### SHOULD THE UK HAVE BREXITED THE EUROPEAN UNION?

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#### **ABSTRACT**

This paper is an analysis of Brexit, and asked the question, "Should the UK have Brexited the European Union?" We use the Analytic Hierarchy Process (AHP) to model the decision based on Benefit-Opportunities-Costs and Risks (BOCR). The AHP structure considers various factors that may be taken into consideration from the perspective of the UK (Saaty, 1980). Questionnaires were used to obtain pairwise comparison judgments from experts and used to derive priorities for the factors and final decision to Brexit. The BOCR model results are combined in two ways. Both results show that the UK should remain a member of the EU. The referendum used showed the opposite result. The approach followed here can be used to educate people when voting on similar decisions.

Keywords: Brexit; AHP; decision-making, Benefits, Opportunities, Cost, Risks, decision analysis, European Union, Eurozone

#### 1. Introduction

We believe that short of some kind of disaster and annihilation, the human race and its cultures are gradually drawing together from the agrarian age to villages, towns, cities, megacities and nations. This is despite much conflict and strife and great wars that have killed tens of millions of people. The European Union is a great and inspired step towards economic unity and in particular financial, social, and political unity.

The world owes much to the English people for this increasing unity not only for the world wide language that draws humanity to communicate together, but also in regards to law and geographic dominance ranging from the United States, Canada, Australia, New Zealand, and of course the United Kingdom itself to a unified India, despite the break up into Pakistan and Bangladesh.

Is it beneficial to the UK and to the world at large in the long run that the UK has broken off from the European Union in its Brexit with dissent coming from Londoners, the Scottish and the Northern Irish people (Irwin, 2015; Moller & Oliver, 2014)? That is the question we wish to comprehensively and logically address in this paper. Of course, we need to consider the UK's economic and political advantages and influence today in the hope that it will be a good decision for the future (Dagnis Jensen & Snaith, 2016). On June 23, 2016, the eligible voters in the UK voted on the EU referendum, "Should the United Kingdom remain a member of the European Union or leave the European Union?" The result of the vote was that the UK should leave the European Union; the breakdown of the votes by region is shown in Table 1 and Table 2.

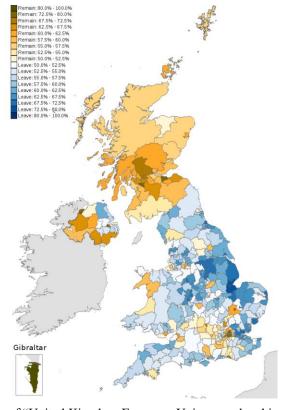
Table 1 Vote results of Brexit (23 June 2016)

Results	Votes	%
Leave	17,410,742	51.89%
Remain	16,141,241	48.11%
Valid votes	33,551,983	99.92%
Invalid or blank votes	25,359	0.08%
Total votes	33,577,342	100.00%
Registered voters/turnout	46,501,241	72.21%

<sup>\*</sup>Source: Wikipedia of "United Kingdom European Union membership referendum, 2016"

Table 2 Results by voting areas in the United Kingdom

Region	Turnout	Remain votes	Leave votes	Remain %	Leave %
England (with Gibraltar)	73.0%	13,266,996	15,188,406	46.62%	53.38%
East Midlands	74.2%	1,033,036	1,475,479	41.18%	58.82%
East of England	75.7%	1,448,616	1,880,367	43.52%	56.48%
London	69.7%	2,263,519	1,513,232	59.93%	40.07%
North East England	69.3%	562,595	778,103	41.96%	58.04%
North West England	70%	1,699,020	1,966,925	46.35%	53.65%
South East England	76.8%	2,391,718	2,567,965	48.22%	51.78%
South West England & Gibraltar	76.7%	1,503,019	1,669,711	47.37%	52.63%
West Midlands	72%	1,207,175	1,755,687	40.74%	59.26%
Yorkshire and the Humber	70.7%	1,158,298	1,580,937	42.29%	57.71%
Northern Ireland	62.7%	440,707	349,442	55.78%	44.22%
Scotland	67.2%	1,661,191	1,018,322	62.00%	38.00%
Wales	71.7%	772,347	854,572	47.47%	52.53%



\*Source: Wikipedia of "United Kingdom European Union membership referendum, 2016"

The overall result of the June 2016 vote was a narrow majority of 51.89% to 48.11% in favor of leaving the EU. We note that only London, Northern Ireland and Scotland are below the majority of 50%.

## 2. BOCR model

In a complete analysis of a decision problem we usually consider the benefits (B), opportunities (O), costs (C) and risks (R) involved. For each control criterion of these B, O, C, and R, one derives priorities for the alternatives of a decision with respect to all the significant influences that cause some alternatives to have higher priority than others. One then combines the weights of the alternatives according to the weights of the control criteria of each of the B, O, C and R assessed in terms of strategic criteria (Wind & Saaty, 1980). Strategic criteria are very basic criteria used by individuals and groups to assess whether they should make any of the many decisions they face in their daily operations. Strategic criteria do not depend on any particular decision for their priorities but are assessed in terms of the goals and values of the individual or organization. Finally, one rates (not compares) the top ranked alternative for each B, O, C and R and uses the resulting weights to combine the values of each alternatives for the four merits and obtain the final answer in the form of priorities whose relative values are important for choosing the best alternative.

The synthesized results of the alternatives for each of the four control B, O, C and R merits are combined, along traditional benefit to cost ratio analysis used in economics, to obtain a ratio outcome by taking the quotient of the benefits times the opportunities to the costs times the risks for each alternative (BO/CR), then normalizing the results over all the alternatives to determine the best outcome. This formula is only useful when one is certain that the relative measurements are commensurate, that is of the same order of magnitude. In other words it is meaningless to divide thousands of dollars for benefits, by pennies for costs; this is tantamount to dividing by numbers close to zero. There is another more reliable way to combine the B, O, C, and R that gives the total outcome. The top ranked alternative is rated (not compared) for each of the B, O, C and R with respect to strategic criteria that are needed to determine the merits of any decision. From this rating one then obtains normalized respective weights, b, o, c and r and computes the total outcome bB + oB - cC - rR for each alternative. In evaluating the benefits (opportunities), one responds to the question of dominance: which alternative contributes the most benefits (opportunities), whereas for costs (risks) one responds to the question which alternative costs (is subject to greater risks) more, which is opposite in sense of the benefits and opportunities and must be subtracted from them. It is known that the ranks obtained from ratio and total syntheses need not coincide.

# 3. Benefits, opportunities, costs and risks of Brexit—the Analytic Hierarchy Process (AHP)

Four hierarchies (Figures 1-4) were developed: one for Benefits, Opportunities, Costs, and Risks (BOCR) to the UK of exiting from the European Union (EU). Each hierarchy results in priorities that sum to 1.000 for Leave or Not Leave.

The priorities are derived from a group decision process. We administered an online survey to collect responses. The AHP questionnaire we used is shown in the Appendix. For each judgment in the questionnaire the respondent selected the dominant factor first, then decided how strongly more dominant the factor was using the 1-9 fundamental scale (Saaty, 1977, 1986). The questionnaire was sent to 90 experts who attended the ISAHP2016 in London and came from the UK. They are all AHP decision making experts; however, not all of them are familiar with the Brexit. Therefore, in our study we used the judgments of four knowledgeable experts who completed the questionnaire. The consistency of judgments was examined for each expert and found to be adequate. Next, we calculated the geometric mean of each judgment from these experts and entered the combined judgment into the Super Decisions model.

The alternatives of the decision are as follows: leave the EU or remain a member of the EU. We constructed the model using the Super Decisions software and inputting the judgments of diverse experts to compute the priorities.

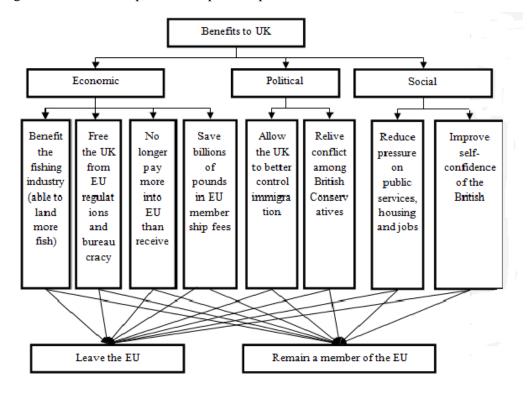


Figure 1. Benefits hierarchy

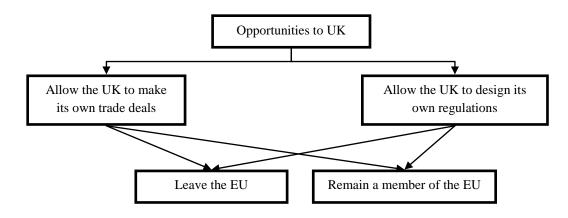
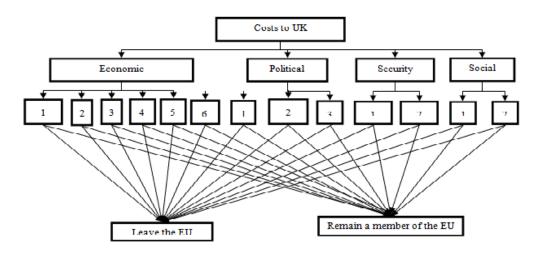
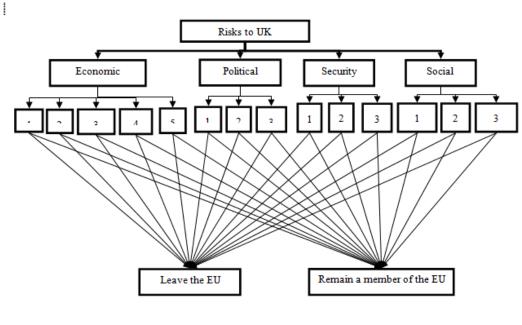


Figure 2. Opportunities hierarchy



#### **ECONOMIC POLITICAL** 1) Result in trade barriers between UK 1) Reduce UK influence on EU and EU 2) Harder to keep close foreign-policy 2) Loss of British stocks links with EU 3) Loss of investments 3) Loss of tax revenue from leaving 4) Recession in economy 5) Sterling fall 6) Loss of the biggest trading partner **SECURITY** SOCIAL 1) Loss of access to EU assets database 1) Can no longer travel freely and surveillance records 2) Loss of technological collaboration 2) Increase the difficulty of tracing the with EU international criminal

Figure 3. Costs hierarchy



#### **ECONOMIC POLITICAL** 1) Decline of financial services industry 1) Diminish UK influence in world 2) Decline of law firms industry affairs 3) London may no longer be finance 2) Harder to keep close foreign-policy center of Europe links with EU 4) Risks of diminishing investment from 3) Risk of losing the UK's prosperity 4) Risk of Scotland leaving the UK 5) US and UK ties may weaken SECURITY **SOCIAL** 1) Cause much possible collateral 1) Negative for health service damage to UK's security 2) Loss of EU food protection 2) Potential risk for conflict with EU 3) Unemployment rate may rise

Figure 4. Risks hierarchy

The results for the four hierarchies are summarized in Table 3. The idealized results in the final column to the right are obtained from each relative priority by dividing each by the largest value. For the Benefits we have relative values that sum to 1 of Leave (0.82) and Remain (0.18). Dividing each by 0.82 we obtain the ideal values of Leave (1.00) and Remain (0.22).

3) Weaken border control through EU

police cooperation

Table 3
Priorities derived from the four hierarchies

	Economic 0.250  Political 0.655	Benefit the fishing industry (able to land more fish) Free the UK from EU regulations and bureaucracy No longer pay more into EU than receive Save billions of pounds in EU membership fees Allow the UK to better control immigration	0.119 0.555 0.064 0.262	Leave the EU
	0.250 Political	No longer pay more into EU than receive Save billions of pounds in EU membership fees	0.064	
	Political	Save billions of pounds in EU membership fees		
			0.262	ட்ப
		Allow the LIK to better central immigration		0.82 (1)
		Anow the UK to better collifor Hillingration	0.833	Remain a member of
· ·		Relive conflict among British Conservatives	0.167	the EU
Benefits	Social	Reduce pressure on public services, housing and jobs	0.200	0.18 (0.22)
Be	0.095	Improve self-confidence of the British	0.800	
Opportunities		Allow the UK to design its own regulations	0.800	Leave the EU 0.83 (1) Remain a member of the EU
Op		Allow the UK to make its own trade deals	0.200	0.17 (0.20)
		Result in trade barriers between UK and EU	0.184	
		Loss of British stocks	0.190	
	Economic	Loss of investments	0.154	
	0.103	Recession in economy	0.150	
		Sterling falls	0.083	
		Loss of the biggest trading partner	0.239	Leave the EU
	D 11:1: 1	Reduce UK influence on EU	0.117	0.86 (1)
	Political 0.231	Harder to keep close foreign-policy links with EU	0.614	Remain a
	0.231	Loss of tax revenue from leaving EU enterprises	0.268	member of the EU
	Security	Loss of access to EU assets database and surveillance records	0.833	0.14 (0.16)
osts	0.624	Increase the difficulty of tracing the international criminal	0.167	
ပိ	Social	Can no longer travel freely	0.250	
	0.042	Loss of technological collaboration with EU	0.750	
		Decline of financial services industry	0.207	_
	Economia	Decline of law firms industry	0.208	Leave the EU
	Economic 0.153	London may no longer be finance center of Europe	0.288	0.87 (1)
	0.133	Risks of diminishing investment from EU	0.179	Remain a
		US and UK ties may weaken	0.119	member of
Risks	Political	Diminish UK influence in world affairs	0.737	the EU 0.13 (0.15)
Ri	0.307	Risk of losing the UK's prosperity	0.085	0.13 (0.13)

	Risk of Scotland leaving the UK	0.177
Copiel	Negative for health service	0.752
Social 0.219	Loss of EU food protection	0.197
0.219	Unemployment rate may rise	0.051
Security 0.322	Cause much possible collateral damage to UK's security	0.189
	Potential risk for conflict with EU	0.054
0.322	Weaken border control through EU police cooperation	0.757

A summary of the idealized priorities shown in Table 3 are given in Table 4.

Table 4 Idealized priority vectors for Leave the EU or Remain in the EU

	Benefits	Opportunities	Costs	Risks
	(B)	(O)	(C)	(R)
Leave the EU	1.00	1.00	1.00	1.00
Remain in the EU	0.23	0.20	0.16	0.15

We structured the hierarchy of strategic criteria shown in Figure 5 from the media coverage of voter concerns and prioritized the factors through the usual pairwise comparison process. The priorities of the strategic criteria thus derived are shown in Table 5.

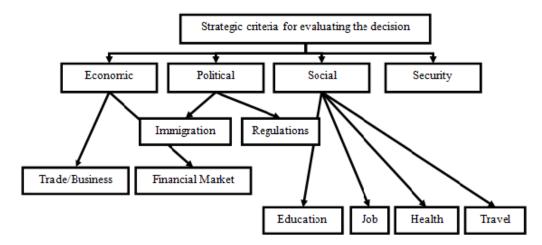


Figure 5. The strategic criteria

Table 5 Overall priorities of strategic criteria

Economic	0.098	Trade/Business	0.089
		Financial Market	0.012
Political	0.244	Immigration	0.225
		Regulations	0.028
Social	0.036	Education	0.148
		Health	0.019
		Job	0.423
		Travel	0.054
Security	0.622		

We then created Table 6 for rating the benefits, opportunities, costs and risks of this decision. It has one column for every lowest level of strategic criteria. We defined intensities for the scale of very high (0.42), high (0.26), medium (0.16), low (0.1), and very low (0.06). Their priorities were derived by making judgments on pairs of intensities in the usual pairwise comparison matrix, asking how much one intensity was preferred to the other.

We evaluated the impact of the highest valued alternative in each of the four hierarchies on the strategic criteria in the ratings table shown in Table 6. In every one of the four hierarchies the highest priority alternative was to Remain in the EU. We selected the appropriate impact for that alternative each cell in Table 5. As an example, for the top leftmost cell (Benefits, Education), we asked what intensity the beneficial impact of leaving would have on Education and concluded it would have a Medium impact, so Medium was entered in the cell. Because it was the highest value alternative in every hierarchy we rated Remain in the EU across every row. The overall priorities for benefits (b = 0.291), opportunities (o = 0.224), costs (c = 0.243) and risks (r = 0.242), are shown outlined in red in Table 6.

Table 6. Priorities for b, o, c, r, from the ratings table

		Super Decisions Ratings										
	Priorities			Financial Market 0.012731	Health 0.019319	Immigration 0.225018	Job 0.428474			Travel 0.054009		
В	0.290519	0.805631	Medium	High	Medium	Very High	Very High	High	High	Low		
0	0.223984	0.621125	High	High	Medium	High	High	Medium	Very High	Low		
С	0.243031	0.673945	Low	Medium	High	High	Very High	High	Medium	Very Low		
R	0.242466	0.672376	Low	High	Medium	High	Very High	High	Medium	Very Low		

### 4. Results

We obtained the overall priorities shown in Table 7 in two ways using the multiplicative formula BO/CR and the additive-negative formula bB+oO-cC-rR. The vectors B, O, C, and R are from Table 4 and the b, o, c, r priorities are from Table 6. We see that "Remain in the EU" is dominant (in bold type) using either formula and is the best alternative.

Table 7
Overall final results

					Re	sults
	В	O	С	R	BO/CR	bB+oO-
Alternatives	b=(0.291)	o=(0.224)	c=(0.243)	r=(0.242)		cC-rR
Leave the EU	1	1	1	1	1	0.029
Remain in the EU	0.218	0.2	0.158	0.147	1.892	0.034

<sup>\*</sup>B, O, C and R (the respective columns above) are the priority vectors for the two alternatives; b, o, c and r are the priorities derived by rating against the strategic criteria.

### 5. Conclusion

The conclusion of this study is that Remain in the EU would have been the best outcome, though it flies in the face of the actual vote which was to Leave the EU. In this study we aimed to predict the best outcome. Whether it really was the best outcome will need to be determined a few years hence as the dust settles. Any decision can be viewed in two ways: what is most likely to occur and what is the best outcome. Frequently they are not the same.

Although this study cannot be considered definitive, the outcome of this exercise leaves one to seriously wonder about citizens voting Yes or No. This is a habit that we practice inherited from the past with no way to measure the intangibles involved or determine their importance. There is a talk today about France and Austria also thinking of leaving the EU, and among others, the Japanese have complained about the large investment they have made in the UK as part of the EU. They say this Brexit decision amounts to significant losses to them now in a message issued on the eve of the G20 summit in China in September 2016. The document entitled "Japan's Message to the UK and EU" warns of dire consequences for "the interests of the world" if an open Europe cannot be maintained. There has not been very strong advocacy for our approach about how to examine the subject carefully before resorting to a Yes-No kind of vote on the outcome as was done in the United Kingdom (Dhingra et al., 2016). Expert opinion and the strength of the judgments should play an important role in making such decisions that have global consequences and involve multi-criteria kind of thinking. Feelings and intuition may not be adequate to obtain the right result.

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### APPENDIX I

Should the UK have Brexited the European Union?

This is a questionnaire of the AHP Benefits-Opportunities-Costs-Risks model to evaluate "Should the UK have Brexited the EU?"

There are five parts to the questions as can be seen below.

Please do the pairwise comparison of all the criteria using the 1-9 dominance scale of absolute numbers:

- 9 Extremely
- 8 Very strongly to extremely
- 7 Very strongly
- 6 Strongly to very strongly
- 5 Strongly
- 4 Moderately to strongly
- 3 Moderately
- 2 Equally to moderately
- 1- Equally

Click ""NEXT" at bottom of the page to begin.

#### \*Required

## Part I: Benefits

Please do the pairwise comparison of all criteria with the 1-9 scale.

Here are the questions we hope you answer first by marking the appropriate circle and then with numbers to indicate how much more the marked item is than the unmarked one.

1-1 Which factor is more dominant: Political or Social with	1
respect to the Benefits to the UK? *	
O Political	
○ Social	

. How muc	ch m	ore o	domi	nant	?*					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
2-1 Which factor is more dominant: Economic or Political with respect to the Benefits to the UK?										
Economic										
Political										
. How muc	ch m	ore o	domi	nant	? *					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more
3-1 Which factor is more dominant: Economic or Social with respect to the Benefits to the UK?										
Economic										
Social										
. How muc	ch m	ore o	domi	nant	? *					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
										shing industry" or "Free the UK et to the Economic Benefits?
Benefit th							•			
Free the U	JK from	n EU reg	gulatio	ns and	bureau	icracy				
. How muc	ch m	ore o	domi	nant	?*					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important

										g industry" or "No conomic Benefits?
Benefit the fis	hing ind	lustry								
No longer pay	more ir	nto EU tl	nan rece	eive						
. How muc	h m	ore o	lomi	nant	? *					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
										ndustry" or "Save billions conomic Benefits?
Benefit the fi	shing in	dustry								
Save billions	of pour	nds in E	U mem	bership	fees					
. How muc	ch m	ore o	lomi	nant	? *					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
	" or "l	No lo								egulations and with respect to the
Free the UK fr	rom EU	regulation	ons and	bureau	cracy					
No longer pay	y more i	nto EU t	han rec	eive						
. How muc	ch m	ore o	lomi	nant	?*					
		22	9923	4		6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
8-1 Which fact bureaucracy" o the Economic I	r "Sav	e billi								s and
Free the UK from	EU regul	ations ar	d bureau	ıcracy						
Save billions of p	ounds in	EU mem	bership f	ees						

How much more dominant? *										
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
9-1 Which factor is more dominant: "No longer pay more into EU than receive" or "Save billions of pounds in EU membership fees" with respect to the Economic Benefits?										
No longer pay	more i	nto EU t	han rece	eive						
Save billions of pounds in EU membership fees										
. How muc	h m	ore o	domi	nant	? *					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
10-1 Which factor is more dominant: "Allow the UK to better control immigration" or "Relive conflict among British Conservatives" with respect to the Political Benefits?										
Allow the UK	to bette	r contro	l immigr	ation						
Relive conflict	t among	g British	Conserv	atives/						
. How muc	h m	ore o	domi	nant	?*					
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important
11-1 Which factor is more dominant: "Improve self-confidence of the British" or "Reduce pressure on public services, housing and jobs" with respect to the Social Benefits?										
Improve self-o	confide	nce of t	he Britis	sh						
Reduce pressure on public services, housing and jobs										
How much more dominant? *										
	1	2	3	4	5	6	7	8	9	
Equally important	0	0	0	0	0	0	0	0	0	Extremely more important

12-1 Whi		terna	tive is	s pre	ferre	d with	n resp	ect t	:o "B	enefiting the fishing	
_ Leave t	he EU										
Remain a member of the EU											
How much more preferred? *											
	1	2	3	4	5	6	7	8	9		
Equally		$\bigcirc$	$\circ$	$\bigcirc$	$\circ$	$\circ$		$\bigcirc$	$\circ$	Extremely more	
13-1 Which alternative is preferred with respect to the criterion "Free the UK from EU regulations and bureaucracy"?											
C Leave the EU											
Remain a member of the EU											
How much more preferred? *											
	1	2	3	4	5	6	7	8	9		
Equally	$\circ$	$\bigcirc$	$\bigcirc$	$\bigcirc$			$\circ$	$\bigcirc$		Extremely more	
more into EU than receive"?  Leave the EU  Remain a member of the EU											
How	much i	more	preteri	red? *							
EIII-	1	2	3	4	5	6	7	8	9	Shoothara	
15-1 Which alternative is preferred with respect to "Save billions of pounds in EU membership fees"?											
C Leave th	ne EU										
Remain	a memb	er of the	e EU								
How	much i	more	prefer	red? *							
	1	2	3	4	5	6	7	8	9		
Equally	$\circ$	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\circ$	$\circ$	$\bigcirc$	$\bigcirc$	Extremely more	
16-1 Which alternative is preferred with respect to the criterion "Allow the UK to better control immigration"?											
○ Leave the EU											
Remain a member of the EU											

How much more preferred? *										
	1	2	3	4	5	6	7	8	9	
Equally	$\circ$	$\bigcirc$	Extremely more							
17-1 Which alternative is preferred with respect to "Relive conflict among British Conservatives"?										
Leave	the El	J								
Remain a member of the EU										
How much more preferred? *										
	1	2	3	4	5	6	7	8	9	
Equally	$\bigcirc$		$\bigcirc$	Extremely more						
18-1 Which alternative is preferred with respect to "Improving the self-confidence of the British"?										
Leave the EU										
Remain a member of the EU										
How	much	more	prefer	red? *						
	1	2	3	4	5	6	7	8	9	
Equally	$\circ$	$\bigcirc$	Extremely more							
19-1 Which alternative is preferred with respect to "Reducing the pressure on public services, housing and jobs"?										
◯ Lea	ve the E	U								
Remain a member of the EU										
How much more preferred? *										
	1	2	3	4	5	6	7	8	9	
Equally	0	$\circ$	$\circ$	0	0	0	0	$\circ$	$\circ$	Extremely more

 $(You\ can\ get\ the\ complete\ question naire\ at\ https://goo.gl/forms/DGdba9TpRkQ757rK2)$