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Measuring Preferences over Income Distributions:An Experimental Investigation of the Atkinson Theorem.

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An experimental investigation of the Atkinson Theorem

Atkinson assumes the social welfare function defined over income is increasing at a decreasing rate and therefore that transfers from rich to poor increase welfare. Simply asking people if they favor such transfers may not reveal their true preferences as the poor may be predisposed to be in favor. Following a suggestion from Harsanyi, we conduct social choice experiments where vectors of payments are selected by majority voting and then positions (rich, poor, etc.) are randomly assigned. We repeat the experiments assigning positions before voting to isolate information effects. In both the US and China we find subjects generally do support transfers but knowlege of position powerfully masks these preferences.

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Anthony Atkinson (1970) demonstrates that if the utility function over income is increasing at a decreasing rate then it is possible to rank preferences over income distributions if the Lorenz curves do not cross. Atkinson went on to demonstrate that conventional summary statistics, such as the Gini coefficient, impose additional conditions on the form of the utility function. Atkinson's method - presupposing a 'reasonable' utility function and deriving corresponding measures of inequality - has proven to be extremely useful and has been copied frequently, Lambert (1993, chapters 3 and 4) provides a survey.

This paper takes a different approach and explores whether preferences over income are in fact increasing at a decreasing rate. The main difficulty is to construct an environment likely to elicit true preferences. As Harsanyi (1953, p. 434) notes, "If somebody prefers an income distribution more favorable to the poor for the sole reason that he is poor himself, this can hardly be considered as a genuine value judgment on social welfare." Fortunately, Harsanyi (1953, p. 434-5) also proposes a solution to our problem. "Now a value judgment on the distribution of income would show the required impersonality to the highest degree if the person who made this judgment had to choose a particular income distribution in complete ignorance of what his own relative position (and the position of those near to his heart) would be within the system chosen. This would be the case if he had exactly the same chance of obtaining the first position (corresponding to the highest income) or the second or the third, etc., up to the last position..." Consequently, we place subjects in an environment where they must choose which of two vectors of monetary payments will be used and ask subjects to vote before randomly assigning subjects to positions. We test Harsanyi's conjecture that knowledge of position may affect the vote by also collecting votes when positions are known.

The expected utility model employed by Atkinson makes no attempt to capture cultural differences. We collected data in Tuscaloosa Alabama, Denver Colorado, Guiyang and Tianjin (both mainland China) to check whether the model predicts well in different cultural contexts. China is particularly interesting because it is well known for espousing equity and equality. We consciously choose sites within national cultures that are quite different from each other to allow for variations within cultures. For example, the Denver economics department is in the liberal arts college while the Tuscaloosa economics department is in the business school. In many ways Guiyang is more like Tuscaloosa and Tianjin more like Denver. Guiyang and Tuscaloosa are home to premier institutions in their region, Tianjin and Denver support programs to reach non-traditional college students.

In general our results are supportive of Atkinson and Harsanyi. Most, but not all subjects, do vote in ways consistent with a utility function that increases at a decreasing rate if positions are not known. Once positions are known, voting is clearly at odds with such preferences underscoring Harsanyi's warning. Of course this does not mean we have successfully measured individual preferences over social equality. As Harsanyi (1953, p. 435) notes, "The disutility of being a loser in a voluntary gamble ... tends to be less than the disutility in the social game..." A minority of our subjects do not exhibit the risk aversion hypothesized by Atkinson, but this may simply reflect the fact that experimenters can not expose their subjects to true social risk. Viewed in this light, it is remarkable that even at quite modest risk levels we obtain broadly supportive results.

I. Experimental Methods and Procedures

Subjects were recruited from undergraduates at the University of Colorado, Denver, Colorado, the University of Alabama, Tuscaloosa, Alabama, Nankai University, Guiyang, China and Guizhou Minority University, Tianjin, China. Guiyang and Tuscaloosa are both southern while Tianjin and Denver are about 1500 miles distant allowing regional separation within national cultures. Students were randomly divided into two groups of 5 at the beginning of the experiment. Each is provided with a record sheet and payoff table, reproduced here as Table 1 after which instructions are read and a practice round conducted.[1] In each round, the experimenter shuffles five cards, ace through five, fans them out face down and walks before the subjects who then point to a card which is placed face up in front of them. The card determines their position within the possible payoff vectors. Subjects vote for vector A or B or abstain by marking their sheet. The experimenter tabulates the vote and announces the majority decision or, in the event of a tie, determines the outcome by tossing a coin. Subjects record the number of points earned. The experimenter checks each record sheet and the next of 20 rounds begins. In all experiments the 10 sets of payoff vectors are used twice. The distinction between the two sets of 10 rounds is whether voting occurs before or after cards have been distributed. Half the experiments begin with impersonal voting and half with positions known to allow experience effects to be separated from the information condition.

In the US, points were converted to dollars at the rate of 200 points = $1. In China, the experiments were run twice at different pay scales with each set of subjects. In the initial set, 200 points were set at the official yuan equivalent of $.10. Subjects were then asked if they would like

1. The instructions used are available from the authors.

to repeat the experiment for 10 times the initial pay.[2] All readily agreed. In the high pay experiments, subjects received the equivalent of more than a month's earnings for an unskilled worker.

The payoff vectors (see table 1) in round 1 are those employed in unpaid surveys collected by Amiel and Cowell (1992) multiplied by 10. The round is intended to insure that any differences between our results and theirs are due to the experimental environment (payment and control over whether positions are known) and not the question asked. In rounds 2 through 5, a vote for B transfers 20 points between different sets of neighbors. If utility is increasing at a decreasing rate then transfers of a particular amount from richer to poorer should produce a net gain in utility. The property is known as the principle of transfers.

Voting for B in Round 6 transfers income from the top four positions, in rough proportion to their income, to the bottom. Round 8 transfers 100 points from top to bottom. Round 7 simply deducts 300 points from the top position. This round will allow us to assess if utility is increasing in income even if only the richest benefit. Rounds 9 and 10 examine a property explored in another paper.

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2. Katchelmeier and Shahata (1992) calibrate low and high pay experiments in the same way. We also followed the practice of employing two sets of translators. Instructions were first translated from English into Chinese by one set. The other set translated the resultant instructions back into English. Adjustments were then made to the Chinese translation to ensure clarity.

II. Results

Figure 1 presents the data for round 8 when positions are unknown and voting is impersonal. We find that impersonal voting is consistent with a utility function that is increasing in income, even if the recipient is already the most fortunate.

Figure 2 concentrates on the transfer principle and the curvature of the utility function. If utility is increasing at a decreasing rate then transfers from richer to poorer ought to be supported. But as the figure clearly shows, the form of the transfer does matter. Large transfers from top to bottom, as in round 8, enjoy strong support across location and pay conditions. Smaller transfers between neighbors just barely receive majority support and transfers from the top four to the bottom are occasionally opposed.

Table two provides 95% confidence intervals for the proportions in the figures based on a binomial distribution. The two categories are supporting the gift or transfer and not supporting; abstentions[1] are recorded as a failure to support. The table may be used to conduct a wide variety of hypothesis tests. The most obvious test is to consider if the sample proportion supporting one of Atkinsons properties is greater than 50%. For this we need only check if the lower limit of the confidence interval is above 50%. Or, we can test whether a treatment, like high pay, or difference in subject pool is significant by determining whether the confidence intervals[2] are non-overlapping. The total number of observations may be determined by referring back to figures 1 and 2.

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[1] There are so few abstentions that deleting them or counting abstentions as .5 makes no material difference.
[2] Such a test assumes the samples are independent. Since the same subjects in China were exposed to either high or low pay, more powerful tests, such as the McNemar test for related samples, are available. But this test and several others failed to produce qualitatively different results.

Beginning with the last row of column I, we see there is overall support for small[3] transfers between neighbors. The entries for part 1 and part 2 of the same column indicate experience increases support although the effect is not statistically significant. However the results from Tuscaloosa and low pay China prevent us from concluding all locations and pay conditions support such small transfers between neighbors. Denver is more supportive than Tuscaloosa and the difference is statistically significant. Averaging over the two locations in China, support in China appears to be somewhere between the two locations in the US, but this is somewhat misleading. Looking back at figure 2 we see that Tianjin is more supportive than Guiyang. It is more accurate to argue that Tianjin and Denver are relatively supportive while Guiyang and Tuscaloosa are more nearly indifferent. Apparently, differences within cultures are at least as important as differences between them.

Examining column II we are unable to conclude that transferring funds from the top four positions to the bottom is supported in any location, pay condition or experience level. This is surprising given the support both for a larger transfer from top to bottom in round 8 and the support for smaller transfers between neighbors in rounds 1-5. Apparently the form of the transfer and not its size or the number of number of positions skipped makes it less popular. One possibility is that the result represents a breakdown of the required impersonality. Subjects know that there is an 80% chance the transfer will harm them and only a 20% chance they will benefit. Another possibility is that subjects tend to focus on either the dollar amount or the probability and do not form expected payments as the expected utility hypothesis supposes Slovic, Fischoff and Lichtenstein (1983) have shown that subjects tend to prefer A to B if A has a higher probability of a small gain but place a higher monetary value on B. They argue that rankings and monetary

[3] The proportions and confidence intervals for rounds 1-5 individually are .519 ±. 077, .569 ± .077, .662 ±. 073, .525 ±. 077 and .588 ±. 076.

valuations are different cognitive processes. Rankings are more closely associated with probabilities and monetary values with amounts to be gained or lost. Round 6 produces a gamble where selecting A has a high probability of a small gain. If voting is like rankings then the deviation from predicted behavior may be due to cognitive imperfections.

The transfer in round 8 from highest to lowest and the gift to the richest in round 7 find strong support in all locations and pay conditions. Apparently there is enough curvature in the utility function that large transfers over several categories are heavily supported and the proposition that more is better finds overwhelming support even if there is an 80% chance someone who is more fortunate will receive the gift. Intriguingly, there is a small minority that opposes such gifts in Denver, high pay China and among experienced subjects.

Looking at the last row of Table 1 we find that the increased support in round 8 compared to rounds 1-5 is statistically significant as is the higher support for the gift in round 7 over the transfer in round 8. This is exactly what one would expect if support is a function of the size of the utility difference. The relatively small transfer between neighbors in rounds 1-5 has a small effect on utility while the larger amount in round 8 transferred over more categories has a larger effect. The even larger gift in round 7 should have the largest effect of all, and does.

The unmistakeable conclusion from the data is that Atkinson's theorem rests on a firm foundation. Even given that we are unable to expose subjects to true social risk, subjects with the required degree of impersonality generally exhibit behavior consistent with a utility function over money that is increasing at a decreasing rate. However there were a few results not predicted by the theory that have independent interest. A rather small minority will oppose gifts to the most fortunate raising the possibility that truly massive gifts to the rich may be opposed. Taking from four categories to support one is not popular. Whether this represents a true social preference, a breakdown of impersonality or a cognitive imperfection is unknown. .

Table 3 reproduces table 2 when subjects voteknowing their position. The table is included to check Harsanyi's conjecture that voting will be significantly affected when subjects know their personal fates.

Once subjects know their position, support for transfers and gifts uniformly declines. For rounds 1-5 none of the locations, pay conditions or experience levels produces results significantly different[4] from indifference. In round 6, subjects reject transfers that harm 80% of the population in a proportion that is not signficantly different from 80%. Transfers from rich to poor do find statistically significant support overall, but support clearly varies by location. Only the gift continues to receive broad support but the minority that opposes such gifts has increased from a few percent to roughly a third. No one voted against receiving the gift. If we restrict attention to the non-recipients fully 42% (±.085) oppose.

Harsanyi was correct to warn that knowlege of personal position powerfully affects voting. If we had failed to create an impersonal environment, we would also have failed to find support for the utility structure underlying Atkinson's theorem. Beyond the obvious and quite reliable point that people vote their pocket[5] book, we find that opposition to gifts is widespread among those who will not receive. Simply being uninvolved in the transfer or gift is apparently

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[4] Our attempt to compare questionairres and experiments in round 1 has not been particularly informative. Our results for round 1 are roughly the same as Amiel and Cowells and whether subjects know their position or not seems to affect rounds with small transfers between neighbors very little. Therefore we can only conclude that for the single round tested, whether subjects fill in a questionairre, vote knowing position or not knowing position is not overwhelmingly important.

[5] If the subject is in a position that stands to gain or lose points, then overall they vote their pocketbook 93% of the time ± 1.9%. There are some votes against self interest in all rounds except round 7, where 32 of 32 votes are to accept the extra 300 points. In all other rounds, individual gains come at someone else's expense and the opposition could represent altruism.

insufficient to produce impersonal decisions. It was Harsanyi's insight that self interest could be harnessed in an impersonal way through a gamble with equi-probable outcomes.

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Table 1

Payoff Vectors

	A					B				
round	ace	two	three	four	five	ace	two	three	four	five
1	10	40	70	100	130	10	50	60	100	130
2	40	80	120	160	200	60	60	120	160	200
3	40	80	120	160	200	40	100	100	160	200
4	40	80	120	160	200	40	80	140	140	200
5	40	80	120	160	200	40	80	120	180	180
6	10	110	120	160	200	90	100	105	140	165
7	10	110	120	160	500	10	110	120	160	200
8	10	10	120	160	500	110	110	120	160	400
9	10	110	120	160	500	110	110	120	160	300
10	10	110	120	160	500	110	110	120	160	200

Table 2 - 95% Confidence Intervals for the Proportion of Supporting Observations

	Tests of the transfer Principle[1]			Test of monotonicity[2]		
	I	II	III	IV		
China:	Rounds 1-5	Round 6	Round 8	lower	mid	upper
High pay	0.595 ± 0.068	0.625 ± 0.150	0.775 ± 0.129	.750	.875	.963
Low pay	0.560 ± 0.069	0.500 ± 0.155	0.825 ± 0.118	.825	.925	1.00
Denver	0.682 ± 0.066	0.500 ± 0.155	0.900 ± 0.093	.750	.875	.963
Tuscaloosa	0.495 ± 0.069	0.575 ± 0.153	0.675 ± 0.145	.963	.999	1.00
Part 1	0.568 ± 0.049	0.600 ± 0.107	0.800 ± 0.088	.906	.963	1.00
Part 2	0.578 ± 0.048	0.500 ± 0.110	0.787 ± 0.090	.794	.875	.938
Overall	0.573 ± 0.034	0.550 ± 0.077	0.794 ± 0.063	.872	.919	.956

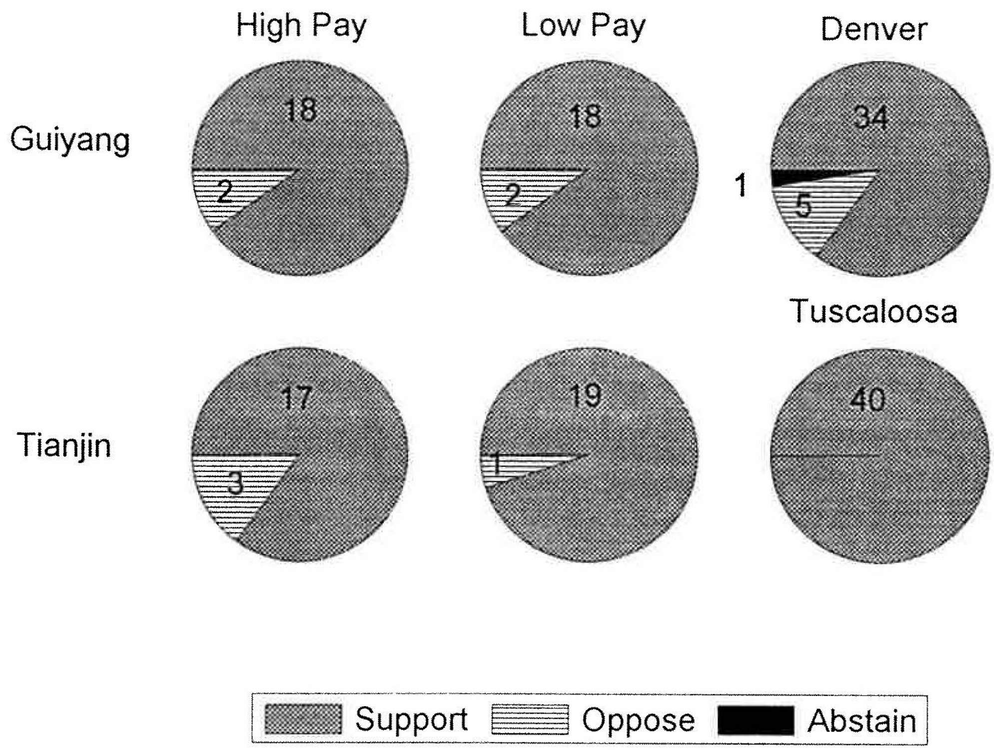
1. Confidence intervals are based on the approximation to a normal curve.
2. Skewness as proportions approach 1 prevents use of the normal curve. Confidence intervals are calculated directly from the binomial distribution.

Table 3 - 95% Confidence Intervals for the Proportion of Supporting Observations
Voting with positions known

	Tests of the Transfer Principle[1]			Test of Monotonicity
	I	II	III	IV
China	Rounds 1-5	Round 6	Round 8	Round 7
High pay	0.480± 0.069	0.200± 0.124	0.600± 0.152	0.525± 0.155
Low pay	0.480± 0.069	0.250± 0.134	0.550± 0.154	0.675± 0.145
Denver	0.480± 0.069	0.325± 0.145	0.725± 0.138	0.725± 0.138
Tuscaloosa	0.435± 0.069	0.225± 0.129	0.450± 0.154	0.725± 0.138
Part 1	0.472± 0.049	0.275± 0.098	0.613± 0.107	0.612± 0.107
Part 2	0.465± 0.049	0.225± 0.092	0.550± 0.109	0.713± 0.099
Overall	0.469± 0.035	0.250± 0.067	0.581± 0.076	0.662± 0.073

1. All confidence intervals are based on the approximation to a normal distribution.

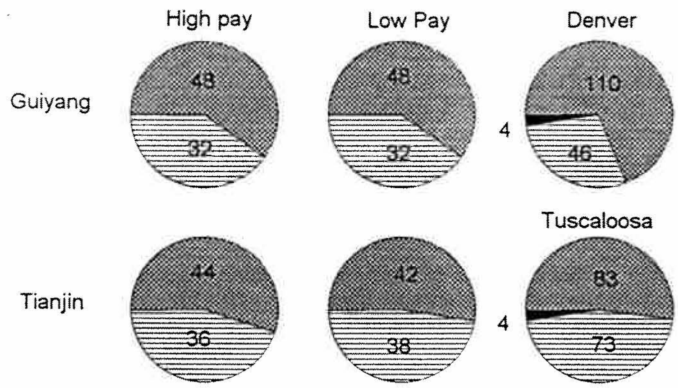
A Test of Monotonicity
Will subjects support a large gift to the top position?
Positions unknown



Three Tests of the Transfer Principle

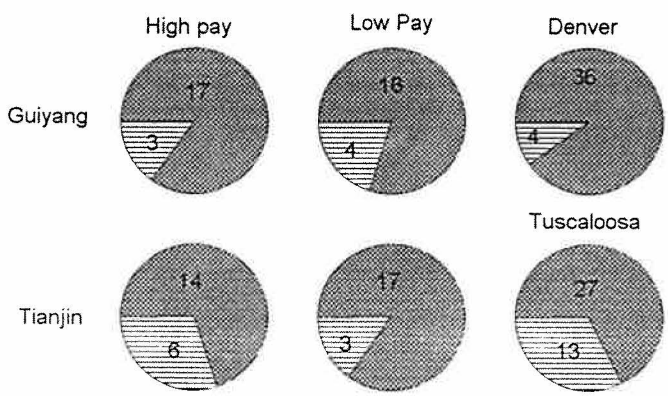
Will subjects support a 20 point transfer between neighbors?

Positions unknown Rounds 2-5



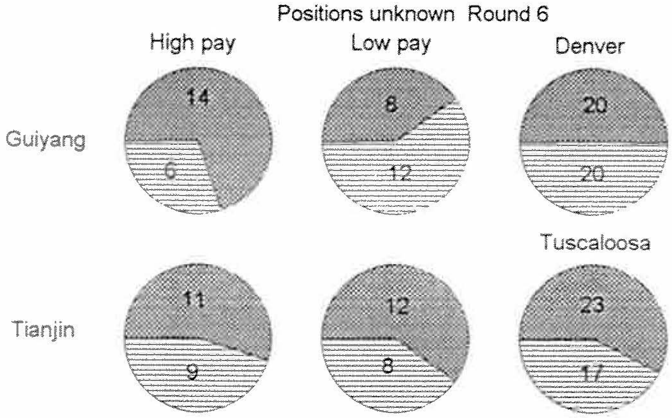
Will subjects support a transfer of 100 points from top to bottom?

Positions unknown Round 8



Will subjects support tranfers from the top four to the bottom?

Positions unknown Round 6



Support Oppose Abstain