously; subjects take
more time responding, and responses have less variance. However, in the majority of studies
incentive size does not change the mean response. We found that the main drawback of using hypothetical rewards was that many Mikea were unwilling or unable to make repeated independent evaluations. Of 80 individuals interviewed, 45 gave stereotyped “stock answers” (Nisbett and Wilson 1977). Without much reflection they responded to the first question with a general philosophical statement that they repeated throughout all subsequent questions regardless of the value of the options being offered. Some quoted local proverbs such as “the distant medicine is no cure” or “what the goat nibbles is quickly gone” (injunctions to take immediate or delayed rewards, respectively). We believe the stereotyped responses are meaningful, and these are being analyzed (Tucker and Tombo in prep); but they are not economic judgments in the neoclassical sense. In another 6 cases, respondents made inconsistent choices, preferring longer delays to shorter ones; these are excluded from analysis. In the remaining 29 cases, participants took their time answering the questions, indicating an honest effort to think through the choices presented to them.

The experimental procedure was as follows. Volunteers were recruited from the forest camps of Behisatse and Bedo and the villages of Vorehe, Ihotre, Namonte, Ampijilova, and Ankililale, during October 2003 and August 2004. Each received a courtesy gift of 1000 Malagasy francs (1/15 of a day’s wage, or enough to purchase 4 cups of coffee in the market). Participants were interviewed in private, although sometimes a close associate or family member was also present. Before the experiment proper, we asked the participant which strategy their household would employ following the ban on hatsake, increased reliance on foraging or manioc cultivation? Of the 29 usable responses, 10 identified as future foragers, 17 as farmers, and 2 as petty marketers.

Then field assistant Jaovola Tombo explained the experiment. The experiment consisted of three trials with three questions each. Each question was a binary choice between one gunnysack now versus X sacks after the trial-specific delays of six months, one month, or twelve months. The value of the delayed option X was adjusted in the second and third questions contingent on the
previous choice. Thus the experiment consisted of nine questions total and revealed three indifference values per participant.

A decision tree for the first trial is presented in Figure 1; the second and third trials are identical except for the delay. The first question was, “which would you prefer: one gunnysack full of maize right now, or 12 sacks of maize after six months?” If the decision-maker preferred the 1 sack now, this indicates that it would take more than 12 sacks for her to tolerate a six-month delay. The second question would then ask which she preferred, 1 sack now versus 24 sacks after six months? If she chose the 24 sacks, then her indifference value is greater than 12 but less than 24. The third question narrows the range, by asking her to choose between 1 sack now versus 18 sacks after six months. If she chose the 1 sack now, then her indifference point is somewhere in the 12 to 18 range. We recorded her response as falling within the 12-18 bin. She will judge any reward less than this value to be not worth waiting six months to receive, while any greater reward is worth a six month wait.

Analysis and results

The indifference values are analyzed to calculate the median discounting rate \((k)\), for the population as a whole, and for the forager and farmer subsets specifically (discounting studies typically report median rates rather than means because the median is a more robust measure of central tendency in skewed distributions). The analyses follow the logic of the hyperbolic discounting model, chosen because it has consistently provided better fits to published data than the alternatives\(^4\) (Mazur 1987; Myerson and Green 1995; Green and Myerson 1996). Imagine a reward that has the value \(A\) when there is no delay \((D = 0)\). For delays greater than zero, the reward value is subjectively discounted. The discounted value \(v_d\) at a given delay is:

\[
v_d = \frac{A}{1 + kD}.
\]
Our analysis computes $k$ given the indifference values revealed by our experiment. An indifference value $v_i$ is the reward amount at delay $D$ that the decision-maker judges to be equivalent in value to a reward $A$ available with no delay. From Eq. (1) it follows that

$$v_i = A(1 + kD).$$

Hyperbolic discounting asserts that indifference values increase linearly as a function of delay.

Figure 2 illustrates an example, using values relevant to our experiment. The immediately available reward $A$ is one gunnysack of maize. Assuming a discount rate of $k = 0.3$/month, if the subject has to wait five months to receive the one sack, she will value it at $v_d = 0.4$ sacks relative to the one sack available now. In order for the subject to be indifferent between 1 sack now and a larger number after 5 months, the larger reward would have to be worth $v_i = 2.5$ sacks. The $k$ value defines the slope of the indifference function. As $k$ decreases, the decision-maker discounts future value to a lesser degree. When $k = 0$ there is no discounting ($v_d = v_i = A$). As $k$ increases, future rewards become increasingly grim prospects from the present perspective.

We calculate $k$ for each category of respondents directly from the data, and use a bootstrap technique to establish confidence intervals. Because Eq. (2) insists that the indifference values scale linearly with delay, it implies that the distribution of responses at each delay has the same functional form—each distribution is merely stretched proportionally. A given test value $k^*$ of the discounting rate determines test indifference values $A(1 + k^*D)$ for each of the three delays. The estimated median value of $k$ is the value of $k^*$ such that half of the responses are above the corresponding test values and half are below (responses of all individuals at all delays are aggregated to determine a single median estimate). While this procedure does not always determine a single value, it nevertheless specifies a narrow range of median $k$ values. Henceforth, our reported $k$ values will refer to median estimates.
A bootstrap procedure (Efron and Tibshirani 1991; Chernick 1999) is used to establish confidence intervals around each $k$ estimate. A bootstrap procedure resamples data with replacement, thereby simulating many realizations of the experiment. Each resample has the same size as the original set. Our calculation resamples 10,000 times, calculating a new median $k$ value for each iteration with the procedure described above. Rather than resample individual indifference values, which are not strictly independent, we resample individual respondents, each of whom has three indifference values.

The bootstrap distributions were skewed, and the original dataset was relatively small. To ensure the accuracy of the confidence intervals, we iterated the bootstrap procedure (Martin 1990; Lee and Young 1999). In other words, we resampled each of the 10,000 iterations described above 2000 times, which is a sufficient number for reliable numerical results (Booth and Hall 1994), to “calibrate” the coverage of the bootstrap confidence intervals. The actual corrections due to this procedure were minimal.

The results are as follows. The median discount rate for all 29 individuals is 2.0/month, with 95% confidence intervals of 1.3-2.8. The median discount rate for foragers, 3.9/month (95% CI = 1.7–7.9), is larger than that of farmers, 1.4/month (95% CI = 0.39-2.5). Because the two confidence intervals overlap it is not immediately obvious that the two rates are significantly different. A more precise and powerful test is to consider the difference statistic of the forager and farmer medians. A one-sided, 95% confidence interval for the difference in median $k$ values between foragers and farmers is 0.09-$\infty$; the statistical significance of a null value is well over 95%.

Thus, based on the data here, we conclude that the median discount rate for foragers is significantly larger than the median rate for farmers.

As an independent check, we also estimated median $k$ values through curve fits to the response distributions. For example, the lognormal distribution is given by
f(x; \sigma) = \exp[-(\log^2x)/2\sigma^2]/[x\sigma(2\pi)^{1/2}], \tag{3}

defined for x > 0. Due to the form of Eq. (2), we can fit this function to the response distributions at all delays if we take x = (v_i - A)/kD. The best fits of this function gives the following estimates: for foragers, k = 4.0 (\sigma = 2.1; 95% k CI = 1.4-12); for farmers, k = 0.39 (\sigma = 2.5; 95% k CI = 0.35-2.0); and for all respondents, k = 1.6 (\sigma = 2.5; 95% k CI = 0.80-3.3). These estimates are in good agreement with the results of the direct estimation method. Fits to other families of one-sided distributions (Weibull, \chi^2) yield similar results.

One possible concern is that the sample sizes here are relatively small, which can lead to underestimation of the true variation of k values. We tested the validity of our small-sample analysis by repeating the entire analysis on many synthetic data sets. For example, to check the forager case, we analyzed 1000 synthetic data sets (each with N = 10) chosen from the best-fit lognormal distribution. For each test data set, we computed the 95% confidence interval to see if it contained the true k value; we found that it only did so (89 \pm 1)% of the time (quoted uncertainty is one standard deviation), suggesting that the N = 10 sample size only slightly underestimates the true sample variation. For the farmer subset (N = 17), the same procedure gives an actual coverage of (94 \pm 1)%. The good agreement with the expected 95% coverage indicates that 17 is a sufficient sample size for this analysis. Checking the (one-sided) 95% confidence interval for the difference statistic, we find an actual coverage of (97.9 \pm 0.4)%.

Thus, we conclude that in spite of the relatively small sample sizes, our statistical conclusions are sound.

Significance for subsistence studies

The discount rates revealed in our experiment confirm Woodburn’s basic thesis. People planning to farm manioc in the coming year discounted future payoffs at a significantly lower rate (k = 1.4/month) than did those who planned to live by “immediate return” foraging activities (k =
3.9/month). This finding is consistent with the results of our other experiment (Tucker in prep). All participants discounted three delayed cups of oil at rates in the range of 0.3 to 0.7/day, but the frequency distribution of responses indicates that those who primarily rely on foraging had a greater median discount rate than those who rely primarily on agriculture.

Although differences in experimental design hamper cross-study comparison, some general inter-societal trends may be discerned. Results from Tsimane’ foraging-horticulturalists of Bolivia may be directly compared with our oil experiment because both offered similarly sized rewards and use the hyperbolic model (Kirby et al. 2002; Godoy et al. 2004). Tsimane’ discount rates for cash rewards (0.12/day or 3.7/month) and candy (0.14/day or 4.3/month) are similar to Mikea rates, which is interesting because both have similar mixed economies. Results from a discounting experiment among rice cultivating peasants in India (Pender 1996), while somewhat more problematic to compare because of larger rewards and analysis using the exponential model, clearly indicate lower discount rates, 0.022-0.099/month. Indian peasants discount at rates similar to those revealed in experiments with undergraduate research subjects (using the hyperbolic model): 0.014/month (Rachlin, Raineri, and Cross 1991); 0.034 to 0.064/month (Green, Fristoe, and Myerson 1994); and 0.010 to 0.033/month (Myerson and Green 1995). Consistent with Woodburn’s thesis, “delayed returns” economies have lesser discount rates than are found among “immediate returns” economies.

A fundamental question, especially with regard to the Mikea case, is the order of causality. If Becker and Mulligan’s (1997) explanation is valid, then Mikea foragers have high discounting rates because they participate in an immediate-returns economy that habituates them to short-term satisfactions. Time preferences would therefore result from economic variation and change. Expected utility theory (or some version of it) suggests the reverse, that Mikea of lower income or wealth prefer foraging because they are unable to tolerate waiting for rewards. If this is true, then
discounting behavior may explain subsistence variation such as differences in Mikea household subsistence portfolios, and transitions such as from a foraging to farming economy (Tucker in press).

Critics of expected utility theory point out that wealth effects have often proved insignificant in risk preference studies (Binswanger 1980; Kachelmeier and Shehata 1992; Henrich and McElreath 2002). Wealth is a large-scale phenomenon, so diminishing marginal utility of wealth cannot predict preferences involving small stakes (Rabin 2000). Decision-makers frame economic choices independent of their income and wealth levels, valuing losses and gains differently (Kahneman and Tversky 1979). However, it remains possible that preferences respond to perceived needs over specific domains, such as resource availability or hunger (Tucker in prep). Future research among Mikea should test whether specific needs predict time preferences.

Applications to environmental protection in the Mikea Forest

Figure 3 explores the first question in our experiment, preference for one sack of maize now or 12 sacks after a delay. Imagine the delayed 12 sacks represents an agricultural harvest (a survey of 247 hatsake fields indicates this is slightly greater than the mean yield from a one hectare field, 931 kg/ha), while one sack represents foraging rewards over a much shorter delay (a family of six harvests the caloric equivalent in wild tubers in an average week). Figure 3 compares the value of the two options, when the agricultural harvest is discounted by (a) the midpoint of the median rates for Indian peasants reported by Pender (1996); (b) the median rate for Mikea who envision an agricultural future; and (c) the median rate for Mikea who envision a foraging future. The graph shows that Indian peasants consistently prefer the delayed agricultural option. Mikea who plan to farm can wait for 12 sacks, but after eight months the delayed option is discounted to less than the immediate reward. Eight months is more than enough time to plant and harvest maize, but is
insufficient for manioc as it is typically cultivated. Mikea foragers may tolerate three months of waiting for a larger reward.

While this graph uses a certain degree of mathematical imagination, we believe it makes a relevant point. Far too often, international development projects assume that higher-yielding food production activities are necessarily superior options to lower-yielding activities. Individual decision-makers may disagree, if they subjectively discount the greater reward because of its cost, risk, or delay. Development planners should not assume that all people discount future rewards at similar (or negligible) rates. While other peasants may discount agricultural harvests similarly to Indian peasants studied by Pender (1996), populations who are not currently engaged in intensive cultivation may have considerably less confidence in the value of delayed rewards.

So far, savanna manioc cultivation has not filled the economic void left over from the end of *hatsake*. While the savanna village of Vorehe was swelling with forest immigrants in 2003 and the forest camp of Bedo seemed poised to become an agricultural village, we saw very little manioc in production in 2004. High temporal discounting rates are probably only part of the problem. Another significant barrier to adoption of manioc is that farmers must obtain legal title to land, a difficult process for illiterate people. Manioc has become more important in one context, lakebed and lakeside gardens. Because the lakebed provides requisite moisture, these fields are less dependent on annual rainfall, and so may be harvested and replanted continually, according to the food needs of the family. The typical plant is left to grow for four to eight months before harvest. Data from 31 savanna fields and 20 lakebed gardens collected in 2004 suggests that the latter method produces one-third the harvest as the standard technique. Manioc is working here because it has been transformed into an immediate-return activity, but at the expense of the higher promised yield.
We join the majority of Mikea in the sentiment that the forest should not be burned to the ground to grow pig feed. The Commission has succeeded in averting this fate. This paper offers one reason why some Mikea may resist the recommended alternatives to hatsake. We hope this paper illustrates the significance of behavioral research for conservation and development projects that seek to change people’s behaviors.

References


Tucker and Steck, Experimental evidence for time preference


Tucker, B. in prep. Do time and risk preferences differ by economic strategy? Choice experiment results in the mixed economy of the Mikea, Madagascar.


The authors wish to thank the people in the study communities for participating, Jaovola Tombo for making the data collection happen, and Tanmoy Bhattacharya for helpful and stimulating discussions. The field component was funded by the Ohio State University’s Office of International Affairs, Department of Anthropology, and College of Social and Behavioral Sciences. Los Alamos National Laboratory facilitated our collaboration.

Madagascar is divided into commune urbaine and commune rurale, urban and rural townships. FiMaMi is the Fikambanana Miaro ny Ala ny Mikea, an association of all the mayors of the townships that include the Mikea Forest north of Toliara and the Belomotse Forest south of Toliara.

The three constituent organizations are Eaux et Forêts, ANGAP (Association Nationale pour la Gestion des Aires Protégées), and SAGE (Service d’Appui à la Gestion de l’Environnement).

The major alternative model is an exponential function with the form \( v_d = Ae^{-kD} \) (Mazur 1987; Myerson and Green 1995; Green and Myerson 1996). When applied to our data, the exponential model yields considerably lower median \( k \) values. However, our main conclusion that foragers discount future rewards at significantly greater rates remains valid (all respondents, \( k = 0.32, 95\% \) CI = 0.27-0.46; foragers, \( k = 0.65, 95\% \) CI = 0.30-1.7; farmers, \( k = 0.26, 95\% \) CI = 0.18-0.36).

Note that the results of the two experiments, when converted into common time units, are dissimilar (cooking oil experiment \( k = 9.1 \) to 21.3/month). This may be due in part to differences in experimental design, but it probably also reflects scalar issues common to preference studies (Kirby and Marakovic 1996; Holt and Laury 2002).

Strictly speaking, Pender’s (1996) results are most directly comparable with those reported in footnote 4. However, both the hyperbolic and exponential models predict similar discounted values and indifference values over a large range of delays, diverging only at the tails.
Figure 1: Decision tree illustrating the three questions asked in the first trial. The second and third trials are identical to the first, except the delay in trial two is one month, and the delay in trial three is twelve months.
Figure 2: Illustration of the hyperbolic discounting model, including the discounted value function $v_d$ given by Eq. (1) and the indifference value function $v_i$, Eq. (2). For illustration purposes, this graph uses a $k$ value of 0.3/month.
Reward amount (gunny sacks of maize) 

Typical maize delay

Typical manioc delay

a. Indian peasants, $k = 0.039$/month (Pender 1996)
b. Mikea farmers, $k = 1.4$/month
c. Mikea foragers, $k = 3.9$/month

Figure 3: The discounted value of one sack of maize now versus 12 sacks later.