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DO TRADE UNION LEADERS VIOLATE SUBJECTIVE EXPECTED UTILITY? SOME INSIGHTS FROM EXPERIMENTAL DATA

ABSTRACT. This paper presents the results of two experiments designed to test violations of Subjective Expected Utility Theory (SEUT) within a sample of Italian trade union delegates and leaders. Subjects priced risky and ambiguous prospects in the domain of gains. Risky prospects were based on games of chance, while ambiguous prospects were built on the standard Ellsberg paradox and on event lotteries whose outcomes were based either on the results of a fictional election or on the future results of the 1999 European Parliamentary election in Italy and the U.K. The experiments show that, although risky prospects were priced at their expected values on average, trade union delegates and leaders did violate SEUT when assessing ambiguous prospects. Moreover, their behaviour depended on the source of uncertainty (Ellsberg paradox vs. electoral results; fictional vs. real election; Italy vs. U.K. election outcomes). We discuss the implications of these results for the economic theory of the trade union.

KEY WORDS: ambiguity, Ellsberg's paradox, trade unions

JEL CLASSIFICATIONS: D81, J51

1. INTRODUCTION

Trade union preferences are often represented by an expected utility function that is concave in real wages and possibly employment, and that may also depend on other variables exogenous to the union (such as the unemployment benefit). The empirical evidence on the nature of trade union preferences is small. Moreover, a problem with the econometric evidence is that the estimates of the trade union utility function rely upon specific assumptions made by researchers on bargaining institutions (for example, monopoly union vs. efficient bargaining), market structure and technology (see, e.g., Pencavel, 1991, ch. 3.6, for a survey).[1]

However, as Pencavel (1991: 66) points out, there is no "empirical application of the expected utility hypothesis to the study of unionism that has chosen to test whether ... [this hypothesis] conforms to observed behaviour." The objective of this work is to address, at least indirectly, Pencavel's concern, by presenting the results of two experiments that were designed and run in order to measure reaction to uncertainty of a small sample of Italian trade union leaders and firm-level delegates.

The experiments presented in this paper do not directly test whether trade union's utility depends on wages and employment according to the expected utility model of preferences. They rather try to test whether the observed behaviour of trade union's leaders and firm-level delegates in an experimental framework may violate Savage's (1954) Subjective Expected Utility Theory (SEUT henceforth). If this is the case, namely if trade union delegates and leaders exhibit reaction to uncertainty or ambiguity, we can argue that the SEUT hypothesis may not be a reasonable specification of trade union preferences. This may have important implications for our understanding of trade union behaviour in the labour market. For example, different degrees of ambiguity reaction may help to explain different trade union attitudes as regards the welfare of the unemployed (namely, why some trade unions are willing to include income security provisions in collective bargaining agreements and some are not; why they might prefer policies increasing their current members' utilities rather the unemployed nonmembers' or potential new members')[2] or technical innovation (namely, why some trade unions oppose technological change more strongly than others).

The plan of the paper is as follows. Section 2 will briefly review the theoretical and experimental issues underlying our analysis. Section 3 will discuss why it is important to use trade union leaders as subjects in experiments. Section 4 will present the experimental results. Section 5 will consider some implications of our results for trade union behaviour as regards the unemployed and technological innovation. Section 6 will conclude with final remarks.

2. NONEXPECTED UTILITY AND REACTION TO AMBIGUITY

Keynes (1921) and Knight (1921) firstly introduced the distinction between risk and uncertainty. Risk denotes a situation in which the probability of events being forecasted is known (or measurable). Uncertainty or ambiguity depicts a situation in which the probability is unknown (or not measurable): the individual decision maker does not have enough information to assign a probability measure to the occurrence of the events being forecasted.

However, this distinction is not relevant for the SEUT. According to the SEUT (see Savage, 1954), given two mutually exclusive events, say, A – tomorrow is going to rain, and B – tomorrow is not going to rain, subjects are always able to form subjective probabilities over them, and their probabilities over the events conform to probability laws. In particular, subjective probabilities sum up to unity: $p(A) + p(B) = p(AUB) = 1$. Moreover, a researcher will be able to infer subjective probabilities over events by observing subjects' bets over them. For example, consider the following two lotteries: if it is going to rain tomorrow, you will get €10, otherwise you will get €0; and the complementary bet: if it is not going to rain tomorrow, you will get €10, otherwise you will get €0. If you prefer to bet on the former rather than on the latter lottery, this means that you regard the event 'it is going to rain tomorrow' as more likely to occur.

The Ellsberg (1961) paradox shows situations in which people may not be able to form subjective probabilities or in which these 'probabilities' do not satisfy the usual laws of probability, that is to say they are nonadditive or do not sum up to unity. In particular, the Ellsberg paradox shows that, given two lotteries with the same outcomes under two disjoint states of the world, people will prefer to bet on the lottery with known rather than unknown probability. This preference has been called 'uncertainty aversion'. In order to understand the link between nonadditivity in probabilities and the violation of SEUT, let us consider the two balls example by Ellsberg.

Subjects are offered to bet simultaneously on an urn and on a colour. Urn A contains 50 black and 50 white balls, while urn B contains 100 balls, black and white but no one knows in which proportion. Which ever colour they have chosen and which ever urn they have decided to draw a ball from, if the drawn ball is of the chosen colour, they earn \$100. The Ellsberg paradox implies that, with no preference over colours, the majority of subjects prefers to bet on urn A. This kind of reasoning can be interpreted as if subjects believed that the sum of the probability of getting a white ball plus the probability of getting a black ball in urn A was bigger than the sum of the probability of getting a white ball plus the probability of getting a black ball in urn B. As long as black and white in urn A are two disjoint events, their union gives us the universal event, whose probability is equal to unity. However, if our subjects prefer to draw a ball from urn A, they seem to believe that the probability of the universal event in urn A is bigger than the probability of the universal event in B: in other words, they seem to believe that the probability of getting a black ball plus the probability of getting a white ball from the urn B is less than unity. Following this kind of reasoning, experimenters have always considered nonadditivity in probabilities (superadditivity if the sum is greater than one; subadditivity if it is less than one) as a signal of violation of SEUT.

The experimental evidence originated by Ellsberg's paradox has shown systematic reaction to uncertainty (see Camerer and Weber, 1992, for a survey). Moreover experiments based upon the Ellsberg paradox have shown that uncertainty reaction may vary according to both the prospect domain (namely, monetary gains vs. monetary losses) and the level of probability (see, e.g., Cohen et al., 1985, 1987; Camerer and Kunreuther, 1989; Sarin and Weber, 1993; Eisenberger and Weber, 1995; Tversky and Fox, 1995; Di Mauro and Maffioletti, 1996, 2004; Gonzales and Wu, 1999; Viscusi and Chesson, 1999).

In order to explain the pervasive and robust violations of SEUT reported by the experimental results, several theories have been developed to account for ambiguity reaction. A first group of theories assumes the existence of a set of probability measures or a set of probability distributions (see, e.g., Gilboa and Schmeidler, 1989; Klibanoff et al., 2003). These theories assume that people act according to their individual attitudes: if they have a neutral attitude towards ambiguity, they consider the probability measure implied by SEUT; if they are ambiguity prone or optimist (*viz*. ambiguity adverse or pessimist), they consider the most (*viz*. least) favourable probability measure. More formally, if $S=(A, B)$ – where $S=\Omega$ is the universal event with prospect $(X, A; 0, B)$ – and A and B are two disjoint events such that $A \cap B = \varnothing$ and $A \cup B = S$, the prospect is evaluated by $W(A)\mathrm{v}(X) + W(B)\mathrm{v}(0)$ – where $v(.)$ is the value function for money, and the likelihood assigned in preference or choice to the two complementary events is not necessarily additive: $W(A) + W(B) \neq 1$. In particular, ambiguity aversion implies that the decision maker's chosen "probability measures" sum up to less than unity, $W(A) + W(B) < 1$, whereas ambiguity proneness implies that $W(A) + W(B) > 1$.

A second group of theories allows for the use of nonlinear probabilities, also called decision weights (see, e.g., Einhorn and Hogarth's (1985) 'anchoring and adjustment' model, Tversky and Kahneman's (1992) Cumulative Prospect Theory (CPT), and Tversky and Wakker (1995)). According to this group of theories, subjects tend to distort probabilities under uncertainty, but nonadditivity of the decision weights $W(A) + W(B) \neq 1$, might be a sufficient, but not a necessary, condition for violations of SEUT: if, for example, subjects use an inverse S-shaped weighting function in which the curvature of the weighting function is perfectly symmetric, they might show decision weights that sum up to unity while still violating SEUT.

From an experimental point of view, it is also important to remember that the first group of theories usually implies expected utility under risk (namely $W(P) + W(1 - P) = 1$ for risky choices), while the second group of theories allows for the use of nonlinear decision weights also under risk. Our experimental analysis of Section 4 below will try to identify violations in SEUT by considering evidence of nonadditivity in probabilities.

3. WHY AN EXPERIMENT WITH TRADE UNION LEADERS?

There are two major sets of criticism to the experimental literature dealing with violations of SEUT: sample selection bias and lack of financial incentives.[3] Firstly, participants in these experiments are usually students. Very few experiments have been run with experts: Einhorn and Hogarth (1985) and Hogarth and Kunreuther (1985) with insurers; Thaler and Ziemba (1988) with racetrack betters; Fox et al. (1996) with option traders; Viscusi and Chesson (1999) with business owners and managers.[4]

The issue is whether or not students and experts systematically react to uncertainty in different ways, and in particular whether students are more sensitive to uncertainty. Actually, we may assume that expertise is likely to reduce reaction to uncertainty: even if the event *per se* remains uncertain, having to deal in your life repeatedly with the same uncertain event might diminish your fear to deal with uncertainty, at least from a psychological point of view: hence, stock brokers, repeatedly investing in stock markets, or trade union leaders, repeatedly bargaining in uncertain environments, might tackle uncertainty in experiments differently from students. Moreover, this distinction between expert subjects and nonexpert subjects goes to some extent in the same direction as the distinction between market and nonmarket experiments: in the former case, we want to check whether experts are more "rational" than students, whereas in the latter case we want to check if people behave in markets differently relative to nonmarket situations.[5]

Hence, to test whether trade union leaders violate SEUT is not only an attempt to answer to Pencavel's concern about the lack of empirical tests on actual trade union behaviour (see Section 1 above), but it is also an answer to the usual criticism that a pool of students might react in a different way from a pool of experts. If we shall find, as in fact we do, that trade union members do violate SEUT, then we can conclude that the Ellsberg paradox is an extremely robust phenomenon. (The consequence of this finding in terms of trade union theory will be sketched in Section 5 below.)

The second major criticism is that experiments on decision making under risk or uncertainty are rarely run by using induced-value methods. If an experiment is designed with student subjects and without an induced-value method, one can argue that reported violations of SEUT may depend not only on sample selection bias, but also that lack of financial incentives may lead to careless performance during the experiment. Hence, in addition to using experts, we paid our subjects, and we used an induced-value method in order to elicit truthful preference revelation,[6] as it will be explained in Section 4.1 below.

A final methodological issue deals with the source of uncertainty. Since Ellsberg (1961), reaction to uncertainty has also been linked to the lack of information. A few experiments have shown a relation between competence or knowledge and reaction to uncertainty: for example, Heath and Tversky (1991) have shown that people might prefer to bet on a judged probability, if they are competent about the uncertain event, while Keppe and Weber (1995) have shown that subjects are less uncertainty adverse when they are asked to invest for a home company than for a foreign company and that this behaviour implies that the difference from unity in the sum of the "probabilities" is smaller in the former than in latter case. In our experiments, we want also to check for these possibilities, so we gave to our subjects the task of evaluating bets on two different sources of uncertainty, one more familiar than the other (i.e. European elections in Italy and the U.K., see Section 4.2.2 below).

4. THE EXPERIMENTS

This section describes two experiments testing whether trade union firm-level delegates and leaders exhibit uncertainty reaction in the gains domain, and whether this differs according to the source of uncertainty. Experiment 1 was based on the original Ellsberg paradox and on fictional election results. Experiment 2 was based on the results of the June 1999 European parliamentary elections both in Italy and the U.K.

4.1. *Experiment 1: fictional elections*

This experiment was designed to test whether trade union leaders exhibit reaction to uncertainty and whether this reaction depends on the range of the probability interval used to represent the ambiguous probabilities. Following the existing literature (see, for example, Camerer and Weber, 1992), we operationalised ambiguity by using a second order probability distribution: in particular, we used a uniform probability distribution. The experimental design was based on the research hypothesis that the subjects' evaluation of vague probabilities is influenced by the size of the interval around the expected probability, such that the larger is the interval around the mean, the bigger is the number of possible probability measures that are simulated by the decision-makers. A few experiments have been run to measure the effect of the probability range in determining individual reaction to uncertainty, with mixed evidence depending on both the prospect domain and the level of probability. (See, for example, Yates and Zucowsky, 1976; Curley and Yates, 1985, 1989; Viscusi and Chesson, 1999.)[7] As we shall see below, this experiment seems to suggest that, when the mean probability level is equal to one half, trade union subjects are ambiguity adverse in the gains domain and their ambiguity aversion raises with the probability range.

Subjects: The subjects of this experiment were trade union delegates at the firm level ($N = 25$). They were approached at the end of two separate meetings of trade union delegates for the chemical industry ($N = 14$) and the mechanical industry ($N = 11$) of one of the largest trade unions of a Northern Italian province (Como).[8] The subjects were asked to participate voluntarily in a study of decision-making under uncertainty. Each participant was offered a 2000 Italian lire (about €1) instant lottery ticket for completing the survey, and the possibility of winning up to 100,000 Italian lire (about €51) for real (see below).

Experimental design: The subjects evaluated seven scenarios: one risky and six ambiguous scenarios. The risky and one of the ambiguous scenarios corresponded to the original Ellsberg Paradox. The other six scenarios were related to a fictional electoral game between two coalitions, A and B. Both chance lotteries and event lotteries were defined as two-outcome prospects (100,000 lire, p; 0, $1 - p$). In the chance lottery, the gamble offered a p% chance of winning 100,000 Italian lire if a white ball was drawn from an opaque bag containing 100 balls, and $(1 - p)$% chance of winning nothing otherwise. In the risky situation, subjects were told that the bag contained 50 white and 50 black balls, thus the known probability was equal to one half, $p = 0.5$. In the ambiguous scenario based on Ellsberg, they were told that the bag contained 100 balls, white and black, but in unknown proportion (i.e. unknown probability). In the ambiguous event lotteries, subjects could win the same amount of money if a coalition A had won the election against a coalition B: uncertainty in the probabilities was generating by giving an imprecise interval of probability to subjects, varying between 0 and 100%. In particular, subjects were told that, according to a highly reputable opinion polls agency, the probability that coalition A won the election against coalition B lay anywhere within a given interval: following Yates and Zucowsky (1976) and Curley and Yates (1985, 1989), all of the probability intervals, namely 40–60%, 30–70%, 20–80%, 10–90%, 0–100%, were centred around an expected mean probability of victory equal to one half. In other words, the election outcome was represented by a uniform probability distribution, bounded by the extremes of the interval, with mean equal to p=0.5.[9] Our research hypothesis was that the subjects' perception of ambiguity increased with the probability interval, keeping the mean probability estimate constant to one half.

In order to elicit certainty equivalents for the risky and ambiguous prospects, subjects were asked to state their *minimum selling price* for their lottery ticket. The scenarios were randomised individually, so as to avoid order effects, and induced-value methods were implemented by using versions of the Becker et al. (1964) procedure.[10]

It is important to note that, while the premium might seem small on North American grounds, it is substantial on Italian grounds, as long as a trade union delegate's average net salary might be around €1,000 per month, namely the €51 premium represents 5.1% of her monthly net salary.[11]

Experimental results: Table I shows means, medians and standard deviations of an index for risk attitudes, denoted as *risk ratio* henceforth, and an index for ambiguity attitudes, denoted as *ambiguity ratio* henceforth, for each lottery.[12] The two indexes are defined as follows. For the risky lottery, risk ratios for each trade union delegate have been calculated by dividing the expected value of the lottery (i.e. $\mathrm{EV} = 50,000$ Italian lire) by each trade union delegate's minimum selling price for the lottery, MSP(R), so that a ratio bigger (*viz*. less) than one indicates risk aversion (*viz*. proneness), whereas a ratio equal to one signals risk neutrality:

$$\text{Risk ratio} = \text{EV/ MSP(R)}$$

In a similar way, in order to measure the differential attitudes towards ambiguity vis-à-vis risk, we have calculated for each individual and each ambiguous lottery an ambiguity ratio by dividing the individual's minimum selling price for the risky lottery, MSP(R), by her/his minimum selling price for each ambiguous lottery, MSP(A):

$$\text{Ambiguity ratio} = \text{MSP(R)/MSP(A)}$$

An ambiguity ratio bigger (*viz*. smaller) than one corresponds to ambiguity aversion (*viz*. proneness), whereas an ambiguity ratio equal to one indicates indifference between risk and ambiguity, as predicted by SEUT.[13]

By looking at the mean values of Table I, it turns out that our subjects display risk neutrality and ambiguity aversion. Ambiguity ratios show an increasing pattern, namely more ambiguity aversion is observed in the sample as the probability interval increases (but for the largest interval 0–100%), as expected. This is also true for the median ambiguity ratios. Note that confidence intervals are wider for the 10–90% and 0–100% interval lotteries, due to the presence of two outliers (i.e. two subjects with an ambiguity ratio equal to 8 and 20, respectively): as long as these extreme values may signal a very strong aversion to ambiguity rather than errors or irrationality, they have not been eliminated from the calculation of the mean.

In order to check whether the trade union delegates' reaction under risk is different from their reaction under uncertainty, we have computed a Wilcoxon signed ranks test for related samples by pairing the risk ratios with the ambiguity ratios for each lottery. We can reject the null hypothesis that there is no difference in reaction under risk and ambiguity at the 5% significance level, but when we consider either the smallest probability interval (risk ratio vs. ambiguity ratio for the 40–60% lottery, p-value $= 0.086$) or the largest interval under the chance lottery[14] (risk ratio vs. ambiguity ratio for the Ellsberg lottery, p-value $= 0.06$). The implications of this test are twofold: first, the trade union delegates of our sample clearly behave differently when facing risk or uncertainty. Second, in spite of the fact that ambiguity is represented through a second order distribution in the fictional election game, subjects seem to consider such a game as more "uncertain" than the Ellsberg lottery.[15]

Moreover, we want to check whether, keeping the mean probability estimate constant, it is the probability interval that determines the size of the reaction to ambiguity. In so far as our experimental hypothesis is that an increase in the probability interval should lead to more ambiguity aversion, we have computed a Page test for ordered alternatives, based on

TABLE I

Experiment 1: Summary statistics for the risk ratio and the ambiguity ratios

N=25	Risk ratio	Ambiguity ratio Ellsberg	Ambiguity ratio 40–60	Ambiguity ratio 30–70	Ambiguity ratio 20–80	Ambiguity ratio 10–90	Ambiguity ratio 0–100
Mean	1.04	1.32	1.17	1.27	1.44	2.44	2.28
Median	0.83	1	1.11	1.17	1.2	1.5	1
St. Dev	0.93	0.96	0.61	0.53	0.86	2.07	3.92
Confidence	0.38	0.4	0.25	0.22	0.35	0.85	1.62
Interval 95%	(0.66–1.42)	(0.92–1.72)	(0.92–1.42)	(1.05–1.49)	(1.09–1.79)	(1.59–3.29)	(0.66–3.9)

Note: The risk ratio has been calculated as EV/MSP(R). The ambiguity ratio has been calculated as MSP(R)/MSP(A) for each ambiguous lottery, where MSP is the minimum selling price. Hence an ambiguity (*viz.* risk) ratio greater than 1 means ambiguity (*viz.* risk) aversion and an ambiguity (*viz.* risk) ratio smaller than one means ambiguity (*viz.* risk) proneness.

the five related samples of the fictional electoral game, by testing the null hypothesis that the median ambiguity ratios are the same against the alternative hypothesis that the median ambiguity ratios are ordered in magnitude, with higher medians as the probability interval increases.[16] The Page test rejects the null hypothesis at the 5% significance level (under the large-sample approximation, given that $N = 25$, the standardised normal version of the Page statistics is $L^* = 2.2$, p-value $= 0.0139$, one-tailed test),[17] thus providing evidence that a higher probability interval, for given probability mean, is likely to be associated with higher ambiguity aversion.

In order to further investigate whether the probability interval matters, we consider the proportion of trade union delegates that are risk and ambiguity adverse, neutral and prone for each lottery. Table II reports these proportions, based on the individual risk and ambiguity ratios.

These data show that, although there is a strong individual reaction to ambiguity at the $p = 0.5$ probability level, namely, the proportion of ambiguity neutral subjects is always less than 36% for the election lotteries, such a proportion is increasing in the probability interval (but for the 10–90% lottery). Actually, a Chi-square goodness of fit test can reject for each lottery, but the 0–100% one, at the 5% significance level the null hypothesis that the proportion of individuals who are ambiguity neutral is equally likely to be observed as the proportion of nonambiguity neutral subjects.[18] Moreover, a Cochran Q test rejects at the 5% level of significance (namely, Cochran's Q = 13.4, p-value $= 0.01$ with df $= 4$) the null hypothesis that the probability of observing an ambiguity neutral individual is the same for all the election lotteries against the alternative hypothesis that such a probability differs according to the probability interval.[19] As long as this latter result seems partly due to the fact that, as the probability interval increases, the proportion of individuals showing ambiguity preference falls, whereas the proportion of ambiguity averse individuals remains fairly stable (but for the 10–90% lottery, see Table II), we do not take it as evidence against our hypothesis that trade union delegates become more ambiguity adverse as the probability interval increases.

TABLE II

Experiment 1: Proportion of risk or ambiguity averse, prone and neutral subjects

	Risk	Ellsberg	40–60	30–70	20–80	10–90	0–100
% neutral (N)	32% (8)	44% (11)	12% (3)	16% (4)	24% (6)	16% (4)	36%(9)
% adverse (N)	12% (3)	36% (9)	52% (13)	56% (14)	52% (13)	68% (17)	40% (10)
% prone (N)	56% (14)	20% (5)	36% (9)	28% (7)	24% (6)	16% (4)	24% (6)
% Tot (N)	100% (25)	100% (25)	100% (25)	100% (25)	100% (25)	100% (25)	100% (25)

Finally, similarly to Viscusi and Chesson (1999: 169–172), we follow an estimation approach to test for range effects in our data. In particular, we use the minimum selling prices (MSP) for each individual and each lottery to conduct a panel data analysis:[20] as long as each subject i answered five different questions related to the fictional election result, we can treat each election lottery as if it were a different time period t and exploit both the "time series" and the cross-sectional variation in the data. In detail, we specify the following model:

$$W(p=0.5)_{it} = \delta_i + \beta \mathrm{RANGE}_t + v_{it}.$$

The dependent variable $W(p=0.5)$ is the weighting function at the expected mean probability of victory $p=0.5$ for each of the two fictional parties. We construct the $W(p=0.5)$ series from the experimental data as follows: given that $v(\mathrm{MSP}) = W(p=0.5)v(100,000) + W(1-p=0.5)v(0)$, where MSP is the minimum selling price of the lottery and $v(.)$ the value function, if we assume that $v(0)=0$ and a linear value function $v(X)=X$,[21] by dividing the certainty equivalents derived from the subjects evaluations by 100,000 (Italian lire), we obtain the decision weights for each individual i in each lottery t: $W(p=0.5) = \mathrm{MSP}/100,000$. The independent variable RANGE is the probability range (0.2, 0.4, 0.6, 0.8, 1), which is the same across individuals; δ_i are individual effects and v_{it} is an additive normally distributed random term representing judgmental inconsistencies.

Table III below presents the panel regression, which is run by using the within groups fixed effects estimator implemented by the Pc-Give10.1 econometric package, in order to remove across treatment (i.e. "time invariant") individual specific effects and to account for unobserved heterogeneity (robust standard errors are reported to control for potential heteroscedasticity as well). Table III shows that, at the mean probability level $p=0.5$, increasing the probability range lowers the probability weight at the 10% significance level.

This is the result we would expect if the trade union delegates are ambiguity adverse, given that ambiguity aversion implies $W(p=0.5) < p=0.5$ here: as long as increasing the

TABLE III
Experiment 1: Probability range effects: within-group fixed effects

Dependent variable: Probability weighting function				
Coefficient	Robust std.error	t-value	t-prob	
Range	−0.1188	0.0654	−1.82	0.073
R^2	0.04			
Nobs	125			
Tests				
Wald (joint):	$\chi^2(1) = 3.294$ [0.07]			
AR(1) test:	N(0,1) = −1.698 [0.09]			
AR(2) test:	N(0,1) = −0.4255 [0.67]			

probability range is expected to raise the reaction to ambiguity, the trade union delegates should increasingly underestimate the objective probability $p = 0.5$ of a monetary gain, implying a negatively estimated coefficient for RANGE. Moreover, the result that the statistical significance of the estimated negative effect is small seems consistent with the existing experimental evidence (see above) according to which, in the gains domain, subjects are averse to ambiguity at high probabilities, whereas they prefer ambiguity at low probabilities. Actually, this experimental evidence suggests that the crossover point of the weighting function is usually included in the interval between 0.3 and 0.4.

Overall, the data of this experiment seem to suggest that the trade union delegates of our sample are ambiguity adverse and that an increase in the probability range at the $p = 0.5$ probability level induces more ambiguity aversion.

4.2. *Experiment 2: real elections*

This experiment was designed in order to measure the shape of the weighting function for trade union leaders at different probability levels and to measure their judged probabilities for the same events. To measure the shape of the weighting function, we first checked whether or not the trade union leaders' value functions were linear in the expected monetary payoff. As we shall see below, the experiment gives only a partial support to such an inference. Moreover, this experiment aimed at measuring reaction to real rather than fictional uncertainty, as represented by lotteries made conditional on real electoral results.

Subjects and experimental design: The design of this experiment followed Fox et al. (1996) (FRT henceforth) closely (see also Kilka and Weber, 2000). The questionnaire was composed of about thirty questions.[22] The $N = 34$ participants were sabbatical and full-time trade union leaders that represent the highest ranks of a local trade union (about three quarters of the total number of the full-time officials for this union). They were approached individually by the experimenter in the headquarter offices of the local trade union. They were asked to match risky prospects both with two positive outcomes and with one single positive outcome. They were also asked to price uncertain prospects with one single positive outcome. The questions were given in random order to the subjects (the questions were randomised individually) so as to avoid order effects. Induced-value methods were used: each participant received a 2000 Italian lire (about €1) instant lottery ticket and had the possibility of winning up to 120,000 Italian lire (about €60) for real. Three days after the 1999 European election took place, an extraction was held at the local trade union's headquarter office: three subjects were chosen at random, one scenario involving the election results was chosen at random, and the subjects were paid according to their answers.

4.2.1. *Risky prospects*

The aim of these questions was to elicit the subjects' value functions and consider their attitude towards choices involving games of chance.

Matching questions: In order to elicit their value functions, the trade union leaders had to consider two problems, involving the comparison between complete and incomplete prospects. The subjects were asked to consider throwing a fair, six-sided dice. In the first problem, the complete prospect A would have paid 120,000 Italian lire if the throwing of the dice had resulted in number 1 being landed, 60,000 Italian lire if it had resulted in number 2, and nothing otherwise. The incomplete prospect B would have paid X Italian lire if 1 had come out, 30,000 lire if 2 had come out, and nothing otherwise. The subjects were asked to indicate the sum of money X that would have made them indifferent between the two prospects A and B.

The second problem was similarly designed: the subjects had to compare the complete prospect C-paying 110,000 Italian lire if 1 had come out, 70,000 lire if 2 had come out and paying nothing otherwise – with the incomplete prospect D-paying X Italian lire for 1, 40,000 lire for 2 and paying nothing otherwise.

For both the problems, the median value of X was equal to the one making the two lotteries indifferent in expected value, given the probability of 1/6 that the dice would have landed either 1 or 2: $\mathrm{X} = 150,000$ Italian lire for lottery A vs. B, and $\mathrm{X} = 140,000$ Italian lire for lottery C vs. D. Moreover, about 35% of the trade union leaders (12 out of 34) reported the expected value of X for at least one lottery (10 out of 34 reported the expected values for both lotteries). In other words, these subjects' indifferences can be interpreted as *evidence of a linear value function* for monetary gains.

As Fox and Wakker (1999) point out in commenting FRT's (1996) paper, these results are consistent with a linear value function provided that the subjects behave according to Expected Utility Theory or Ordinary Prospect Theory. However, this is not necessarily the case if the subjects behave according to CPT: under CPT, it may be misleading to infer that subjects' value functions are linear when observing values of X matching the expected value of the prospect. The reason is that the reported matching value X could reflect the combination of both a nonlinear decision weight and a nonlinear value function that just by chance turns out to be equal to the expected value of the prospect. In our paper, this problem can be relevant, as long as 44.2 and 41.2% of the subjects, for the first and second matching question respectively, priced prospects below their expected value, which may be taken as evidence of concave utility functions or risk aversion under Expected Utility. (Note that 20.5 and 23.5% of the subjects priced prospects above their expected value, which may indicate convex utilities or risk love under expected utility.)[23] Below, we shall maintain the hypothesis of a linear value function, but we shall also briefly consider the implications of assuming a nonlinear value function for the shape of the weighting function that emerges from our data.[24]

Pricing questions: Similarly to FRT, the subjects were asked to state their minimum selling price for nine risky prospects. Each prospect was offering to pay 120,000 Italian lire with a given probability of winning. The probability of winning varied from 0.1, 0.2, 0.3, 0.4...to 0.9. (Details are available on request from the authors.) The subjects received the risky prospects in random order.

The value of the minimum selling price of the prospect (120,000 lire, p) represents the subjective certainty equivalent. If the subjects use the decision weight $W(p)$ instead of probabilities to evaluate risky prospects, the value of the minimum selling price conditional on probability p, v(MSP, p), is equal to: $v(\text{MSP},\ p) = W(p).v(120{,}000\ \text{lire}) + W(1-p).v(0)$. Provided that the value function v is linear, or v(lire) = lire, and that $v(0) = 0$, the decision weight at any given probability level is given by the ratio between the corresponding minimum selling price and the prize of the prospect: $W(p) =$ (MSP, p)/120,000.

As we have already discussed above, there is evidence that the value function v(.) might be linear. (Recall that this was indeed the case at median values across subjects.) However, on the basis of our data, we cannot exclude *a priori* that the value function is concave instead. If this latter is the case, the ratio (MSP, p)/120,000 would underestimate the true value of the weighting function. As a first approximation, we start by assuming that the value function is linear and proceed from here. The implications of relaxing this assumption will be briefly considered below. With a linear value function, the median value of $W(p)$ = (MSP, p)/120,000 across subjects can be taken as the decision weight at each probability value p. These median values are reported in Table IV below.

Table IV shows that, under the assumption of a linear value function, the resulting weighting function is also almost linear, which indicates that the trade union leaders in our sample were risk neutral in the domain of gains for the range 0 to 120,000 Italian lire. This result is consistent with FRT's finding that option traders price risky prospects at their expected value (see FRT, 1996, Figure 1, p. 9). In turn, this result is also in sharp contrast with the existing evidence on student subjects, showing that, in the gains domain, students tend to overestimate risky prospects at low probability values and underestimate them at high probability values. Typically, such an observed behaviour gives rise to S-shaped weighting functions with a crossing point at around $p = 0.4 - 0.5$ (see, for example, Tversky and Kahneman, 1992). We believe that such a result is quite remarkable, as long as trade union leaders are less likely to be trained in actuarial calculus than options traders are.

However, if the trade union leaders' utility function were actually nonlinear, our conclusion of a linear weighting function would be wrong. Following, for example, Tversky and Kahnemann (1992), assume that the value function of each trade union's leader is given by a power value function that is concave in monetary payoffs: $v(lire) = (lire)^{\alpha}, 0 < \alpha < 1$. The weighting function under different values of $\alpha = 0.1$, 0.2, 0.3, 0.4,...0.9 (still using median values of (MSP, p) across subjects at each probability value) is reported in Table V.

Table V shows that, for values of the parameter $\alpha < 0.5$, the weighting function always *overestimates* the probability of the

TABLE IV

Experiment 2: Risky prospects: Median values of the weighting function $W(p)$ = (MSP,p)/120,000 across subjects at each probability value p

	$p=0.1$	$p=0.2$	$p=0.3$	$p=0.4$	$p=0.5$	$p=0.6$	$p=0.7$	$p=0.8$	$p=0.9$
$W(p)$	0.166	0.2	0.316	0.408	0.5	0.587	0.66	0.8	0.833

Note: Median values of the weighting function under the assumption of linear value function, or v(lire) =lire prospect (that is, the weighting function is concave). For values of $\alpha > 0.5$, however, the crossover point occurs at values of $p > 0.8$, implying a weak S-shaped effect on the weighting function.[25]

Had we assumed a median trade union leader's concave utility function (which would have been consistent with risk-adverse behaviour under expected utility), observed behaviour would still have violated expected utility according to our data. In other words, because the median weighting function is highly nonlinear in such a case, there is a distortion in probability that is inconsistent with expected utility. If and only if utility is linear, our data suggest a linear weighting function, or risk-neutral behaviour by part of the trade union leaders in this sample. However, note that risk-neutrality does not necessarily imply ambiguity neutrality, as we shall discuss in the next section. prospects related to the results of the June 1999 elections for the European Parliament. The prospects would have paid 120,000 Italian lire if a target event had occurred, and nothing otherwise. The subjects had to price eight lotteries in which the target event was defined as the percentage of votes received by conservative parties in Italy (that is, the Polo coalition) and by the Conservative party in the U.K.[26] The working assumption was that our trade union leaders would have been more familiar with the Italian political system than with the British system. The eight targets (four for each election) were selected on the basis of opinion polls published in the British and Italian national press in May 1999. (Although this information was not given to the subjects.) Therefore, the targets were as follows: for the Italian election, less than 35%, between 35 and 40%, between 40 and 45%, 45% or above; for the U.K. election, less than 25%, between 25 and 28%, between 28 and 31%, 31% or above.[27] Following such pricing questions, the subjects had to indicate their judgement on the probabilities of the target events.[28] The order of the questions was randomised individually, but the four questions for each election appeared together.

Decision weights: Section 4.2.1 above presented evidence in favour of trade union leaders' linear value functions in the range between 0 and 120,000 Italian lire. If we now assume linearity, it is possible to derive the decision weight for each target event as the ratio between the reported minimum selling price and the lottery prize as follows:

$$W(A) = \text{Minimum Selling Price}/120{,}000.$$

Using the estimates for each of the four target events, we can calculate the sum of the decision weights for each individual subject. These data are reported in Table VI, where column 2 refers to the Italian election results and column 4 to the U.K. election results.

If a subject behaves according to SEUT, the sum of the decision weights for the four Italian lotteries, and similarly for the four U.K. lotteries, is equal to unity: $W(A) + W(B) + W(C) + W(D) = 1$. If this is the case, we can conclude that our trade union leaders are ambiguity neutral or better that their weighting functions add up to one.[29] However, as reported in Table VI, the totality of trade union leaders shows some reaction to uncertainty, with about 74% for the Italian election and about 67% for the U.K. election lotteries showing superadditive decision weights. In particular, the median decision weight was 1.61 for the Italian election and 1.42 for the U.K. election. Because our trade union leaders consistently overestimate the probability of the positive prospect, we can take this result as evidence of ambiguity proneness.

Judged probabilities: After having priced the ambiguous lotteries, the subjects were asked to indicate their judgements of probability for each target event. Columns 3 and 5 of Table VI above report the sum of these judged probabilities. If we denote with $p(A)$ the judged probability of the uncertain event A, SEUT would again predict additive probabilities: $p(A) + p(B) + p(C) + p(D) = 1$. We can see that the median sum of the judged probabilities for the Italian election is 1.35, whereas for the U.K. election is 1.31. In other words, there

TABLE V

Experiment 2: Risky prospects: Weighting function $W(p)=[(\mathrm{MSP}, p)/120,000]^{\alpha}$

W(p)	$p=0.1$	$p=0.2$	$p=0.3$	$p=0.4$	$p=0.5$	$p=0.6$	$p=0.7$	$p=0.8$	$p=0.9$
$\alpha=0.1$	0.836	0.851	0.891	0.914	0.933	0.948	0.960	0.978	0.982
$\alpha=0.2$	0.698	0.725	0.795	0.836	0.87	0.899	0.927	0.956	0.964
$\alpha=0.3$	0.583	0.617	0.708	0.764	0.812	0.852	0.885	0.935	0.947
$\alpha=0.4$	0.487	0.525	0.631	0.699	0.758	0.808	0.850	0.915	0.929
$\alpha=0.5$	0.407	0.447	0.563	0.639	0.707	0.766	0.816	0.894	0.913
$\alpha=0.6$	0.340	0.381	0.502	0.584	0.659	0.727	0.784	0.875	0.896
$\alpha=0.7$	0.285	0.324	0.447	0.534	0.616	0.689	0.753	0.855	0.879
$\alpha=0.8$	0.238	0.276	0.398	0.488	0.574	0.653	0.723	0.836	0.864
$\alpha=0.9$	0.199	0.235	0.355	0.446	0.536	0.619	0.694	0.818	0.848

Note: (MSP, p) is the median value of the minimum selling price across subjects at each probability value p.

TABLE VI
Experiment 2: Ambiguous prospects: Decision weights and judged probabilities for individual subjects under a linear value function

Scenarios	Decision weights Italy	Judged probs Italy	Decision weights U.K.	Judged probs U.K.
Subjects				
1	3.00	2.00	3.50	2.00
2	1.25	1.10	0.33	1.00
3	1.58	1.75	1.58	1.60
4	2.25	1.35	1.25	0.65
5	0.38	1.60	0.33	1.20
6	2.50	2.40	2.50	1.70
7	0.77	1.90	0.43	2.70
8	2.00	1.80	1.08	1.70
9	0.19	1.25	0.77	1.55
10	1.42	1.30	0.92	1.10
11	2.33	1.25	2.08	1.25
12	0.33	1.00	0.31	1.00
13	1.62	1.20	1.10	0.90
14	0.05	1.30	0.07	1.10
15	2.99	1.31	2.00	1.31
16	1.96	1.80	1.50	1.70
17	0.11	1.40	0.10	0.80
18	0.85	0.90	0.86	1.15
19	1.57	1.95	0.82	0.85

Subjects				
20	2.87	1.20	1.58	1.01
21	0.67	1.95	1.38	1.68
22	2.40	2.30	3.10	3.10
23	0.17	1.80	0.17	1.60
24	2.00	2.40	1.83	2.20
25	2.00	2.00	1.92	2.60
26	1.92	1.50	2.00	2.00
27	2.83	1.08	1.83	1.38
28	2.50	1.10	2.00	1.96
29	1.17	1.32	3.50	1.03
30	1.17	1.00	1.13	1.00
31	1.67	1.00	NA	NA
32	2.75	0.50	2.83	0.50
33	4.67	0.85	2.08	0.90
34	1.33	1.50	1.42	1.90
Median	1.6167	1.35	1.4167	1.31

Note: Columns 1 and 3: Decision weights for the European Election Results in Italy and the UK, respectively, derived as the sum of individual decision weights over four lotteries, A, B, C, D with the same prize, where, for example, $W(A)$ = [Minimum Selling Price for lottery A/120,000]. Columns 2 and 4: Judged Probabilities for the European Election Results in Italy and the UK, respectively, derived as the sum of the stated probabilities over the same four lotteries A, B, C, D. If the decision weights or the judged probabilities differ from unity, this is interpreted as evidence of violation of Subjective Expected Utility.

is still evidence of superadditivity or ambiguity proneness in our data.

Comparison: These results are even more striking if we look at Table VII below, in which we report the proportion of individuals whose sum of decision weights or judged probabilities is equal, bigger or smaller than one. Irrespective of the theoretical model one is willing to adopt, superadditivity (i.e. sum bigger than one) or subadditivity (i.e. sum less than one) show both that subjects are violating SEUT and that they are reacting to uncertainty: moreover, this uncertainty reaction is statistically significant.[30]

In this respect, our subjects show an extreme reaction to ambiguity in both the Italian and the U.K. elections. In both situations, this reaction is stronger for decision weights than for judged probabilities and in both cases the majority of subjects reveal superadditivity in their decision weights as well as in their judged probabilities, although the median difference between decision weights and judged probabilities is stronger for the Italian than for the U.K. elections.

Next, we want to check whether reaction to ambiguity was independent or not of the method used for measuring it, namely decision weights vs. judged probabilities. Median values as well as the proportions reported in Table VII above reveal that the trade union leaders are less ambiguity prone when assessing their judged probabilities. However, this result may depend on our assumption of a linear value function that may introduce a bias towards proneness in computing decision weights. (Judged probabilities show subjective degrees of belief and are thus independent of any particular assumption made about the shape of the value function.)

In order to test whether reaction to ambiguity for each separate election was independent of the way ambiguity reaction was measured, we computed the Wilcoxon signed ranks tests, by pairing the two related samples (ITWeight, ITJudgedProb) and (UKWeight, UKJudgedProb) separately. These tests are reported in Table VIII below (see columns 2 and 3): we cannot reject the null hypothesis that measuring ambiguity reaction

TABLE VI

Experiment 2: Ambiguous prospects: Proportion of individuals whose sum of decision weights or judged probabilities is equal, bigger or smaller than one

	Decision weight Italy	Judged probability Italy	Decision weight U.K.	Judged probability U.K.
% SUM =1 (N)	0% (0)	9% (3)	0% (0)	15% (3)
% SUM<1(N)	26% (9)	9% (3)	33% (11)	18% (6)
% SUM>1 (N)	74% (25)	82% (28)	67% (22)	67% (24)
% Tot (N)	100% (34)	100% (34)	100% (33)	100% (33)

with either method is equivalent for each separate election. We can conclude that any bias of the decision weights potentially introduced by the linear specification of the value function did not affect significantly the subjects' responses.[31]

Secondly, we want to check whether reaction to ambiguity was different depending on the source of uncertainty. For given measure of ambiguity reaction, we note that the trade union leaders exhibited stronger superadditivity when evaluating the Italian rather than the U.K. election as far as the decision weights are concerned, but this difference in superadditivity is extremely small when we compare judged probabilities between Italy and the U.K.

Therefore, for given measure of ambiguity reaction, we tested the null hypothesis that reaction to ambiguity is independent of its source, by using the Wilcoxon signed ranks tests for the two pairs of related samples (ITWeight, UK Weight) and (ITJudgedProb, UKJudgedProb). These tests are shown in Table VIII (see columns 4 and 5): only when we compare decision weights for Italy and the U.K., we can reject the null hypothesis at conventional significance levels.

Given these results, we can conclude that decision weights and judged probabilities are similar methods for measuring

TABLE VII

Experiment 2: Ambiguous prospects: Wilcoxon signed ranks tests

	ITJudgedProb–ITWeight	UKJudgedProb–UKWeight	UKWeight–ITWeight	UKJudgedProb–ITJudgedProb
Z	−0.822	−0.363	−2.016	−0.36
p-value	0.21	0.36	0.02	0.35

Note: One-tailed Wilcoxon signed ranks tests ITJudged Probabilities vs. IT Decision Weights (column 2); U.K. Judged Probabilities vs. U.K. Decision Weights (column 3); U.K. Decision Weights vs. IT Decision Weights (column 4); U.K. Judged Probabilities vs. IT Judged Probabilities (column 5).

subjects' stronger when they have less knowledge over the occurrence of the event, namely the victory of the U.K. Tories in our experiment. This hypothesis is not supported by our data as predicted by CPT instead.

An alternative interpretation of our results is that trade union leaders felt more competent about the Italian than the U.K. elections: as a consequence, they behaved more optimistically while assessing the former than the latter election. This interpretation is consistent with Kilka and Weber's (2000) findings that subjects evaluating future stock prices in the US and Germany were "more optimistic about those stocks they felt more competent about than those they felt less competent about" (see also Heath and Tversky, 1991). However, if we look at the Wilcoxon tests, this interpretation is only valid when we consider the decision weights.

The fact that decision weights are statistically significantly different between the two elections seems to suggest that the decision weights are capturing something that is not captured by the judged probabilities instead. One possible interpretation is that the subjects were more emotionally involved when considering the Italian electio. For example, Rotten streich and Hsee (2001) show that decision weights might be more S-shaped when people are dealing with affect-rich choices, while Maffioletti and Santoni (2004) have shown the same result with event lotteries based on real elections. If we are capturing something that is in the weighting function, and the difference between the weighting function and the corresponding judged probability is not statistically significant at the same time, this may be interpreted as follows: as long as the weighting functions are derived indirectly from the subjects' minimum selling price and utilities (based on money), the weighting functions are perhaps capturing something that is in the utility function. In the case of political elections, we have the prize of the lottery and the victory of a certain party. The occurrence of this latter event may influence in some way each subject's utility and this may partially explain the difference between subjects' attitudes when considering decision weights vis-à-vis judged probabilities. Moreover this emotional involvement may explain the difference in the decision weights when considering the Italian vis-à-vis the U.K. elections (namely, Italians attach no utility to the victory of the U.K. Tories).

5. IMPLICATIONS FOR TRADE UNION BEHAVIOUR

The experimental results of Section 4 seem to support the hypothesis that individual trade union leaders, by reacting to ambiguity, systematically violate SEUT.

What do these results tell us about trade union behaviour in the labour market? It is unclear whether ambiguity reaction at the individual level aggregates in corresponding behaviour by part of the trade union. On the one hand, many economists would argue that markets, and more generally institutions, may help correcting mistakes individuals make, by allowing rational agents to have a larger impact on equilibrium than irrational agents (see footnote 5 above). For example, political discussions and collective decision-making procedures could smooth out heterogeneous expectations, pointing to rational decision-making. Blinder and Morgan's (2004) experimental evidence support the hypothesis that group decisions are more accurate without being slower than individual decisions.

On the other hand, psychologists have shown that "group decision-making actually exacerbates the biases observed in individual decision-making", especially in large groups and under majority-rule voting (see Kerr et al. 1996: 714). Bone et al. (1999) have also shown that, when the subjects act as a group rather than as individuals, there are increasing violations of the independence axiom of EU thus of SEUT.

This discussion opens up the question as to where effective decision-making power lies in the union. Following Pencavel (1991: 56–7), many labour economists tend to interpret the union's objective function as the leadership's rather than the aggregation of the utility functions of the union members. If this is the case, observed violations of SEUT by individual union leaders may well imply that union behaviour does not conform to SEUT.

What are the possible implications of ambiguity reaction by part of the trade union? For example, consider trade union attitudes to the unemployed. It has been argued that income security provisions are more likely to be observed in collective bargaining agreements covering those sectors "with a high rate of business mortality" or "where intermittent employment is usual" (see Pencavel, 1991: 68, footnote 19 for US evidence). As long as in these sectors the probability of unemployment of a union member is unknown (because business survival probabilities are unknown), ambiguity averse trade unions may prefer writing severance pay provisions into labour contracts. However, if trade unions have more information on the probability of unemployment of a union member, for example because reductions in employment occur by inverse seniority within firms, and provided that firm survival is not under threat, we would expect less ambiguity reaction that may imply less interest for policies in favour of the unemployed.[32] Moreover, ambiguity aversion may help to explain why "the union is more likely to take account of the welfare of an unemployed individual who had once been an active unionist, who is likely to become one in the future, or who has friends or relatives among the employed union members" (Pencavel, 1991: 68) rather than taking account of the welfare of an unknown (to the union) unemployed worker (see also Section 2 above).

Ambiguity reaction may also help to explain differing trade union attitudes to the introduction of technological innovation in the workplace.[33] These attitudes may be related to the nature of management–union relationship. For example, suppose that management introduces an automated inspection and quality control system. This decision may create uncomfortable ambiguity if workers and unions are unclear on the scope of this innovation and, in particular, on how it may affect current workers' unemployment probability: ambiguity aversion may lead to union's resistance to innovation. However, suppose that management explains extensively to the union the scope and likely effects of innovation: this additional information reduces ambiguity as perceived by the union, which may imply less resistance to innovation. We would expect that the stronger is the information flow from management to union, the lower is union's resistance to innovation, ceteris paribus: management can use the collective voice function of the union (see Booth, 1995: 65) both ways (from and to the union) to reduce workers' resistance to innovation.

So far our discussion has focused on the possible implications of ambiguity aversion for trade union behaviour. However, our Experiment 2 shows that trade union leaders may well be ambiguity prone. This may have important implications as regards the theoretical models one would like to select in order to model trade union behaviour under ambiguity.

We believe that the result of Experiment 2 is important and can be usefully compared with other experimental works. Actually, the idea of investigating on ambiguity proneness is not new, but results have been for a long time not clearcut. Few early general experiments have reported the presence of ambiguity preference (see, for example, Heath and Tversky, 1991; Hogarth and Einhorn, 1990; Fox and Tversky, 1995). More recently, Wakker et al., (2003) and Di Mauro and Maffioletti (2001b) have shown that individuals may be ambiguity prone and not only ambiguity averse in an insurance context. This seems especially true when subjects make a comparison between something that they do know and something that they do not know much about. For example, in Heath and Tversky (1991) subjects prefer betting on a lottery based on judged probabilities rather than on a risky lottery with equivalent probabilities when they do know about the topic, while they prefer betting on the risky lottery if they do not know about the topic.[34] These results have been so robust that recently a few new theoretical models of ambiguity have been introduced to allow for ambiguity preference, see Ghirardato et al. (2004) and Maccheroni et al. (2004). In addition, both of these models find a functional form to express ambiguity reaction, which can be usefully used in applications.

In general, the majority of applications have used until now Choquet Expected Utility, which allows for ambiguity aversion only and needs specific assumptions prior to the use. As far as applications to the labour market are concerned, Mukerji and Tallon (2004) have recently shown that ambiguity averse workers with CEU preferences may optimally choose not to include any indexation coverage in wage contracts when inflation is uncertain. Although their model provides an alternative explanation to the stylised fact that indexation clauses are not observed in the majority of wage contracts that does not rely on the presence of exogenous transaction costs,[35] as long as CEU preferences are consistent with ambiguity aversion only, on the face of our experimental evidence one should be cautious in using CEU preferences for modelling trade union behaviour in general.[36]

6. CONCLUSIONS

This paper has shown that violations of SEUT are widespread among our sample of Italian trade union delegates and leaders. Although our results cannot be generalised easily, they seem to suggest that the standard labour economists' assumption on trade union's objectives (namely, that the trade union maximises the expected utility function of a typical or median member/leader) cannot be taken for granted. We plan to research next the implications of formally replacing this assumption with alternative nonexpected utility models as regards the predictions of the economic theory of the trade union. However, we have already argued that ambiguity reaction may be a useful concept for understanding trade union behaviour as regards, for example, the unemployed and technical innovation. We would expect that the more ambiguity averse unions are, the more they will be concerned with unemployment of union's member, the less they will be concerned with unemployment of nonmembers, and the more they will try to resist technical innovations, *coeteris paribus*.

Finally, although we cannot make direct comparisons between Experiments 1 and 2, due to framing effects, our results seem to suggest that trade union firm-level delegates may react differently to ambiguity than their leadership. This may have important implications for our understanding of the role played by the degree of centralisation of union decisions on economic variables.

APPENDIX A

EXPERIMENT 1 : *English translation of invitation and instruction*

We are working on a research project on how trade-union members make decisions under risk or under uncertainty. *The University of Torino and the University of Warwick (U.K.) are involved in the project.*

We are looking for 40 volunteers to answer a questionnaire. The questionnaire is related to hypothetical electoral results. You will have to answer to seven questions.

In the questionnaire, you will find seven lotteries similar to that reported in the following example:

Let us consider the following situation. Next Sunday the national political elections will be held. Two coalitions can win these elections: coalitions *A* and *B*.

You do not have any precise estimate on which coalition will be the winner in these elections. New parties constitute and new leaders run these coalitions.

However, an agency with a high reputation had made some forecast on the electoral results. This agency forecasts that coalition A will obtain a number of votes between 40 and 60%.

You have a ticket of the following lottery:

If coalition *A* wins the election, you will win 100,000 lire, otherwise you will not win anything.

Which is your minimum selling price for your lottery ticket?

Minimum selling price for my ticket =

At the end of each lottery we are asking you to state the minimum selling price of your lottery ticket, that is the minimum amount of money that you are willing to accept in exchange for your lottery ticket.

In practice, you possess a lottery ticket that can lead to a win of 100,000 lire with a given probability. You can either play the lottery or sell the ticket. If you play the lottery, you can win either 100,000 or nothing. If you sell the ticket, you will receive in exchange a given sum of money, but you will be unable to play the lottery.

In return for your participation, you will receive a scratch card. Then, we shall extract three names among the persons who have participated to the experiment (that is, we shall extract three numbers corresponding to the progressive numbers we have distributed at the beginning of the experiment).

At the end of the experiment, a lottery will be chosen at random. A number between 0 and 100 will also be chosen at random. This number will represent the buying price of the experimenter. Let us assume that the previous lottery is the one picked up at random.

Suppose that your minimum selling price for this lottery is 70,000 lire.

The randomly chosen number is 75, corresponding to 75,000 lire buying price offered by the experimenter. In this case, you will receive 75,000 lire (that is, the buying price of 75,000 exceeds your minimum selling price). If the randomly chosen number is equal to 40 instead (that is, 40,000 lire), you will play the lottery for real (the 40,000 lire buying price is less than your minimum selling price), and will have the chance of winning 100,000 lire.

It is important that you state your minimum selling price that corresponds to your real preferences, otherwise you can find yourself playing the lottery when you would have preferred to receive a lower sum of money for sure, or accepting a certain amount of money when you would have preferred to play the lottery.

You will examine lotteries that have a maximum prize of 100,000 lire: thus, some of you will have the chance of winning 100,000 lire for real.

Thank you for your participation and if something is not clear, please ask the experimenter. We are reminding you that there are no right or wrong answers.

APPENDIX B

EXPERIMENT 2: *English translation of invitation and instructions*

We are working on a research project on how trade-union members make decisions under risk or under uncertainty. *The University of Torino and the University of Warwick (U.K.) are involved in the project.*

We are looking for 30 volunteers to answer a questionnaire. The questionnaire is related to the electoral results for the European elections on June 13th. The questionnaire is composed of several parts. There are about 30 questions to answer.

In the first part of the questionnaire, you will be asked to compare two lotteries of the following type:

A Roll a die
If 1 comes out, you win 1200 lire
If 2 comes out, you win 900 lire
If 3, 4, 5, 6 come out, you win nothing.
B Roll a die
If 1 comes out, you win X =?
If 2 comes out, you win 350 lire
If 3, 4, 5, 6 come out, you win nothing.
and indicate the sum of money (the value of X) that makes you indifferent between the two lotteries. (That is, the X sum of money such that you are indifferent between playing lottery *A* or lottery *B*.)

In the second part of the questionnaire, you will be presented with several lotteries. The lotteries are of two types:

A type Consider to possess the following lottery ticket:
There is an opaque bag with 10 balls, 5 white balls and 5 black balls.

If you pick up a white ball, you win 20,000 lire, otherwise you win nothing.

B type Sunday, June 13, the European elections will be held. You possess the following lottery ticket:
You win 120,000 lire, if the Democratici di Sinistra (Democrats of the Left) obtain less than 20% of the electorate votes.

At the end of each lottery, you will be asked to state the minimum selling price for your lottery ticket.

In practice, it is as if you possessed a lottery ticket for real. Take *A* type lottery. You can decide whether you sell this lottery ticket or you keep it. Suppose that your minimum selling price is 6000 lire. This means that you would sell your lottery ticket, if someone paid you at least 6000 lire; otherwise, you prefer keeping the lottery ticket and play it.

Moreover, you will be presented with several scenarios similar to the *B* type lottery questions in the second part of the questionnaire. Then, you will be asked to estimate the probability, for example, that the Democrats of the Left will obtain less than 20% of the electorate votes. You will be asked to give a personal estimate on the 0–100 scale. If for example you think that the Democrats of the Left have a 80% chance of casting less than 20% of the electorate votes, you will write 80%.

In return for your participation, you will receive an instant lottery ticket. Three persons will be chosen randomly among those who have participated to the experiment (that is, we shall extract three numbers corresponding to the progressive numbers we have distributed at the beginning of the experiment).

At the end of the experiment, a lottery will be chosen at random. A number between 0 and 100 will also be chosen at random. This number will represent the buying price of the experimenter. Let us assume that the following lottery has been picked up at random:

A type Consider to possess the following lottery ticket: There is an opaque bag containing 10 balls, 5 white balls and

5 black balls. If you pick up the white ball, you win 20,000 lire, otherwise you win nothing.

Suppose moreover that you minimum selling price is 6000 lire. Number 7 is drawn. That is, the experimenter's buying price is 7000 lire. You will receive 7000 lire (the 7000 lire offer exceeds your minimum selling price). If number 4 is drawn instead (4000 lire), you will play the lottery for real (the 4000 offer is below your minimum selling price), hence you will have the chance of winning 20,000 lire.

It is important that you state the minimum selling price corresponding to your true preferences, otherwise you might find yourself playing the lottery when you would have preferred a lower sum of money for sure, or accepting a sum of money when you would have preferred playing the lottery.

The lottery drawns will be held a few days after the June 13th European elections, as long as type B lottery are based on the election outcome. The lottery draws will be made by trade union personnel, not by the experimenter.

The lotteries you will be examining have 120,000 lire as maximum prize: hence, someone will have the chance of winning 120,000 lire for real.

Thank you for your participation and if something is not clear, please ask the experimenter.

We are reminding you that there are not right or wrong answers.

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NOTES

1. Clark and Oswald (1993) and Oswald (1996) provide direct estimates of trade union's leaders objectives by means of surveys.
2. The standard explanation is of course that union leaders maximise the welfare of their constituents. However, reaction to ambiguity by union members may in part explain this behaviour.
3. Here, we are dealing with experiments of decision making under uncertainty, but the same criticisms apply with respect to violations of Expected Utility theory.
4. For a recent discussion of this problem applied to experiments in labour economics, see Falk and Fehr (2003).
5. If violations of SEUT are reduced when market institutions are used to elicit preference, then economists might choose not to bother about uncertainty, see Di Mauro and Maffioletti (2001a, 2003) for experiments on decision-making under uncertainty. For the effect of markets on other violations of SEUT, see, e.g., Cox and Grether (1996), Evans (1997), and List (2003).
6. For a complete account of the differences between using or not incentives, see Camerer and Hogarth (1999).
7. The experimental evidence typically finds ambiguity aversion (*viz*. preference) at high probabilities for gains (*viz*. losses) and at low probabilities for losses (*viz*. gains), where high (*viz*. low) probability means above (*viz*. below) one half, see, e.g., Di Mauro and Maffioletti (2004).
8. Trade union membership density is about 40% in the local area; this local trade union confederation represents about 40% of the unionised workforce.
9. The English translation of one of the sentences used in the scenarios reads as follows: "Next Sunday the national political elections will be held. Two coalitions can win these elections: coalition A and B. You do not have any precise estimate on which coalition will be the winner in these elections. New parties constitute and new leaders run these coalitions. However, an agency with a high reputation has made a forecast on the electoral results. This agency forecasts that coalition A will obtain a number of votes between 40 and 60%. You possess the following lottery ticket: If coalition A wins the election, you win 100,000 Italian lire; otherwise you win nothing. Which is your *minimum selling price* for this lottery ticket?" The full set of questions are available on request from the authors; see Appendix A for the English translation of the instructions.
10. At the end of the experiment, three subjects were chosen at random, one scenario was chosen at random, and the subjects were paid according to their questionnaire answers. The details of the methodology used are

available from the authors upon request. The Becker et al. (1964) device is a standard method used to elicit preferences: it implies generating randomly the experimenter's offer of buying or selling the lotteries evaluated by the subjects. For an application, see, e.g., Fox et al. (1996) and Eisenberger and Weber (1995). We used this method because our work follows Fox et al. (1996)'s approach, so the results of the two experiments can be compared. We are however aware of the criticisms to this method; moreover, we want to stress that, having to deal with trade union delegates and leaders as subjects, we were somehow constrained by time and organisational problem.

11. Note that the average net monthly salary of an assistant professor is about €1,000 in the Italian universities.
12. On the basis of the risk and ambiguity ratios, we computed both the Wilcoxon–Mann–Whitney test and a t-test for independent samples for each lottery in order to check whether ambiguity reaction was different between the two samples of trade union delegates (chemical industry vs. mechanical industry). These tests could not reject the null hypothesis of no difference in ambiguity reaction at the 1% significance level (40–60% lottery: $p_w = 0.97$, $p_t = 0.67$; 30–70%: $p_w = 0.39$, $p_t = 0.27$; 20–80%, $p_w = 0.69$, $p_t = 0.6$; 10–90%: $p_w = 0.6$, $p_t = 0.49$; 0–100%, $p_w = 0.9$, $p_t = 0.41$; risk: $p_w = 0.53$; $p_t = 0.19$; Ellsberg ambiguity, $p_w = 0.33$, $p_t = 0.35$; p-values for two-tailed test: p_w refers to the Wilcoxon–Mann–Whitney test, p_t to the t-test). Henceforth, we shall treat the two samples as coming from the same population.
13. Similar definitions for risk and ambiguity ratios have been frequently used in the literature: see among the others Di Mauro and Maffioletti (1996, 2004).
14. From a statistical point of view, the Ellsberg paradox can be represented as a uniform probability distribution in an interval between 0 and 100% as well. The Wilcoxon signed ranks tests relating the risk ratio vs. the other ambiguity ratios were as follows: risk vs. 30–70%, p-value = 0.05; risk vs. 20–80%, p-value = 0.01; risk vs. 10–90%, p-value = 0.01; risk vs. 0–100%, p-value = 0.012.
15. According to Segal (1987) subjects should perceive the uniform distribution as the most ambiguous one.
16. More precisely, let θ_j be the population median in the jth ambiguous election lottery: the null hypothesis that the medians are the same, H_0: $\theta_{40-60} = \theta_{30-70} = \theta_{20-80} = \theta_{10-90} = \theta_{0-100}$ is tested against the alternative hypothesis H_1: $\theta_{40-60} \leqslant \theta_{30-70} \leqslant \theta_{20-80} \leqslant \theta_{10-90} \leqslant \theta_{0-100}$ with at least one strict inequality. On the computation of the Page test, see e.g. Hollander and Wolfe (1999: 284–294).
17. Note that, as long as ties are observed in the data for several individuals in one or more lotteries and average ranks are used to deal

with these ties, the large-sample approximation overestimates the null variance of the Page statistics, thus the procedure is conservative, see Hollander and Wolfe (1999: 292) for a discussion.

18. The Chi-square goodness of fit test for each lottery is as follows. 40–60% lottery: Chi-square = 14.4 (p-value = 0); 30–70% lottery: Chi-square = 11.56 (p-value = 0.001); 20–80% lottery: Chi-square = 6.76 (p-value = 0.01); 10–90% lottery: Chi-square = 11.56 (p-value = 0); 0–100% lottery: Chi-square = 1.96 (p-value = 0.162).
19. In order to implement the Cochran Q test, and as well the Chi-square goodness of fit test, we have transformed the original data by dividing them in two groups: the ambiguity neutral individual responses (taking the value of 1 in each cell of the data matrix) and the others (taking the value of zero).
20. We thank the anonymous referee for having suggested us this approach.
21. This assumption is made for simplicity and does not affect our analysis qualitatively, as long as a range effect on the weighting function is inconsistent with EU maximisation irrespective of the shape of the value function.
22. See Appendix B for the English translation of the instructions. The questionnaire is available from the authors upon request.
23. Fox and Wakker (1999) argue that this is not a serious problem in FRT, as long as the large majority of their options traders subjects-about three quarters of the total-priced prospects according to their expected value for each of the two matching tasks. They conclude: “it is highly implausible that [in FRT] such a large number of respondents would have used nonlinear weighting and nonlinear value in precisely equal and opposite ways”.
24. Ideally, when the subjects behave according to CPT, it would be worthy to consider alternative methods to elicit the value functions. Examples of such methods are Tversky and Kahneman’s (1992) joint estimates of the value function and the weighting function by parametric fitting; and Wakker and Deneffe’s (1996) nonparametric approach, see Gonzales and Wu (1999) for a survey. However, we leave this task for future work.
25. Tversky and Kahneman (1992) estimated a median value for this parameter equal to 0.88. Their analysis generates such a S-shaped weighting function.
26. The full set of questions is available from the authors upon request. Two typical questions are reported here: “On Sunday 13th June, the European elections will be held. You have a ticket of the following lottery: You will win 120,000 Italian lire if Forza Italia, CCD, AN/Patto Segni will obtain less than 35% of the electoral votes, otherwise you will win nothing. What is your minimum selling price for

your lottery ticket?"; "The U.K. voters will also participate to the European Election. You have the following lottery ticket: You will win 120,000 Italian lire, if the Conservative Party (namely the Tories) will obtain 28% or more, but less than 31%, of the U.K. electorate votes, otherwise you will win nothing. What is your minimum selling price for your lottery ticket?"
The Polo Coalition and the Conservative Party obtained 38.1 and 35.7% of the votes, respectively.

27. The probability range of the lotteries was chosen according to the latest electoral forecasts in the two countries.
28. For example, a typical question was: "The U.K. voters will also participate to the European Election. The Conservative Party (the Tories) will obtain 28% or more but less than 31% of the U.K. electorate vote. What is your probability estimate [of this prediction]?".
29. Recall from Section 2 above that nonadditivity of the decision weights is a sufficient condition for violation of SEUT according to some theoretical models, while for other models we might have violations of SEUT even when additivity is present.
30. We perform a Chi-square test on the data showed in Table VII, and the test rejects, for each treatment, at the 1% level the null hypothesis that the proportion of subjects showing ambiguity reaction is due to a random factor. (Chi square for Decision Weight Italy = 7.5 (1 df); Judged Probability Italy = 36.7 (2 df); Decision Weight UK = 3.66 (1 df), Judged Probability U.K. = 23.4 (2 df).)
31. As Kilka and Weber (2000) point out, the received view is that the value function may be thought of as being approximately linear for small payoffs. Our results further support this view.
32. For example, if one considers workers interested by collective bargaining agreements in the U.S. in 1980, it turns out that severance pay provisions covered 34.3% of workers in retail trade, 41.6% in services, but only 7.3% in mining, see Pencavel (1991: 64, tab. 3.1).
33. For example, 775 plant-level data from the British Workplace Industrial Relations Survey of 1984 show that 6% of union representatives strongly opposed technical innovation, 27% were slightly resistant and the remaining 67% were slightly in favour or strongly in favour of innovation, see Dowrick and Spencer (1994: 316).
34. Heath and Tversky (1991) used lottery based either on football or on politics.
35. Under SEUT, a risk averse worker dealing with a risk neutral employer would like to include an indexation clause in the optimal wage contract, unless the (exogenous) costs of doing so are prohibitively high.
36. For example, Maffioletti and Santoni (2003) apply Einhorn and Hogarth (1985) 'anchoring and adjustment model' to Alesina's partisan model of

the business cycle and show that the political business cycle, under election uncertainty, depends on the ambiguity attitude of the wage setters; moreover, ambiguity proneness may indeed explain why wage setters may want to sign nominal wage contract before the election occurs.

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