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Social Valuation of EQ-5D Health States: The Chilean Case

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ABSTRACT

Background: Cost-effectiveness analysis has been recommended by many national agencies around the world as a valid methodology to improve resource allocation within the health-care system. If the preferences of the society are taken into account in such a decision-making process, it is generally recommended that these values should be elicited by using a generic health-related quality-of-life instrument, such as the EuroQol five-dimensional (EQ-5D) questionnaire. **Objectives:** To estimate a set of social values for EQ-5D questionnaire based on the time trade-off valuation technique for use in Chile. **Methods:** A valuation questionnaire was applied to a probabilistic sample of 2000 individuals, aged 20 years or older, living in the Metropolitan region. The fieldwork took place during October to November 2008. Utility weights for 42 health states were calculated directly by the application of time trade-off. Several random effect and ordinary least-squares regression models were fitted to these valuations to predict the full set of 243 health states generated by the EQ-5D system. The best model was chosen by applying criteria of parsimony, goodness of fit, and prediction capacity. **Results:** The selected regression model was robust and showed better predictive characteristics than others reported in similar studies conducted elsewhere. The chosen regression model showed a R^2 of 0.34, mean absolute error of 0.017, and high predictive capacity. **Conclusions:** This study provides an EQ-5D social value set for domestic use in Chile. Our results differ from those reported in other countries, justifying the need to perform local studies that adequately reflect societal health preferences.

Keywords: Chile, EQ-5D, health status, preference weights, time trade-off (TTO).

Introduction

The valuation of EuroQol five-dimensional (EQ-5D) questionnaire health states in terms of their domestic social preferences is of primary importance for any country that intends conducting economic evaluation to inform high-level decisions regarding the allocation and use of scarce health-care resources. The problem facing many countries that lack such a domestic value set is that of identifying an appropriate alternative source. The EuroQoL Group provides some advice on this matter through its Web site, advocating that if it is not possible to identify a suitable "donor" source of EQ-5D values then the U.K. Measurement and Valuation of Health (MVH) value set should be considered as the default option. There are other alternatives of course, including the BIOMED visual analogue scale value set produced by pooling valuation data from several European countries. More recent and novel methods for estimating provisional value sets for EQ-5D have been proposed by using valuation exchange rates [1]. Within Latin America, there are two other options based on the analysis of Spanish-speaking Hispanics in the U.S. valuation survey [2] and the recently published results of an Argentine population survey [3]. Clearly, any values based on such second-best approaches are likely to be in error, but the extent of such errors remains unknown (and unknowable) until primary valuation data can be collected from a national population survey.

During 2008, a decision was made within the Chilean Superintendency of Health, a governmental institution responsible for the oversight of health insurances, to commission a valuation survey to calibrate EQ-5D for subsequent use in economic evaluation and health technology assessment applications within Chile. A specific requirement set by the Superintendency was that the study methodology should be based on the MVH protocol [4]. The timetable stipulated required speedy action to describe and document the methods, recruit and train interviewers, identify and recruit respondents, complete the fieldwork, undertake the analysis, and submit a final report.

This article deals primarily with the analysis of the valuation data generated in this Chilean survey and the selection of a model for use in estimating time trade-off (TTO) utilities for EQ-5D health states. In so doing, it raises a number of issues regarding the specification of such models and the means by which we might consider marginal differences between alternative models. These have wider significance for the EuroQoL Group, especially when faced with the future comparison of three- and five-level models, but also in examining alternative estimation models that are often based on somewhat different components.

Conflicts of interest: The authors have no conflicts of interest to report.

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Methods

Data and study population

Data analyzed in this research was obtained from the Chilean Valuation of the EuroQol EQ-5D Health States study that was carried out by the Research Department of the Superintendency of Health between October and November 2008. The target population was 4,627,801 millions civilians, noninstitutionalized adults, aged 20 years or more, who resided in the Metropolitan region that contains approximately 41% of the total Chilean population and also represents the geographical area where the capital of the country (Santiago) is located. Based on sociodemographic information obtained from the last available census conducted in 2002, a multistage probability sample of 2000 individuals was drawn from the target population. Sample-size estimations were based on the estimated number of respondents needed to detect a difference of 0.05 in mean TTO scores between two EQ-5D health states with a type I probability error of 5%, 80% power, and design effect of 1.2. TTO mean values and standard deviations used for the sample calculation were taken from the Spanish-speaking Hispanic respondents who participated in the U.S. Valuation of the EuroQol EQ-5D Health States study [2,5]. As in the U.S. study [5], data were collected through household interviews performed by 22 professional interviewers who were trained in two sessions by P.K. and V.Z. 1 month before the start of the fieldwork. No economic incentive was offered to the respondents before or after interviews. Subjects were excluded from the analysis if they had incomplete or inconsistent valuation data based on criteria reported elsewhere [5].

EQ-5D

The EQ-5D is a standardized measure of health status that describes health by a classification system that comprises five dimensions (i.e., mobility, self-care, usual activities, pain/discomfort, and anxiety/depression) and three levels of severity for each dimension (i.e., no problem, moderate problem, and severe problems) [6]. A set of 243 health states is defined by this descriptive system, each one labeled by a unique five-digit code. Thus, the health state 11111 represents having no problems on any dimension and 33333 represents having severe problems in all five dimensions. To ease the valuation task for the respondents, a subset of 42 EQ-5D health states was sorted into 5 overlapping subsets of 12 health states following the same adapted MVH U.K. protocol used in the 2002 U.S. Valuation of the EuroQol EQ-5D Health States study [5]. Within these five sets, the state unconscious was removed given that it is not formally defined by the five-dimensional classification system and plays no part in any estimation model. The main instrument used in this study was the official Chilean EQ-5D questionnaire, provided by the EuroQol Group through its Web site http://www.euroqol.org. This official version was slightly modified in terms of the labeling of the "self-care" dimension in which the first level of severity was rephrased from "I have no problems with self-care" to "I have no problem washing or dressing myself." This modification was introduced to improve consistency within this category.

TTO protocol

Respondents were asked to value one of the five subsets of EQ-5D health states selected at random by using the TTO elicitation protocol [7]. This methodology consists essentially in providing a con-

Table 1 – Sociodemographic and self-reported health characteristics of the study sample and Chile.

	Metropolitan region	Metropolitan region$_{wgt}$	Chile
Gender, % (n)			
Female	62.0 (1239)	52.5 (1051)	51.2 (5.8189.13)*
Male	38.0 (761)	47.5 (949)	48.8 (5.555.816)*
Age, % (n)			
Mean (SE)	46.83 (0.4)	43.46 (0.4)	43.7 (16.1)*
20–44 years	47.6 (953)	56.2 (1125)	55.8 (6.345.981)*
45–64 years	35.0 (699)	31.5 (629)	31.5 (3.587.621)*
65+ years	17.4 (348)	12.3 (246)	12.7 (1.441.127)*
Educational attainment, % (n)			
<8 years	15.8 (316)	13.1 (262)	28.5 (2.834.392)†
8–12 years	52.4 (1048)	52.2 (1045)	47.1 (4.687.127)†
13+ years	30.6 (611)	33.4 (669)	24.4 (2.424.701)†
Self-reported health problems, % (n)			
Mobility	20.8 (416)	17.3 (347)	15.4††
Self-care	8.6 (173)	7.7 (153)	3.9††
Usual activities	16.0 (321)	14.0 (281)	17.1††
Pain/discomfort	44.2 (883)	39.6 (793)	50.8††
Anxiety/depression	33.9 (678)	30.9 (618)	42.3††
Self-rated VAS, % (n)			
Mean (SE)	73.82 (0.46)	75.68 (0.46)	75.42 (0.3)††
81–100	37.8 (757)	41.8 (837)	42.3††
61–80	33.4 (667)	33.3 (666)	32.2††
41–60	21.4 (429)	18.4 (368)	18.2††
21–40	4.7 (94)	4.1 (82)	6.3††
0–20	2.6 (53)	2.3 (47)	1.0††

SE, Standard error; VAS, visual analogue scale.
* Source: Population figures were estimated for June 2008, National Statistics Institute (INE).
† Source: 2002 National Census, National Statistics Institute (INE).
†† Source: 2005 EQ-5D health survey, Superintendency of Health.

tinuous set of two options for a given health state till the respondent reaches a point where he or she is indifferent to both alternatives. The first set of options is whether a given health state is better or worse than being dead. If the respondent thinks that the given health state is better than being dead, he or she is then asked to state whether it is preferred to live in that state for 10 years or to live in full health for x number of years ($x \leq 10$); if the given health state is assessed as worse than dead, the two options offered are either to live in the given state for ($10 - x$, where $x < 10$) years followed by living in full health for x years or immediate death. TTO values are then bounded between −1 and 1 following a linear transformation that is reported in detail elsewhere [7].

Statistical analysis

A number of random effect (RE) and linear regression models were used to analyze the TTO valuation data. The former approach takes into account the variability in responses within and between individuals. The latter, on the other hand, allows us to incorporate the survey design given that it is possible to apply sampling weights to correct for any imbalance in the achieved sample.

In terms of the modeling, the dependent variable was calculated as 1 minus the transformed TTO value assigned by each individual. Independent variables included a set of 10 dummy variables (i.e., M2, M3, Sc2, Sc3, Ua2, Ua3, Pd2, Pd3, Ad2, and Ad3) and a constant that represents having a problem in any of the five EQ-5D dimensions. In addition, extra independent variables were tested to account for interaction between different dimensions. These interaction terms were as follows:

- N2: whether there is any dimension on level 2;
- C2: the number of dimensions on level 2;
- C2sq: the square of the number of dimensions on level 2;
- N3: whether there is any dimension on level 3;
- C3: the number of dimensions on level 3;
- C3sq: the square of the number of dimensions on level 3;
- X2: whether there are two or more dimensions on level 2 or 3;
- X3: whether there are three or more dimensions on level 2 or 3;
- X4: whether there are four or more dimensions on level 2 or 3;
- X5: whether there are five dimensions on level 2 or 3.

Regression models with different combinations were individually tested in RE and multiply tested through a stepwise procedure in ordinary least-squares, without imposing restrictions on the number of additional interaction terms to be included. Goodness-of-fit statistics considered relevant in the analysis were Pearson's correlation coefficient between the observed and the predicted health state values (i.e., R^2 overall), the mean absolute error (MAE) for predicting the 42 core EQ-5D health states, and the number of predictive errors greater than 0.025, 0.05, and 0.10. Normality of the residuals was analyzed by using scatter plots. Heteroskedasticity was explored by using the Breusch–Pagan test. Specification of the models was analyzed by using the Ramsey RESET test. Robustness of the model was assessed by randomly splitting the sample into two and using the predicted value set of one-half to estimate the observed values of the other half. Observed TTO values were compared with corresponding values from Argentina [3], Spanish-speaking Hispanics from the United States [2], Spain [8], and the United Kingdom [4]. All the statistical analyses were conducted by using Stata 10 [9].

Results

Completed interviews were obtained from 2000 individuals after 5008 household visits. From the total of households, 21% of the

Table 2 – Parameter estimates and fit statistics for alternative random effect (RE) and ordinary least-squares (OLS) regression models in the Chilean valuation study.

	Basic (RE)		N3 (RE)		C3sq (RE)		C3sq + X5 (RE)		C3sq (OLS)		C3sq + X5 (OLS)	
	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*	Coefficient	*P*
MO2	0.128 (0.007)		0.124 (0.007)		0.114 (0.007)		0.108 (0.008)		0.121 (0.010)		0.115 (0.010)	
MO3	0.310 (0.010)		0.300 (0.010)		0.452 (0.012)		0.448 (0.012)		0.454 (0.017)		0.449 (0.017)	
SC2	0.130 (0.007)		0.136 (0.007)		0.126 (0.007)		0.118 (0.008)		0.129 (0.010)		0.121 (0.010)	
SC3	0.312 (0.010)		0.289 (0.010)		0.425 (0.012)		0.421 (0.012)		0.431 (0.016)		0.428 (0.016)	
UA2	0.178 (0.008)		0.130 (0.008)		0.135 (0.008)		0.126 (0.008)		0.129 (0.010)		0.119 (0.011)	
UA3	0.342 (0.010)		0.250 (0.011)		0.402 (0.010)		0.411 (0.010)		0.404 (0.014)		0.413 (0.014)	
PD2	0.107 (0.008)		0.125 (0.008)		0.116 (0.008)		0.110 (0.008)		0.108 (0.009)		0.103 (0.009)	
PD3	0.301 (0.009)		0.251 (0.009)		0.403 (0.010)		0.398 (0.010)		0.403 (0.013)		0.397 (0.013)	
AD2	0.094 (0.007)		0.099 (0.007)		0.105 (0.007)		0.100 (0.007)		0.114 (0.010)		0.108 (0.010)	
AD3	0.246 (0.008)		0.196 (0.009)		0.360 (0.010)		0.353 (0.010)		0.367 (0.013)		0.359 (0.014)	
Intercept	0.107 (0.010)		0.070 (0.010)		0.080 (0.010)		0.092 (0.012)		0.083 (0.008)		0.096 (0.008)	
N3			0.184 (0.011)									
C3sq					−0.025 (0.001)		−0.027 (0.001)		−0.026 (0.002)		−0.028 (0.002)	
X5							0.049 (0.013)				0.052 (0.017)	0.003
R^2 overall	0.337		0.342		0.344		0.344		0.346		0.346	
Mean absolute error	0.048		0.036		0.02		0.017		0.021		0.016	
No. (of 42) > 0.025	30		27		18		10		18		10	
No. (of 42) > 0.05	17		12		2		1		2		2	
No. (of 42) > 0.10	4		0		0		0		0		0	

Note: All coefficients significant at $P < 0.001$ unless otherwise stated. Standard errors are given in parentheses. R2 overall represents the correlation between observed and predicted time trade-off values.
The official report of the Chilean valuation study included a recommendation to adopt a model in which four dummy variables were used corresponding to the number of level 3 elements in each health state (F13, F23, F33, and F43). F13 was set to 1 if there was one level 3 element, else 0. The C3 squared term captures a similar effect more efficiently. Since the results are virtually identical, the more parsimonious model is shown here.

addresses were ineligible and only 7% of the individuals did not respond to the survey, resulting in a response rate of 40%.

Sociodemographic and self-reported health characteristics of the achieved sample are described and compared with national figures in Table 1. After the application of corrective weights to the raw data, age and gender distribution of the sample (i.e., 52.5% female and 43.46 years mean age) closely resemble the characteristics of the country as a whole. The level of education as expected tends to be higher in the Metropolitan region when compared with the national figure. In terms of self-reported health characteristics, the highest prevalence of any EQ-5D health problem was in the pain/discomfort and anxiety/depression dimensions, with 39.6% and 30.9%, respectively. Higher prevalence on these two dimensions has been reported previously for Chile in a nonprobabilistic sample of the population selected by quota in 2005 [10]. Both the mean and the distribution of visual analogue scale scores appear to be extremely similar between the Metropolitan region and Chile.

On the basis of the data completeness and logical consistency criteria previously described, the final sample included 1967 respondents. Several RE and ordinary least-squares models were developed to fit the TTO valuations; models only with the highest goodness of fit are reported in Table 2. In both types of regression models, the best functional form comprised a constant, the basic 10 dummy variables for the five dimensions, plus two extra interaction terms: C3sq and X5. Only C3sq yielded a negative estimate, which produces a positive quadratic adjustment according to the number of level 3 in a given EQ-5D health state. As expected, RE models generally produced a slightly better goodness of fit in comparison with the ordinary least-squares model. The C3sq + X5 was the best-performing RE model of all, with an R^2 of 0.344, MAE of 0.017, and lowest number of errors greater than 0.025 (i.e., 10 of 42) and 0.05 in absolute magnitude (i.e., 1 of 42). Directly observed and predicted values for the 42 health states are presented in Table 3.

Residuals of the C3sq + X5 (RE) model do not appear normally distributed in a normal probability plot showing a slightly

Table 3 – Observed and predicted values for 42 health states based on the C3sq + X5 (random effect) model.

Health state	Observed			Predicted	
	n	Mean	Standard error	Mean	Absolute error
11112	787	0.765	0.013	0.808	0.043
11113	391	0.616	0.025	0.582	0.034
11121	787	0.809	0.010	0.798	0.011
11122	394	0.689	0.020	0.698	0.009
11131	390	0.570	0.026	0.537	0.033
11133	790	0.266	0.024	0.265	0.001
11211	785	0.790	0.011	0.782	0.008
11312	394	0.438	0.030	0.424	0.014
12111	786	0.775	0.012	0.790	0.015
12121	391	0.712	0.019	0.680	0.032
12211	394	0.654	0.022	0.664	0.010
12222	787	0.467	0.020	0.454	0.013
12223	391	0.250	0.034	0.228	0.022
13212	394	0.270	0.034	0.288	0.018
13311	788	0.190	0.025	0.184	0.006
13332	391	−0.195	0.034	−0.179	0.016
21111	786	0.799	0.012	0.800	0.001
21133	392	0.107	0.036	0.157	0.050
21222	787	0.457	0.020	0.464	0.007
21232	394	0.226	0.034	0.203	0.023
21312	392	0.328	0.032	0.316	0.012
21323	391	0.062	0.035	0.034	0.028
22112	394	0.589	0.025	0.582	0.007
22121	790	0.593	0.017	0.572	0.021
22122	394	0.471	0.028	0.472	0.001
22222	394	0.276	0.032	0.297	0.021
22233	394	−0.146	0.035	−0.136	0.010
22323	392	−0.127	0.035	−0.133	0.006
22331	788	−0.026	0.025	−0.019	0.007
23232	394	−0.174	0.033	−0.186	0.012
23313	790	−0.143	0.024	−0.142	0.001
23321	789	−0.065	0.024	−0.034	0.031
32211	392	0.234	0.034	0.243	0.009
32223	391	−0.228	0.033	−0.188	0.040
2232	391	−0.232	0.033	−0.223	0.009
32313	394	−0.177	0.034	−0.179	0.002
32331	394	−0.225	0.033	−0.224	0.001
33212	392	−0.070	0.036	−0.079	0.009
33232	391	−0.328	0.033	−0.391	0.063
33321	790	−0.244	0.023	−0.239	0.005
33323	394	−0.424	0.030	−0.452	0.028
33333	1965	−0.494	0.012	−0.497	0.003

Table 4 – Chilean predicted preference weights for 243 EuroQol five-dimensional questionnaire health states based on the C3sq + X5 (random effect) model.

State	Value	State	Value	State	Value	State	Value	State	Value
11111	1	12322	0.196	21233	0.031	23221	0.17	32132	−0.048
11112	0.808	12323	0.024	21311	0.416	23222	0.021	32133	−0.166
11113	0.582	12331	0.089	21312	0.316	23223	−0.151	32211	0.243
11121	0.798	12332	−0.011	21313	0.144	23231	−0.037	32212	0.143
11122	0.698	12333	−0.129	21321	0.306	23232	−0.186	32213	−0.029
11123	0.472	13111	0.514	21322	0.206	23233	−0.304	32221	0.133
11131	0.537	13112	0.414	21323	0.034	23311	0.076	32222	−0.016
11132	0.437	13113	0.242	21331	0.099	23312	−0.024	32223	−0.188
11133	0.265	13121	0.404	21332	−0.001	23313	−0.142	32231	−0.074
11211	0.782	13122	0.304	21333	−0.119	23321	−0.034	32232	−0.223
11212	0.682	13123	0.132	22111	0.682	23322	−0.183	32233	−0.341
11213	0.456	13131	0.197	22112	0.582	23323	−0.301	32311	0.039
11221	0.672	13132	0.097	22113	0.356	23331	−0.187	32312	−0.061
11222	0.572	13133	−0.021	22121	0.572	23332	−0.336	32313	−0.179
11223	0.346	13211	0.388	22122	0.472	23333	−0.4	32321	−0.071
11231	0.411	13212	0.288	22123	0.246	31111	0.487	32322	−0.22
11232	0.311	13213	0.116	22131	0.311	31112	0.387	32323	−0.338
11233	0.139	13221	0.278	22132	0.211	31113	0.215	32331	−0.224
11311	0.524	13222	0.178	22133	0.039	31121	0.377	32332	−0.373
11312	0.424	13223	0.006	22211	0.556	31122	0.277	32333	−0.437
11313	0.252	13231	0.071	22212	0.456	31123	0.105	33111	0.147
11321	0.414	13232	−0.029	22213	0.23	31131	0.17	33112	0.047
11322	0.314	13233	−0.147	22221	0.446	31132	0.07	33113	−0.071
11323	0.142	13311	0.184	22222	0.297	31133	−0.048	33121	0.037
11331	0.207	13312	0.084	22223	0.071	31211	0.361	33122	−0.063
11332	0.107	13313	−0.034	22231	0.185	31212	0.261	33123	−0.181
11333	−0.011	13321	0.074	22232	0.036	31213	0.089	33131	−0.116
12111	0.79	13322	−0.026	22233	−0.136	31221	0.251	33132	−0.216
12112	0.69	13323	−0.144	22311	0.298	31222	0.151	33133	−0.28
12113	0.464	13331	−0.079	22312	0.198	31223	−0.021	33211	0.021
12121	0.68	13332	−0.179	22313	0.026	31231	0.044	33212	−0.079
12122	0.58	13333	−0.243	22321	0.188	31232	−0.056	33213	−0.197
12123	0.354	21111	0.8	22322	0.039	31233	−0.174	33221	−0.089
12131	0.419	21112	0.7	22323	−0.133	31311	0.157	33222	−0.238
12132	0.319	21113	0.474	22331	−0.019	31312	0.057	33223	−0.356
12133	0.147	21121	0.69	22332	−0.168	31313	−0.061	33231	−0.242
12211	0.664	21122	0.59	22333	−0.286	31321	0.047	33232	−0.391
12212	0.564	21123	0.364	23111	0.406	31322	−0.053	33233	−0.455
12213	0.338	21131	0.429	23112	0.306	31323	−0.171	33311	−0.129
12221	0.554	21132	0.329	23113	0.134	31331	−0.106	33312	−0.229
12222	0.454	21133	0.157	23121	0.296	31332	−0.206	33313	−0.293
12223	0.228	21211	0.674	23122	0.196	31333	−0.27	33321	−0.239
12231	0.293	21212	0.574	23123	0.024	32111	0.369	33322	−0.388
12232	0.193	21213	0.348	23131	0.089	32112	0.269	33323	−0.452
12233	0.021	21221	0.564	23132	−0.011	32113	0.097	33331	−0.338
12311	0.406	21222	0.464	23133	−0.129	32121	0.259	33332	−0.487
12312	0.306	21223	0.238	23211	0.28	32122	0.159	33333	−0.497
12313	0.134	21231	0.303	23212	0.18	32123	−0.013		
12321	0.296	21232	0.203	23213	0.008	32131	0.052		

bow-shaped pattern that indicates that residuals have excessive skewness. The Breusch–Pagan test produced a P value of <0.001 that rejects the null hypothesis that the variance of the residuals is homogeneous and therefore confirms the heteroscedasticity of residuals. The Ramsey RESET test indicated that all tested models suffer to some extent from misspecification, which is a common finding in these types of models given that no independent variables are related to particular characteristics of the respondent. The C3sq + X5 (RE) models proved to be robust given that the value set estimated on a randomly selected half of the sample closely predicted the values of the other half with an MAE of 0.028 and a high, significant correlation ($R^2 = 0.996$). The full set of Chilean preference weights for the 243 EQ-5D health states based on the selected C3sq + X5 (RE) model is provided in Table 4.

Observed TTO values' comparison between different countries showed that Chilean valuations tend to be lower than those previously reported in Argentina [3] and in the United States by the Spanish-speaking Hispanics [2] (Fig. 1). Nonetheless, when Chilean TTO values were compared against valuations collected in Spain [8] and the United Kingdom [4], they showed a surprisingly high level of agreement across the entire EQ-5D health spectrum (albeit for the subset of 42 states for which values had been directly elicited), being the closest to the Spanish values with a mean absolute difference of 0.088 ($R^2 = 0.976$).

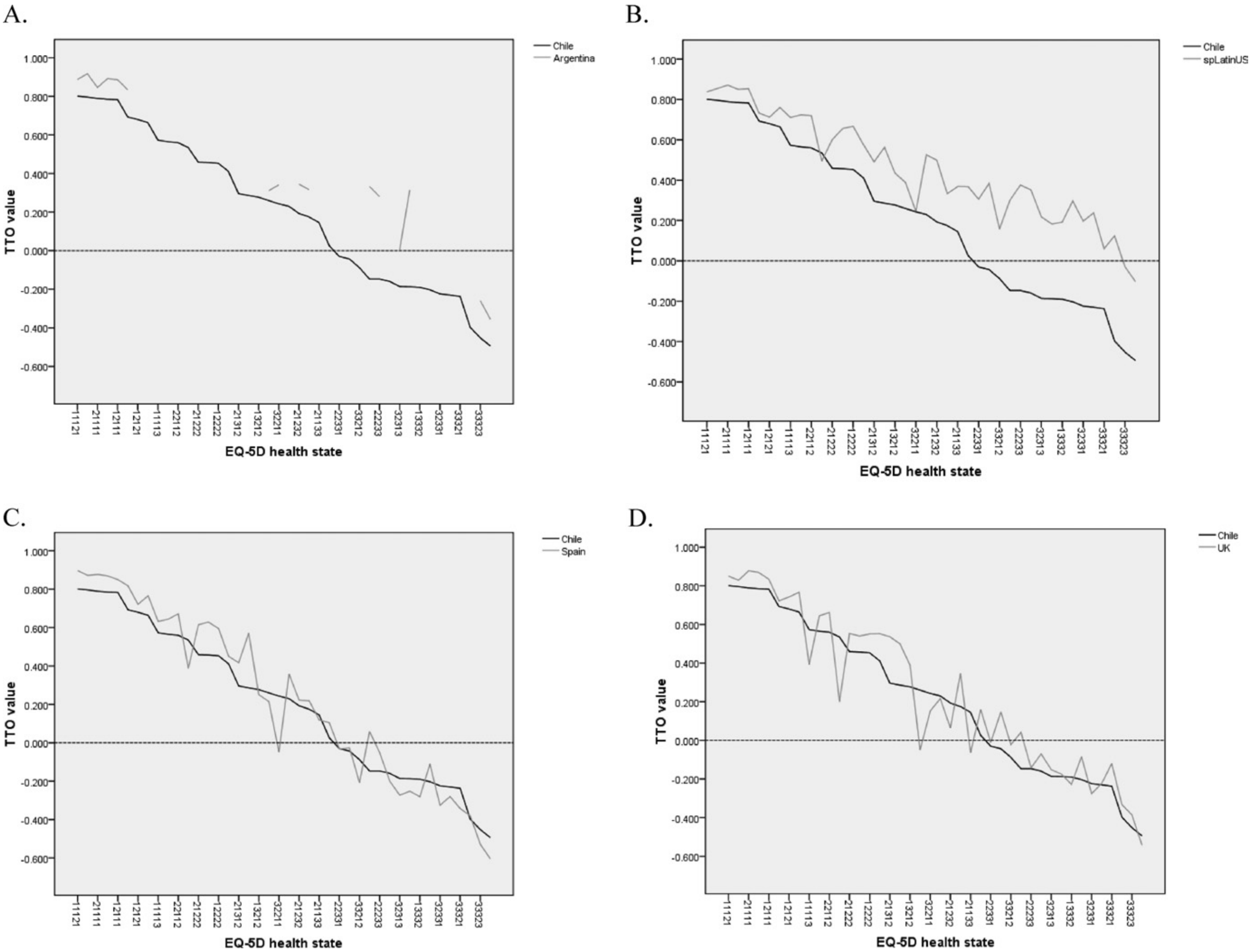

Fig. 1 – Comparison of observed time trade-off (TTO) values in Chile versus Argentina (A), Spanish-speaking Hispanics in the United States (B), Spain (C), and the United Kingdom (D). Note: Comparisons are based on 42 EuroQol five-dimensional (EQ-5D) questionnaire health states with the exemption of Argentina where only 22 health states were valued.

Discussion

To the best of our knowledge, this study represents only the second EQ-5D valuation project to be performed in South America after the experience reported in Argentina [3]. The sample frame in our case was limited to the largest geographical area of the country by budget constrains and the explicit requirement of the Superintendency of Health. Because of this geographic restriction, we believed that it would be convenient to conduct further research to assess the impact that this constraint could have had on the overall results of this study. The Superintendency also set as a condition that the Chilean EQ-5D valuation study should follow the MVH protocol [4] in terms of the number of states selected for valuation tasks. This particular requirement left open the question of whether or not the development of a more efficient study protocol for use in Latin America is possible.

In the Chilean EQ-5D valuation study, only minor modifications to the original U.K. protocol were made: 1) Respondents valued a randomly selected fixed set of EQ-5D health states; these sets were previously used in the U.S. Valuation of EQ-5D Health States study; 2) the state unconscious was not considered in any valuation task; and 3) the official Chilean EQ-5D questionnaire was slightly modified for this study in its "self-care" dimension in which the first level of severity was rephrased from "I have no problems with self-care" to "I have no problem washing and dressing myself." The decision of modifying the first level of severity on this dimension was based on feedback given by the interviewers during the training sessions. Although no psychometric tests were performed to support the implementation of this minor change, the research group thought that this modification would improve the consistency in the dimension's descriptions without critically compromising the structure of the questionnaire.

In terms of regression modeling, the development of the model C3sq + X5 provided the best fit for the valuation data with few prediction errors based on both REs and ordinary least-squares regressions. Given the inherent correlation structure of the valuation data, the former outperformed the latter in terms of goodness of fit. Corrective weights do not significantly alter the beta coefficients when applied to raw data; nonetheless, they did produce few logical inconsistencies in the full 243 estimated EQ-5D value set and therefore the C3sq + X5 (RE) model was selected as the preferred one.

All the regression models produced residuals that were not normally distributed; nonetheless, this condition is not required in order to obtain unbiased estimates of the regression coefficients. Heteroscedascity of the residuals was found in the selected C3sq + X5 (RE) model and was accordingly corrected through the estimation of robust standard errors. Splitting the sample randomly into two and using one half to predict the values of the other half confirmed robustness of the chosen model with high correlation between estimated and predicted values and an MAE of 0.028.

Comparison of observed TTO values between countries allows the analysis of valuations without the noise introduced by modeling techniques. Chilean values differ clearly from the ones recently reported in Argentina [3] and in the United States by the Spanish-speaking Hispanics [2]. Despite the fact that only 22 EQ-5D health states were assessed in Argentina, the distribution of values looks very similar to the Hispanic community in the United States. The opposite occurs when Chilean values are graphically compared with those from Spain and the United Kingdom, which both show extremely congruent results. Similarities are closer to the Spanish TTO values with a mean absolute difference of 0.088. These findings give support to the idea that different societies value health status differently and this process is not related necessarily to geographical areas or culture but may be associated with other unobserved variables. To improve the understanding of differences in health preferences between different societies, more research based on the microlevel analysis of multinational studies is urgently needed.

Conclusion

This study generated a preference-weighting system for the EQ-5D health states in Chile. The chosen C3sq + X5 (RE) regression model produces a value set with good fit, an MAE of 0.017, and only one prediction error exceeding 0.05 in absolute magnitude. We hope that our results will contribute to the development of cost-utility analysis in Chile and encourage other countries in the region to perform similar studies in their societies with the aim of improving decision-making processes in Latin America.

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