

ONLINE APPENDIX

Appendix A: Spatial Analysis

Table A1. Spatial diagnostics for share of ‘Leave’ vote in the Brexit referendum

	Diagnostic value	p-value
Lagrange multiplier spatial error	163.243	0.000
Lagrange multiplier spatial lag	2.397	0.122
Robust Lagrange multiplier spatial error	160.979	0.000
Robust Lagrange multiplier spatial lag	0.134	0.714

Interpretation of Table A1:

There are two possible explanations for spatially dependent behavior: spatial dependence (due to diffusion effects) or attributional dependence (due to the geographic clustering of the sources of the behavior). These two types of sources of spatial dependence require different types of statistical modeling. Hence, the first step in our spatial analysis is to conduct a series of Lagrange Multiplier diagnostics tests to assess whether a spatial lag or a spatial error model is more appropriate (Darmofal, 2015).

We can observe that both the LM spatial lag and the robust LM spatial lag diagnostic tests are not significant which indicates that spatial dependence is not an issue in our analysis. However, the LM spatial error and the robust LM spatial error diagnostic tests are both statistically significant.

These diagnostic tests suggest that OLS estimates might not fully capture the spatial dependence and that a spatial error model is appropriate. The results of the robustness spatial error models are presented in Table A2 below.

Reference

Darmofal, D. (2015). *Spatial Analysis for the Social Sciences*. New York: Cambridge University Press.

Table 2. ML spatial error estimates for support for Brexit in the 2016 referendum

VARIABLES	(1)	(2)	(3)
Δ in real household income 2014-2015	-.018 (.135)		
Δ in real household income 2005-2015		-.236*** (.065)	
Δ in real household income 1997-2015			-.125*** (.034)
Population density 1997 (logged)	.566* (.339)	.258 (.341)	.358 (.334)
% population older than 65 (1997)	.723*** (.150)	.734*** (.147)	.701*** (.147)
Household income 1997 (logged)	-5.191** (1.576)	-6.247*** (1.574)	-6.102*** (1.572)
% population in manufacturing (1997)	.411*** (.047)	.407*** (.047)	.405*** (.047)
Constant	78.681*** (15.274)	90.638*** (15.311)	91.556*** (15.413)
λ	.873*** (.046)	.859*** (.048)	.838*** (.052)
AIC	2556.58	2543.66	2543.42
Observations	380	380	380

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix B: Robustness models and figures (based on the results presented in Table 2)

Figure A1. Predicted values of support for Brexit in the referendum at the local level

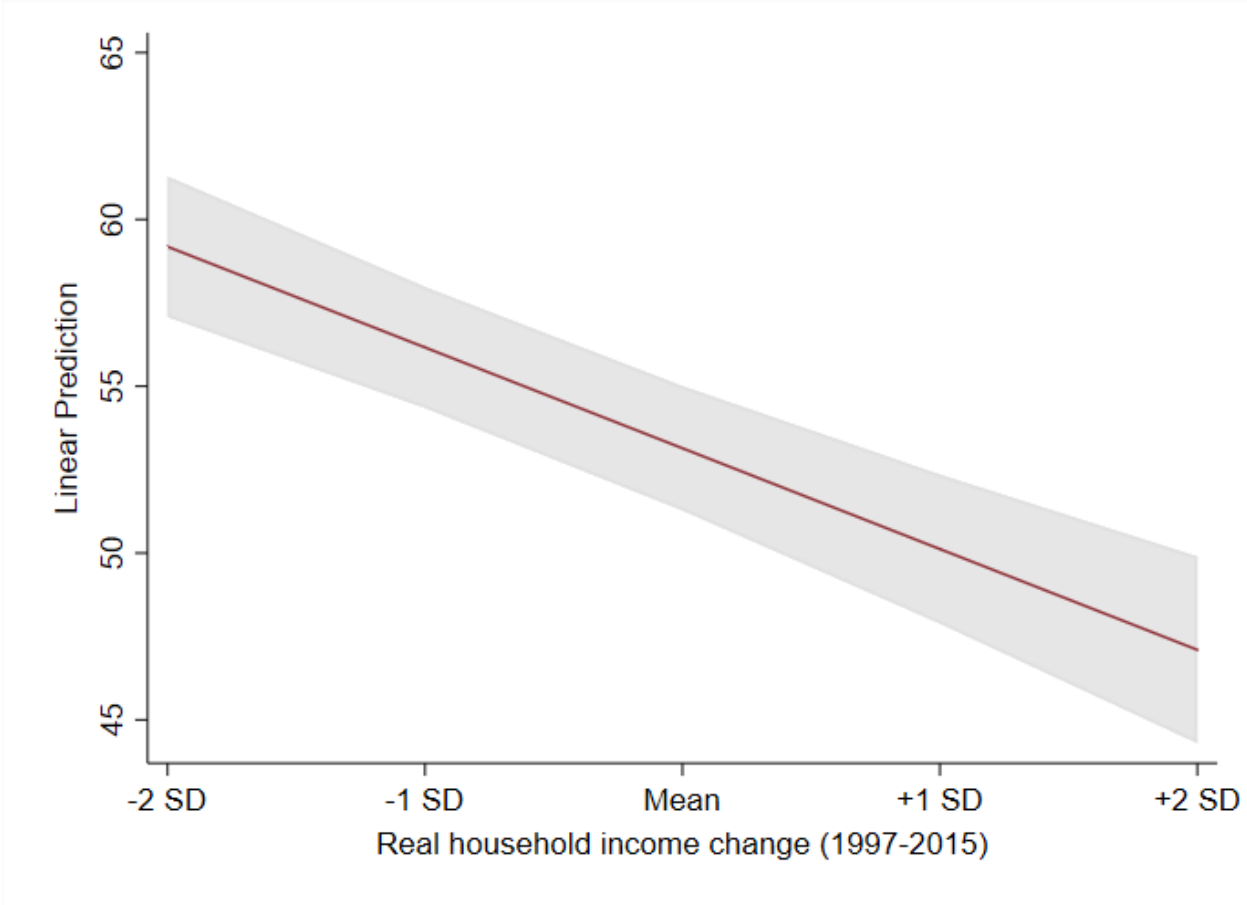


Table A3. OLS estimates for support for Brexit in the 2016 referendum (alternative specification)

	(1)	(2)	(3)
	OLS models (region-clustered SE)		
VARIABLES			
Δ in real household income 2014-2015	.039 (.142)		
Δ in real household income 2005-2015		-.242*** (.057)	
Δ in real household income 1997-2015			-.134** (0.036)
Population density 2015 (logged)	2.680** (.949)	2.326** (.908)	2.318** (.849)
% population older than 65 (2015)	.681** (.172)	.709*** (.163)	.646** (.148)
Household income 2015 (logged)	3.471 (2.503)	4.709** (2.329)	4.294* (2.532)
% population in manufacturing (2015)	.382** (.105)	.360** (.103)	.352** (.100)
% with high school education (2015)	-.761*** (.063)	-.756*** (.060)	-.754*** (.059)
% foreign population (2015)	.068 (.086)	.085 (.084)	.089 (.085)
Constant	21.994 (26.249)	10.336 (24.167)	18.251 (25.498)
AIC	2344.42	2325.24	2319.69
Observations	369	369	369

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A4. OLS estimates for support for Brexit in the 2016 referendum (employee compensation models)

	(1)	(2)	(3)
VARIABLES	OLS models (region-clustered SE)		
Δ in real employee compensation 2014-2015	-.049 (.112)		
Δ in real employee compensation 2005-2015		-.249*** (.063)	
Δ in real employee compensation 1997-2015			-.066*** (.016)
Population density 1997 (logged)	.281 (.524)	.207 (.489)	.379 (.457)
% population older than 65 (1997)	.998*** (.247)	.995*** (.223)	.955*** (.203)
Household income 1997 (logged)	-5.675*** (2.914)	-6.606** (2.476)	-6.139** (2.270)
% population in manufacturing (1997)	.538*** (.079)	.498*** (.074)	.479*** (.072)
Constant	77.741** (32.045)	86.988*** (27.719)	85.662*** (25.991)
AIC	2712.28	2693.82	2688.09
Observations	380	380	380

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A5. OLS estimates for support for Brexit in the 2016 referendum (unemployment models)

VARIABLES	(1)	(2)
	OLS models (region-clustered SE)	
Δ in unemployment rate 2014-2016	.137 (.237)	
Δ in unemployment rate 2004-2016		1.519*** (.317)
Population density 1997 (logged)	.559 (.571)	.755 (.491)
% population older than 65 (1997)	1.224*** (.307)	.953*** (.225)
Household income 1997 (logged)	-4.560 (3.996)	-5.057*** (3.450)
% population in manufacturing (1997)	.597*** (.086)	.512*** (.066)
Constant	60.579 (42.795)	69.193* (36.793)
AIC	2277.04	2357.71
Observations	317	334

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A6. OLS estimates for support for Brexit in the 2016 referendum (house price change model)

<hr/>	
	(1)
<hr/>	
VARIABLES	
<hr/>	
Δ in house prices 2007-2016	-0.123*
	(.066)
Population density 1997 (logged)	-.165
	(.354)
% population older than 65 (1997)	.485**
	(.132)
Household income 1997 (logged)	-5.406
	(3.285)
% population in manufacturing (1997)	.363
	(.057)
Constant	93.859**
	(30.913)
AIC	2380.82
Observations	348
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Robust standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Appendix C: Variables used to construct the “cultural grievances” indicator

Table A7. Survey items used to capture cultural grievances in the BES survey

Variables	Survey Items
	ANTI-IMMIGRATION/NATIVISM
immigEcon	Do you think immigration is good or bad for Britain's economy? (recoded into 1=good for economy...7= bad for economy)
immigCultural	And do you think that immigration undermines or enriches Britain's cultural life? (recoded into 1=max ... 7=min) [higher values indicate that immigration undermines Britain's cultural life]
immigself	Some people think that the UK should allow *many more* immigrants to come to the UK to live and others think that the UK should allow *many fewer* immigrants. Where would you place yourself on this scale? (recoded into 0=many more...10=many fewer)
AsylumMore	Do you think that Britain should allow more or fewer asylum seekers to come and live in Britain? (recoded into 0=many more...10=many fewer)
euMore	Do you think that Britain should allow more or fewer workers from other EU countries to come and live in Britain? (recoded into 0=many more...10=many fewer)
noneuMore	Do you think that Britain should allow more or fewer workers from outside the EU to come and live in Britain? (recoded into 0=many more...10=many fewer)
studentsMore	Do you think that Britain should allow more or fewer foreign students to come and live in Britain? (recoded into 0=many more...10=many fewer)
familiesMore	Do you think that Britain should allow more or fewer families of people who already live here to come and live in Britain? (recoded into 0=many more...10=many fewer)
changeImmig	Do you think that the level of immigration is getting higher, getting lower or staying about the same? (1=getting a lot lower...5=getting a lot higher)
	EUROSCEPTICISM
euUndermineIdentity	How much do you agree or disagree with the following statement? “Being a member of the European Union undermines Britain’s distinctive identity” (1=strongly disagree...5=strongly agree)

EUIntegrationSelf	Some people feel that Britain should do all it can to unite fully with the European Union. Other people feel that Britain should do all it can to protect its independence from the European Union. Where would you place yourself and the political parties on this scale? (0=unite fully with the European Union...10=protect our independence)
europaeness	Where would you place yourself on this Europeanness scale? (recoded into 1=max...7=min)
	ETHNOCENTRISM
ethno1	How much do you agree or disagree with the following statement? "Britain has a lot to learn from other countries in running its affairs" (recoded into 1=strongly agree...5=strongly disagree)
ethno2	How much do you agree or disagree with the following statement? "I would rather be a citizen of Britain than of any other country in the world" (1=strongly disagree...5=strongly agree)
ethno5	How much do you agree or disagree with the following statement? "The world would be a better place if people from other countries were more like the British" (1=strongly disagree...5=strongly agree)
blackEquality	Please say whether you think attempts to give equal opportunities to ethnic minorities have gone too far or have not gone far enough in Britain. (1= not gone nearly far enough...5=gone much too far)
	NOSTALGIA
al1	How much do you agree or disagree with the following statement? "Young people today don't have enough respect for traditional British values" (1=strongly disagree...5=strongly agree)
harkBack	How much do you agree or disagree with the following statement? "Things in Britain were better in the past" (1=strongly disagree...5=strongly agree)

Table A8: Factor analysis using 18 BES survey items capturing “cultural grievances”

	Factor 1
immigEcon	0.835
immigCultural	0.846
immigself	0.876
AsylumMore	0.818
euMore	0.808
noneuMore	0.720
studentsMore	0.702
familiesMore	0.776
changeImmig	0.693
euUndermineIdentity	0.750
EUIntegrationSelf	0.754
européanness	0.656
ethno1	0.534
ethno2	0.365
ethno5	0.475
blackEquality	0.651
all	0.605
harkBack	0.557

Note: Entries are the result of a principal-component factor analysis. 1 component extracted. Eigenvalue= 8.912.

Appendix D: Robustness models (based on the results presented in Table 3)

Table A9. Information on scales used in robustness models and Cronbach's alphas

Scale	Variables used	Cronbach's alpha
Anti-immigration scale 1	<ul style="list-style-type: none"> • immigEcon • immigCultural 	0.89
Anti-immigration scale 2	<ul style="list-style-type: none"> • immigself • AsylumMore • euMore • noneuMore • studentsMore • familiesMore 	0.92
Euroscepticism scale	<ul style="list-style-type: none"> • euUndermineIdentity • EUIntegrationSelf 	0.82
Ethnocentrism scale	<ul style="list-style-type: none"> • ethno1 • ethno2 • ethno5 • blackEquality 	0.65
Nostalgia scale	<ul style="list-style-type: none"> • all • harkBack 	0.64

Table A10. Determinants of anti-immigration attitudes in the United Kingdom (multilevel models)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ANTI-IMMIGRATION SCALE 1					ANTI-IMMIGRATION SCALE 2				
Male	-.101*** (.021)	-.102*** (.021)	-.102*** (.021)	-.118*** (.022)	-.116*** (.021)	.000 (.028)	-.001 (.028)	-.000 (.028)	-.012 (.030)	-.009 (.029)
Age	.009*** (.001)	.010*** (.001)	.009*** (.001)	.009*** (.001)	.009*** (.001)	.018*** (.001)	.018*** (.001)	.018*** (.001)	.017*** (.001)	.018*** (.001)
Education	-.407*** (.008)	-.406*** (.008)	-.406*** (.008)	-.412*** (.008)	-.410*** (.009)	-.504*** (.011)	-.504*** (.011)	-.503*** (.011)	-.510*** (.011)	-.507*** (.011)
Working class	.168*** (.022)	.168*** (.022)	.168*** (.022)	.166*** (.023)	.160*** (.023)	.190*** (.031)	.189*** (.031)	.189*** (.031)	.190*** (.032)	.178*** (.032)
Δ in real household income 2014-2015	.018** (.007)					.015 (.009)				
Δ in real household income 2005-2015		-.009** (.003)					-.012** (.004)			
Δ in real household income 1997-2015			-.006*** (.002)					-.006** (.002)		
Δ in unemployment 2014-2016				-.004 (.008)					-.009 (.011)	
Δ in unemployment 2004-2016					.037*** (.009)					.048*** (.013)
Population density 1997 (logged)	.002 (.013)	-.008 (.013)	-.005 (.013)	-.000 (.015)	.011 (.014)	-.005 (.018)	-.018 (.018)	-.012 (.018)	-.014 (.020)	.002 (.019)
% population older than 65 (1997)	.014** (.006)	.013** (.006)	.013** (.006)	.016** (.007)	.012* (.006)	.003 (.008)	.003 (.008)	.002 (.008)	.003 (.009)	-.000 (.008)
Household income 1997 (logged)	-.043 (.086)	-.100*** (.087)	-.129*** (.087)	.012 (.101)	-.007 (.096)	-.060** (.115)	-.125 (.115)	-.144 (.117)	-.001 (.135)	-.010 (.129)
% population in manufacturing (1997)	.011*** (.002)	.011*** (.002)	.011*** (.002)	.014*** (.002)	.013*** (.002)	.015*** (.003)	.015*** (.003)	.015*** (.003)	.018*** (.003)	.016*** (.003)
Constant	5.106*** (.867)	5.766*** (.866)	6.138*** (.880)	4.595*** (1.003)	4.782*** (.953)	7.277*** (1.156)	8.033*** (1.152)	8.306*** (1.177)	6.836*** (1.347)	6.870*** (1.280)
Observations	25,507	25,507	25,507	23,427	24,030	22,894	22,894	22,894	20,982	21,530
Number of districts	373	373	373	311	328	373	373	373	311	328
Number of regions	11	11	11	11	11	11	11	11	11	11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A11. Determinants of Eurosceptic attitudes in the United Kingdom (multilevel models)

	(1)	(2)	(3)	(4)	(5)
Male	0.022 (.031)	.021 (.031)	.021 (.031)	.014 (.031)	.011 (.031)
Age	.026*** (.001)	.026*** (.001)	.026*** (.001)	.026*** (.001)	.025*** (.001)
Education	-.477*** (.012)	-.476*** (.012)	-.476*** (.012)	-.479*** (.012)	-.478*** (.012)
Working class	.145*** (.033)	.144*** (.033)	.144*** (.033)	.151*** (.034)	.141*** (.034)
Δ in real household income 2014-2015	.015 (.009)				
Δ in real household income 2005-2015		-.007 (.004)			
Δ in real household income 1997-2015			-.006*** (.002)		
Δ in unemployment 2014-2016				-.009 (.010)	
Δ in unemployment 2004-2016					.025** (.012)
Population density 1997 (logged)	-.039** (.017)	-.048** (.017)	-.047*** (.017)	-.046** (.019)	-.029 (.018)
% population older than 65 (1997)	.024** (.008)	.023** (.008)	.022** (.008)	.028** (.009)	.024** (.008)
Household income 1997 (logged)	-.025 (.113)	-.072 (.113)	-.113** (.114)	.004 (.126)	-.021 (.123)
% population in manufacturing (1997)	.014*** (.003)	.014*** (.003)	.014*** (.002)	.018*** (.003)	.017*** (.003)
Constant	6.728*** (1.129)	7.281*** (1.132)	7.781*** (1.150)	6.426*** (1.251)	6.637*** (1.223)
Observations	24,743	24,743	24,743	22,709	23,293
Number of districts	373	373	373	311	328
Number of regions	11	11	11	11	11

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table A12. Determinants of ethnocentric attitudes in the United Kingdom (multilevel models)

	(1)	(2)	(3)	(4)	(5)
Male	.076*** (.008)	.076*** (.008)	.076*** (.008)	.076*** (.009)	.075*** (.009)
Age	.009*** (.000)	.009*** (.000)	.009*** (.000)	.009*** (.000)	.009*** (.000)
Education	-.111*** (.003)	-.111*** (.003)	-.111*** (.003)	-.113*** (.003)	-.113*** (.003)
Working class	.011 (.009)	.011 (.009)	.011 (.009)	.014 (.010)	.012 (.009)
Δ in real household income 2014-2015	.002 (.002)				
Δ in real household income 2005-2015		-.004*** (.001)			
Δ in real household income 1997-2015			-.002** (.001)		
Δ in unemployment 2014-2016				-.003 (.003)	
Δ in unemployment 2004-2016					.008** (.004)
Population density 1997 (logged)	-.001 (.005)	-.004 (.005)	-.003 (.005)	-.004 (.005)	-.001 (.005)
% population older than 65 (1997)	.005** (.002)	.005** (.002)	.005** (.002)	.005** (.002)	.005 (.002)
Household income 1997 (logged)	.049 (.032)	.032 (.032)	.022 (.032)	.069* (.036)	.062* (.035)
% population in manufacturing (1997)	.004*** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)	.004*** (.001)
Constant	2.562*** (.324)	2.757*** (.322)	2.883*** (.328)	2.411*** (.365)	2.454*** (.355)
Observations	23,818	23,818	23,818	21,843	22,415
Number of districts	373	373	373	311	328
Number of regions	11	11	11	11	11

Standard errors in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

Table A13. Determinants of nostalgia for the national past in the United Kingdom (multilevel models)

	(1)	(2)	(3)	(4)	(5)
Male	-.048*** (.011)	-.048*** (0.011)	-.048*** (0.011)	-.047*** (.011)	-.049*** (.011)
Age	.005*** (.000)	.005*** (.000)	.005*** (.000)	.005*** (.000)	.006*** (.000)
Education	-.168*** (.004)	-.168*** (.004)	-.168*** (.004)	-.168*** (.004)	-.168*** (.004)
Working class	.160*** (.011)	.160*** (.011)	.160*** (.011)	.161*** (.012)	.160*** (.011)
Δ in real household income 2013-2015	.003 (.003)				
Δ in real household income 2005-2015		-.004*** (.001)			
Δ in real household income 1997-2015			-.002** (0.001)		
Δ in unemployment 2014-2016				-.002 (.003)	
Δ in unemployment 2004-2016					.011** (.004)
Population density 1997 (logged)	.001 (.006)	-.002 (.006)	-.001 (.006)	-.000 (.006)	.004 (.006)
% population older than 65 (1997)	.007** (.003)	.007** (.003)	.006** (.003)	.008** (.003)	.005 (.003)
Household income 1997 (logged)	-.038 (.040)	-.059 (.040)	-.071* (.040)	-.032 (.045)	-.038 (.044)
% population in manufacturing (1997)	.006*** (.001)	.006*** (.001)	.006*** (.001)	.006*** (.001)	.006*** (.001)
Constant	3.929*** (.399)	4.172*** (.397)	4.322*** (.405)	3.880*** (.451)	3.945*** (.438)
Observations	25,708	25,708	25,708	23,571	24,185
Number of districts	373	373	373	311	328
Number of regions	11	11	11	11	11

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix E: Sensitivity Analysis (based on the mediation analysis presented in Table 4)

Table A14. Sensitivity results

	Δ in real household income 1997-2015	Δ in unemployment 2004-2016
ρ at which ACME= 0	.65	.69
$R^2M_i * R^2Y_i$ at which ACME = 0	.42	.47

These sensitivity analyses were estimated using the “Medsens” statistical package in Stata (Hicks & Tingley, 2011).

Interpretation of the sensitivity results:

When both the mediator and outcome variable are continuous and fit with a linear regression, the mediation effect under the sequential ignorability assumption is equivalent to fitting two regressions:

$$M_i = \alpha_2 + \beta_2 T_i + \xi_2 X_i + \epsilon_{i2}$$

$$Y_i = \alpha_3 + \beta_3 T_i + \gamma M_i + \xi_3 X_i + \epsilon_{i3}$$

The results presented in the first row in Table A14 show that for the point estimate of the average causal mediation effects (ACME) reported in Table 4 in the paper to be 0, the correlation between ϵ_{i2} and ϵ_{i3} should be .65 in the mediation model using “ Δ in real household income 1997-2015” as the treatment variable and .69 in the mediation model using “ Δ in unemployment 2004-2016.” These results are presented graphically in Figure A2 below.

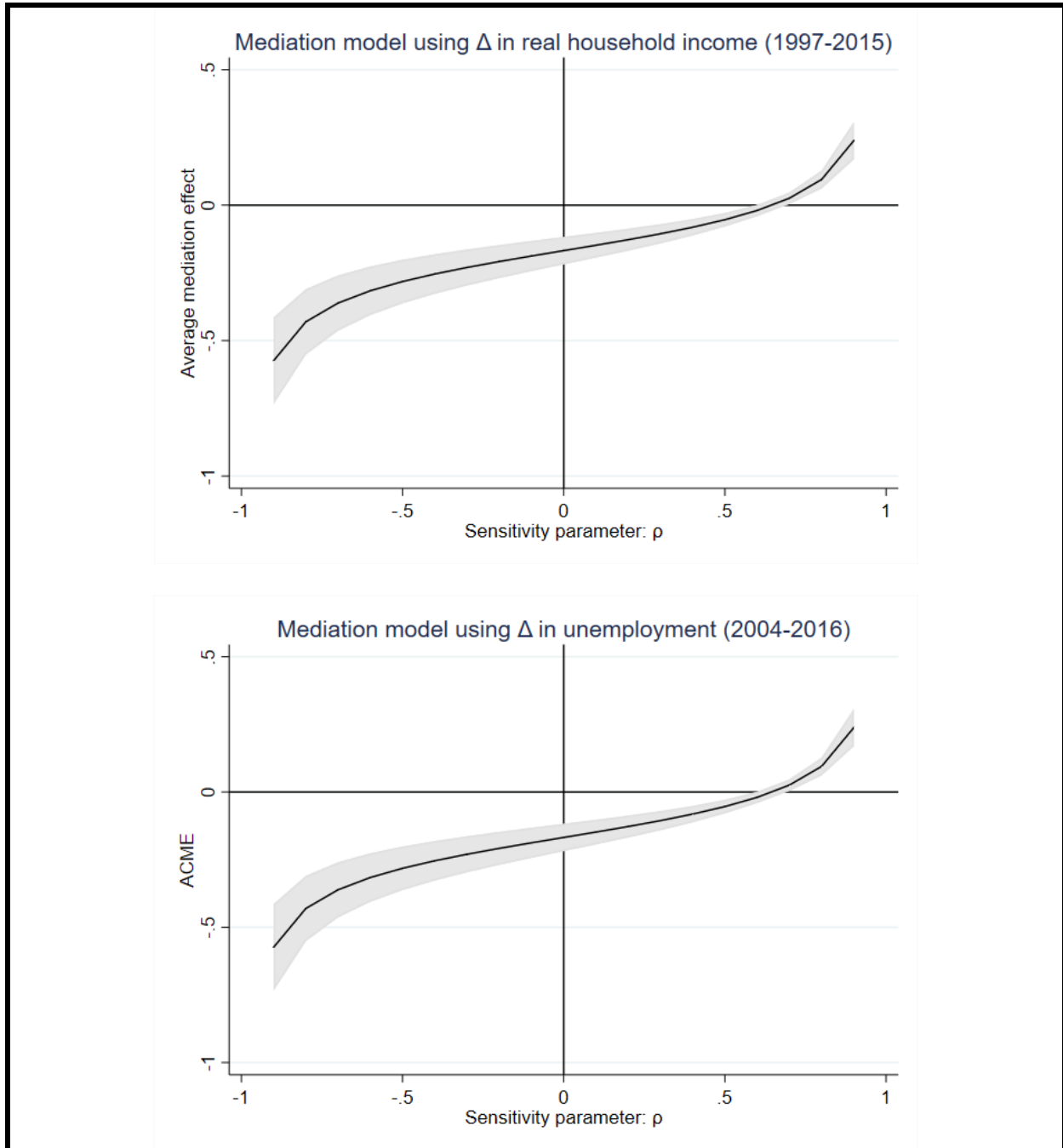
The results presented in the second row in Table A14 report the product of R^2 's measures of sensitivity for the mediator and outcome models. The results suggest that an omitted confounder must explain 65% of the remaining variance in the mediator and 65% of the remaining variance in the outcome, $0.65 \times 0.65 \approx 0.42$, for the ACME to be zero in the “household income” mediation model. Similarly, an omitted confounder must explain 69% of the remaining variance in the mediator and 69% of the remaining variance in the outcome, $0.69 \times 0.69 \approx 0.47$, for the ACME to be zero in the “unemployment” mediation model.

In other words, the sensitivity analyses presented here show that the significant mediation effects presented in the paper are highly robust to violations of the sequential ignorability assumption.

Reference:

Hicks, R., & Tingley, D. (2011). Causal mediation analysis. *Stata Journal*, 11(4), 605-619.

Figure A2. Average causal mediation effect as a function of degree of violation of the sequential ignorability assumption



These figures illustrate the ACMEs of cultural grievances and the sensitivity parameter ρ (with 95% CIs). In both mediation models, the ACMEs remain significant until ρ reaches 0.65–0.69.

Note: Sensitivity estimates calculated using Stata Package “Medsens” (Hicks & Tingley, 2011). All estimations based on 1,000 simulations.