Supplement to "Smoking initiation: Peers and personality"

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Appendix A: Additional tables and figures

Table A.1. Add health survey items and factor analysis for personalities.

Item Identifier	Description	Factor Loadings ES	Factor Loadings CO	Factor Loadings EX	Regression Coef. ES	Regression Coef. CO	Regression Coef. EX
H1PF30	You have a lot of good qualities	0.6207			0.3164		
H1PF32	You have a lot to be proud of	0.6602			0.3930		
H1PF33	You like yourself just the way you are	0.4145			0.0150		
H1PF34	You feel like you are doing everything just about right	0.3502			−0.0371		
H1PF35	You feel socially accepted	0.4191			0.0408		
H1PF36	You feel wanted and loved	0.4903			0.1137		
H1PF18	You get as many facts about the problem as possible when you have problems to be solved		0.6300			0.2778	
H1PF19	You think of as many different ways to approach a problem as possible when you are attempting to find a solution		0.6700			0.3195	
H1PF20	You generally use a systematic method for judging and comparing alternatives when making decisions		0.6245			0.2741	
H1PF21	You usually try to analyze what went right and what went wrong after carrying out a solution to a problem		0.5680			0.2295	
S62B*	I feel close to people at school			0.7014			0.3543
S62E*	I feel like I am a part of this school			0.7175			0.3786
S62O*	I feel socially accepted			0.6245			0.2696

Note: These 13 items are selected by the Lexical approach and the exploratory factor analysis according to Young and Beaujean (2011). We conduct a factor analysis on these items and identify one main factor for each personality measure, which explains more than 90% of variation. We report the rotated factor loadings for each item and the regression coefficients for predicting factor scores (Thomson (1951)). ES: emotional stability; CO: conscientiousness; EX: extroversion. * denotes that data source is Wave I in-school survey.

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TABLE A.2. Peer effects on smoking dummy and frequency—SC-SAR models with just own latent variables.

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Endogenous effect						
	0.0676***			0.0727***		
	(0.0079)			(0.0079)		
Low-to-low (λ_{11})		0.0745***	0.0581***		0.1116***	0.0748***
		(0.0138)	(0.0161)		(0.0128)	(0.0172)
High-to-low (λ_{12})		0.0274	0.0510***		0.1105***	0.0717***
		(0.0188)	(0.0170)		(0.0206)	(0.0187)
Low-to-high (λ_{21})		0.0398**	0.0466**		0.0338	0.0765***
		(0.0173)	(0.0174)		(0.0182)	(0.0198)
High-to-high (λ_{22})		0.0373**	0.0486**		0.0474**	0.0670***
		(0.0172)	(0.0138)		(0.0186)	(0.0145)
Own and contextual effect	Yes	Yes	Yes	Yes	Yes	Yes
Group fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
σ_u^2	0.1446	0.1343	0.1360	3.7938	3.6015	3.6138

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model, but without latent contextual effects. The asterisks *** (**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). ES: emotional stability; CO: conscientiousness. In the heterogeneous peer effect case, "high" means personality trait score above school average, and "low" means personality trait score below the school average. A-to-B denotes the peer effect that B receives from A.

TABLE A.3. Peer effects on smoking–SC-SAR models with both endogenous networks and personality (specification based on equation (6)).

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Smoking						
Endogenous effect						
	0.0689***			0.0770***		
	(0.0086)			(0.0085)		
Low-to-low (λ_{11})		0.0720***	0.0482***		0.1041***	0.0771***
		(0.0154)	(0.0171)		(0.0126)	(0.0165)
High-to-low (λ_{12})		0.0214	0.0406***		0.0985***	0.0755***
		(0.0204)	(0.0172)		(0.0211)	(0.0186)
Low-to-high (λ_{21})		0.0389*	0.0439***		0.0200	0.0783***
		(0.0209)	(0.0185)		(0.0176)	(0.0199)
High-to-high (λ_{22})		0.0324	0.0394*		0.0367	0.0694***
		(0.0189)	(0.0145)		(0.0189)	(0.0142)
Own & contextual effects	Yes	Yes	Yes	Yes	Yes	Yes
σ_u^2	0.1406	0.1345	0.1346	3.6723	3.6178	3.6461
Emotional stability						
Maternal care	0.2505***	0.2459***	0.2478***	0.2425***	0.2432***	0.2424***
	(0.0130)	(0.0131)	(0.0131)	(0.0130)	(0.0129)	(0.0131)
Male	0.1840***	0.1803***	0.1822***	0.1787***	0.1797***	0.1816***
	(0.0141)	(0.0136)	(0.0139)	(0.0136)	(0.0138)	(0.0138)
Black	0.0839***	0.0877***	0.0884***	0.0894***	0.0877***	0.0883***
	(0.0230)	(0.0223)	(0.0233)	(0.0228)	(0.0228)	(0.0230)
Hisp	−0.0664**	−0.0651**	−0.0655**	−0.0616**	−0.0637**	−0.0629**
	(0.0261)	(0.0259)	(0.0260)	(0.0252)	(0.0261)	(0.0254)
Asian	−0.2047***	−0.2024***	−0.1994***	−0.2038***	−0.2103***	−0.2063***
	(0.0326)	(0.0345)	(0.0332)	(0.0343)	(0.0334)	(0.0330)
Other race	−0.0393	−0.0432	−0.0410	−0.0413	−0.0432	−0.0438
	(0.0308)	(0.0310)	(0.0304)	(0.0296)	(0.0303)	(0.0292)
σ_v^2	0.3591	0.3560	0.3574	0.2848	0.2887	0.2834

(*Continues*)

TABLE A.3. *Continued.*

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Conscientiousness						
Maternal care	0.1618***	0.1594***	0.1582***	0.1572***	0.1592***	0.1595***
	(0.0154)	(0.0161)	(0.0157)	(0.0151)	(0.0164)	(0.0154)
Male	0.0416**	0.0386**	0.0395**	0.0369**	0.0401**	0.0386**
	(0.0164)	(0.0165)	(0.0160)	(0.0167)	(0.0170)	(0.0165)
Black	0.0578**	0.0657**	0.0610**	0.0579**	0.0607**	0.0600**
	(0.0274)	(0.0276)	(0.0276)	(0.0269)	(0.0267)	(0.0285)
Hisp	−0.0600*	−0.0558*	−0.0595*	−0.0572*	−0.0573*	−0.0579*
	(0.0314)	(0.0315)	(0.0308)	(0.0315)	(0.0319)	(0.0318)
Asian	0.0465	0.0484	0.0495	0.0426	0.0399	0.0417
	(0.0394)	(0.0410)	(0.0399)	(0.0382)	(0.0399)	(0.0405)
Other race	−0.0296	−0.0293	−0.0301	−0.0319	−0.0304	−0.0315
	(0.0369)	(0.0370)	(0.0369)	(0.0364)	(0.0368)	(0.0357)
σ_v^2	0.5749	0.5574	0.5543	0.5361	0.5357	0.5303
Extraversion						
Maternal care	0.1813***	0.1779***	0.1775***	0.1737***	0.1757***	0.1755***
	(0.0160)	(0.0156)	(0.0158)	(0.0153)	(0.0154)	(0.0164)
Male	0.0689***	0.0653***	0.0676***	0.0630***	0.0636***	0.0659***
	(0.0166)	(0.0167)	(0.0168)	(0.0164)	(0.0164)	(0.0172)
Black	−0.1066***	−0.1041***	−0.1015***	−0.0966***	−0.1019***	−0.1008***
	(0.0275)	(0.0271)	(0.0286)	(0.0284)	(0.0283)	(0.0280)
Hisp	−0.0225	−0.0217	−0.0192	−0.0177	−0.0201	−0.0207
	(0.0309)	(0.0323)	(0.0312)	(0.0317)	(0.0321)	(0.0316)
Asian	−0.1592***	−0.1541***	−0.1512***	−0.1609***	−0.1600***	−0.1630***
	(0.0398)	(0.0400)	(0.0405)	(0.0401)	(0.0395)	(0.0400)
Other race	−0.1346***	−0.1360***	−0.1362***	−0.1371***	−0.1385***	−0.1396***
	(0.0373)	(0.0366)	(0.0358)	(0.0372)	(0.0370)	(0.0374)
σ_v^2	0.5491	0.5330	0.5282	0.5369	0.5287	0.5403

(*Continues*)

Table A.3. *Continued.*

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Link formation						
Constant	0.4312***	0.4476***	0.4521***	0.2410***	0.2227***	0.2061***
	(0.0821)	(0.0757)	(0.0863)	(0.0776)	(0.0745)	(0.0830)
Grade	2.7328***	2.7336***	2.7256***	2.6873***	2.6981***	2.6943***
	(0.0387)	(0.0359)	(0.0385)	(0.0409)	(0.0403)	(0.0380)
Sex	0.3625***	0.3662***	0.3636***	0.3539***	0.3615***	0.3656***
	(0.0329)	(0.0334)	(0.0337)	(0.0294)	(0.0328)	(0.0335)
Race	1.1036***	1.1133***	1.1231***	1.0862***	1.0798***	1.0811***
	(0.0381)	(0.0405)	(0.0404)	(0.0402)	(0.0371)	(0.0406)
Emotional stability	0.1828***	0.2051***	0.1981***	0.2993***	0.2806***	0.2946***
	(0.0340)	(0.0350)	(0.0363)	(0.0391)	(0.0380)	(0.0430)
Conscientiousness	0.0816***	0.1103***	0.1154***	0.0919***	0.0968***	0.1037***
	(0.0279)	(0.0274)	(0.0296)	(0.0249)	(0.0306)	(0.0310)
Extraversion	−0.0829***	−0.0567	−0.0482	−0.0902***	−0.0713***	−0.0990***
	(0.0318)	(0.0330)	(0.0331)	(0.0353)	(0.0342)	(0.0315)
δ_1	−4.2009***	−4.6450***	−4.5735***	−4.2852***	−4.3386***	−4.0161***
	(0.1764)	(0.2689)	(0.1547)	(0.1481)	(0.1741)	(0.1212)
δ_2	−2.9791***	−2.6994***	−2.7141***	−3.8084***	−3.6186***	−3.8034***
	(0.0865)	(0.0714)	(0.0569)	(0.1496)	(0.0896)	(0.1027)
δ_3	−2.5722***	−2.6704***	−2.6942***	−3.4240***	−3.5185***	−3.5899***
	(0.1128)	(0.0721)	(0.0552)	(0.1456)	(0.0823)	(0.1229)
δ_4	−2.5441***	−2.6318***	−2.6548***	−1.1625***	−1.1627***	−1.1524***
	(0.1144)	(0.0730)	(0.0616)	(0.0620)	(0.0678)	(0.1008)
AICM	191,220	195,390	181,760	246,490	246,310	265,590
se(AICM)	4470	5908	4908	8626	8615	7254

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model. The asterisks ***(**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). Group fixed effects are included in all equations for smoking and personalities. In equations for personalities, we also include *weak parent control*, *prof*, *home*, *other job* as explanatory variables but their coefficients are not significant and, therefore, not reported in this table. "High" means personality trait score above school average, and "low" means personality trait score below the school average.

TABLE A.4. Peer effects on smoking—SC-SAR models with both endogenous networks and personality (specification based on equation (7)).

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Smoking						
Endogenous effect						
	0.0514***			0.0767***		
	(0.0088)			(0.0084)		
Low-to-low (λ_{11})		0.0833***	0.0628***		0.1139***	0.0828***
		(0.0137)	(0.0165)		(0.0127)	(0.0166)
High-to-low (λ_{12})		0.0289	0.0535***		0.1064***	0.0813***
		(0.0196)	(0.0175)		(0.0203)	(0.0188)
Low-to-high (λ_{21})		0.0529***	0.0545***		0.0323	0.0838***
		(0.0181)	(0.0177)		(0.0188)	(0.0204)
High-to-high (λ_{22})		0.0450***	0.0520***		0.0490**	0.0721***
		(0.0178)	(0.0149)		(0.0186)	(0.0148)
σ_u^2	0.1381	0.1390	0.1389	3.6736	3.6923	3.6436
Emotional stability						
Endogenous effect						
	−0.0239*	−0.0251**	−0.0221*	−0.0334***	−0.0291**	−0.0233**
	(0.0128)	(0.0108)	(0.0118)	(0.0118)	(0.0122)	(0.0113)
σ_v^2	0.3076	0.3067	0.3111	0.3077	0.3080	0.3063
Conscientiousness						
Endogenous effect						
	−0.0135	−0.0077	−0.0071	−0.0045	−0.0097	−0.0058
	(0.0094)	(0.0095)	(0.0111)	(0.0096)	(0.0107)	(0.0110)
σ_v^2	0.5265	0.5320	0.5298	0.5332	0.5301	0.5303
Extraversion						
Endogenous effect						
	0.0315***	0.0286***	0.0330***	0.0277***	0.0273***	0.0290***
	(0.0092)	(0.0091)	(0.0088)	(0.0094)	(0.0100)	(0.0095)
σ_v^2	0.5038	0.5145	0.5006	0.5127	0.5080	0.5065
Link formation						
Constant	0.4892***	0.5058***	0.5099***	0.5223***	0.5173***	0.5005***
	(0.0776)	(0.0759)	(0.0708)	(0.0744)	(0.0772)	(0.0735)
Grade	2.7074***	2.7040***	2.7036***	2.7097***	2.7038***	2.6998***
	(0.0382)	(0.0369)	(0.0378)	(0.0396)	(0.0400)	(0.0393)
Sex	0.3510***	0.3541***	0.3540***	0.3508***	0.3524***	0.3517***
	(0.0322)	(0.0321)	(0.0326)	(0.0326)	(0.0325)	(0.0329)
Race	1.0909***	1.0923***	1.0901***	1.0939***	1.0938***	1.0841***
	(0.0419)	(0.0412)	(0.0413)	(0.0405)	(0.0411)	(0.0395)
δ_1	−4.0791***	−4.1871***	−4.0638***	−4.1444***	−4.0619***	−4.3541***
	(0.1539)	(0.1725)	(0.1951)	(0.1926)	(0.1446)	(0.2234)
δ_2	−3.8302***	−3.6956***	−3.7240***	−3.6624***	−3.8046***	−3.6862***
	(0.1244)	(0.1252)	(0.1147)	(0.1162)	(0.1136)	(0.1643)

(*Continues*)

TABLE A.4. *Continued.*

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
δ_3	−3.4747***	−3.5022***	−3.5276***	−3.4654***	−3.4848***	−3.4040***
	(0.1443)	(0.1338)	(0.1284)	(0.1327)	(0.1375)	(0.1300)
δ_4	−1.2659***	−1.2913***	−1.3238***	−1.3812***	−1.3263***	−1.2627***
	(0.0942)	(0.0813)	(0.0813)	(0.0871)	(0.0937)	(0.0766)
AICM	195,310	192,690	179,850	227,330	235,340	250,180
se(AICM)	4943	4768	3998	6974	5426	6335

Note: Group fixed effects are included in all equations. In the equations for personalities, we also include *weak parent control*, *prof*, *home*, *other job* as explanatory variables but their coefficients are not significant and, therefore, not reported. Rest as in Table A.3.

TABLE A.5. Peer effects on smoking dummy and frequency—SC-SAR model with endogenous networks and exogenous personalities stratified on basis of sample average.

	Smoke Dummy		Smoke Frequency	
	ES	CO	ES	CO
Endogenous effect				
Low-to-low (λ_{11})	0.0646***	0.0455***	0.1037***	0.0664***
	(0.0146)	(0.0177)	(0.0137)	(0.0157)
High-to-low (λ_{12})	0.0259	0.0361**	0.0973***	0.0530***
	(0.0189)	(0.0189)	(0.0214)	(0.0186)
Low-to-high (λ_{21})	0.0231	0.0414**	0.0235	0.0611***
	(0.0181)	(0.0184)	(0.0188)	(0.0190)
High-to-high (λ_{22})	0.0471***	0.0316**	0.0569***	0.0515***
	(0.0171)	(0.0161)	(0.0185)	(0.0145)
Own effect	Yes	Yes	Yes	Yes
Contextual effect	Yes	Yes	Yes	Yes
Group fixed effect	Yes	Yes	Yes	Yes
Endogenous network formation	Yes	Yes	Yes	Yes
σ_ε^2	0.1363	0.1362	3.7308	3.5820

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis. The asterisks *** (**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 50,000 iterations with the first 5000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). ES: emotional stability; CO: conscientiousness. In the heterogeneous peer effect case, A-to-B denotes the peer effect that B receives from A. "High" means personality trait score above overall sample average, and "low" means personality trait score below the overall sample average.

TABLE A.6. Peer effects on smoking—results on interactions between personality and peer effects.

	Smoke Dummy		Smoke Frequency	
	ES	CO	ES	CO
Endogenous effect				
λ_1	−0.0168*	−0.0099	−0.0524***	−0.0170
	(0.0101)	(0.0094)	(0.0114)	(0.0101)
λ_2	−0.0261**	−0.0069	−0.0204	−0.0074
	(0.0133)	(0.0123)	(0.0135)	(0.0116)
λ_3	0.0255**	0.0147	0.0169	0.0281***
	(0.0129)	(0.0105)	(0.0141)	(0.0104)
Own & contextual effects	Yes	Yes	Yes	Yes
Endogenous link formation	Yes	Yes	Yes	Yes
Group fixed effects	Yes	Yes	Yes	Yes
σ_u^2	0.1298	0.1335	3.7602	3.5071

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model. The asterisks *** (**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). λ_1, λ_2, and λ_3 correspond to the coefficients in equation (8).

TABLE A.7. Peer effects on smoking dummy and frequency—row-normalized SC-SAR models.

	Smoke Dummy			Smoke Frequency		
	Homogeneous	ES	CO	Homogeneous	ES	CO
Endogenous effect						
	0.0806***			0.1890***		
	(0.0178)			(0.0161)		
Low-to-low (λ_{11})		0.0912***	0.0844***		0.1569***	0.1416***
		(0.0214)	(0.0240)		(0.0200)	(0.0233)
High-to-low (λ_{12})		0.0437*	0.0553*		0.1773***	0.1376***
		(0.0268)	(0.0278)		(0.0274)	(0.0281)
Low-to-high (λ_{21})		0.0423*	0.0602**		0.0770***	0.1517***
		(0.0264)	(0.0251)		(0.0271)	(0.0266)
High-to-high (λ_{22})		0.0415	0.0504**		0.0699**	0.1219***
		(0.0267)	(0.0220)		(0.0282)	(0.0221)
Own and contextual effect	Yes	Yes	Yes	Yes	Yes	Yes
Endogenous link formation	Yes	Yes	Yes	Yes	Yes	Yes
Group fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
σ_ε^2	0.1348	0.1332	0.1340	3.8388	3.5684	3.5682

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis. The asterisks *** (**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 50,000 iterations with the first 5000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). ES: emotional stability; CO: conscientiousness. In the heterogeneous peer effect case, "high" means personality trait score above school average, and "low" means personality trait score below the school average. A-to-B denotes the peer effect that B receives from A.

TABLE A.8. Descriptive statistics for add health in-home saturated sample, in-home subsample, and in-school sample.

	Saturated Sample		In-home Subsample		In-school Sample	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Smoke dummy	0.1915	0.3938	0.1891	0.3916	0.1761	0.3809
Smoke frequency	0.8518	2.1571	0.7368	1.9671	0.6700	1.8870
Emotional stability	0.0968	0.6560	0.0456	0.6974	0.0723	0.6904
Extraversion	0.1702	0.8171	0.0905	0.8373	0.0802	0.8312
Male	0.4539	0.4982	0.4561	0.4981	0.4783	0.4995
Black	0.1277	0.3339	0.2601	0.4388	0.2251	0.4177
Hisp	0.0426	0.2020	0.0994	0.2993	0.1163	0.3206
Asian	0.0128	0.1123	0.0403	0.1967	0.0406	0.1974
Other race	0.0610	0.2395	0.0618	0.2407	0.0664	0.2490
Prof	0.2496	0.4331	0.2594	0.4384	0.2454	0.4303
Home	0.1106	0.3139	0.1476	0.3547	0.2046	0.4034
Nonprof	0.4766	0.4998	0.4249	0.4944	0.3405	0.4739
Conscientiousness	−0.0593	0.8704	−0.0528	0.8522		
Smoke parent	0.6199	0.4858	0.6397	0.4801		
School taught	0.8993	0.3012	0.9275	0.2593		
Low parent control	0.6965	0.2184	0.7014	0.2217		
Maternal care	4.5511	0.4993	4.5613	0.5233		
Number of networks	13		74		74	
Sample size	705		4194		19,140	

Table A.9. Peer effects on smoking—comparison of results from add health in-home saturated sample, in-home subsample, and in-school sample.

	In-Home Saturated Sample		In-Home Subsample		In-Home Sub-Sample With Fewer Regressors		In-School Sample	
	Dummy	Frequency	Dummy	Frequency	Dummy	Frequency	Dummy	Frequency
Endogenous (moderated by ES)								
Low-to-low (λ_{11})	0.0923***	0.0856***	0.0881***	0.0875***	0.0900***	0.0962***	0.0975***	0.1053***
	(0.0267)	(0.0259)	(0.0226)	(0.0181)	(0.0218)	(0.0179)	(0.0052)	(0.0051)
High-to-low (λ_{12})	−0.0525	0.0082	0.0211	0.0492**	0.0332	0.0724***	0.0535***	0.0974***
	(0.0392)	(0.0432)	(0.0235)	(0.0244)	(0.0253)	(0.0260)	(0.0063)	(0.0062)
Low-to-high (λ_{21})	−0.0048	−0.0236	0.0073	−0.0510**	0.0127	−0.0314	0.0793***	0.0684***
	(0.0361)	(0.0347)	(0.0242)	(0.0213)	(0.0230)	(0.0216)	(0.0059)	(0.0069)
High-to-high (λ_{22})	0.0196	−0.0357	0.0308*	0.0558***	0.0438**	0.0742***	0.0580***	0.0703***
	(0.0371)	(0.0379)	(0.0194)	(0.0186)	(0.0191)	(0.0193)	(0.0051)	(0.0053)
Own & contextual effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Endogenous link formation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Group fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
σ_u^2	0.0996	2.9963	0.1255	3.1375	0.1262	3.2737	0.1245	2.9067

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model. The asterisks *** (**,*) indicates that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). ES: emotional stability. "High" means personality trait score above school average, and "low" means personality trait score below the school average. A-to-B denotes the peer effect that B receives from A. The In-home saturated sample contains 13 schools and 705 students. The In-home subsample contain 74 schools and 4194 students. The In-school sample contains 74 schools and 19,140 students. Regressors *conscientiousness, parent smoke, low parent control, maternal care, school taught* are excluded in the In-home subsample with fewer regressors in order to match the regressors used in the In-school sample.

Table A.10. Placebo test for examining peer effects on father's education.

	SAR Model			SCSAR Model				
				SCSAR(1)	SCSAR(2)	SCSAR(3)	SCSAR(4)	SCSAR(5)
Endogenous effect								
	0.0419***	0.0187***	0.0160**	0.0160**	0.0152**	0.0139*	0.0118	0.0046
	(0.0069)	(0.0047)	(0.0073)	(0.0073)	(0.0074)	(0.0074)	(0.0075)	(0.0090)
Own effect								
Low parent control	−0.0180	−0.0243	−0.0229	−0.0227	−0.0241	−0.0232	−0.0227	−0.0230
	(0.0153)	(0.0169)	(0.0170)	(0.0170)	(0.0167)	(0.0169)	(0.0167)	(0.0167)
Maternal care	0.0117***	0.0300*	0.0299***	0.0300***	0.0293***	0.0292***	0.0295***	0.0291***
	(0.0031)	(0.0067)	(0.0068)	(0.0065)	(0.0069)	(0.0067)	(0.0067)	(0.0068)
Male	0.0178***	0.0211***	0.0205***	0.0206***	0.0206***	0.0204***	0.0204***	0.0202***
	(0.0073)	(0.0071)	(0.0073)	(0.0073)	(0.0074)	(0.0073)	(0.0072)	(0.0072)
Black	−0.0816***	−0.0621***	−0.0596***	−0.0591***	−0.0600***	−0.0597***	−0.0597***	−0.0599***
	(0.0102)	(0.0116)	(0.0121)	(0.0121)	(0.0123)	(0.0120)	(0.0124)	(0.0121)
Hisp	−0.0937***	−0.0947***	−0.0915***	−0.0908***	−0.0911***	−0.0914***	−0.0912***	−0.0916***
	(0.0122)	(0.0135)	(0.0135)	(0.0137)	(0.0135)	(0.0136)	(0.0134)	(0.0134)
Asian	0.0199	0.0209	0.0176	0.0184	0.0177	0.0169	0.0177	0.0171
	(0.0158)	(0.0170)	(0.0174)	(0.0176)	(0.0175)	(0.0175)	(0.0172)	(0.0174)
Other race	−0.0373**	−0.0385**	−0.0364**	−0.0361**	−0.0374**	−0.0363**	−0.0372**	−0.0360**
	(0.0160)	(0.0160)	(0.0162)	(0.0160)	(0.0166)	(0.0162)	(0.0159)	(0.0163)
Prof	0.6090***	0.5854***	0.5846***	0.5846***	0.5839***	0.5844***	0.5848***	0.5839***
	(0.0110)	(0.0112)	(0.0112)	(0.0110)	(0.0112)	(0.0110)	(0.0113)	(0.0114)
Home	0.1786***	0.1955***	0.1965***	0.1959***	0.1954***	0.1960***	0.1955***	0.1964***
	(0.0205)	(0.0206)	(0.0205)	(0.0207)	(0.0209)	(0.0204)	(0.0208)	(0.0207)
Nonprof	0.2791***	0.2820***	0.2825***	0.2824***	0.2823***	0.2829***	0.2827***	0.2823***
	(0.0081)	(0.0083)	(0.0082)	(0.0082)	(0.0081)	(0.0082)	(0.0083)	(0.0081)
Mom edu	0.2419***	0.2211***	0.2207***	0.2205***	0.2209***	0.2208***	0.2198***	0.2194***
	(0.0076)	(0.0077)	(0.0077)	(0.0078)	(0.0076)	(0.0076)	(0.0076)	(0.0078)
σ_ε^2	0.1446	0.1413	0.1412	0.1412	0.1408	0.1409	0.1402	0.1367
Contextual effect	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Group fixed effect	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis. The asterisks *** (**,*) indicate that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 50,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992).

TABLE A.11. Checking exclusion restrictions from the outcome equation.

	Smoke Dummy	Smoke Frequency
	Homogeneous	Homogeneous
Endogenous effect		
	0.0381***	0.0738***
	(0.0099)	(0.0086)
Total same grade friends	−0.0025	−0.0195
	(0.0084)	(0.0427)
Total same sex friends	0.0051	−0.0463
	(0.0117)	(0.0609)
Total same race friends	−0.0135	−0.0670
	(0.0087)	(0.0494)
Aggre. diff. in ES	0.0084	−0.0055
	(0.0059)	(0.0292)
Aggre. diff. in CO	−0.0004	0.0165
	(0.0045)	(0.0237)
Aggre. diff. in EX	−0.0021	−0.0064
	(0.0054)	(0.0273)
Own and contextual effect	Yes	Yes
Group fixed effect	Yes	Yes
σ_u^2	0.1363	3.6811
Link formation		
Constant	1.0096***	1.0105***
	(0.0824)	(0.0778)
Grade	2.7420***	2.7504***
	(0.0388)	(0.0394)
Sex	0.3536***	0.3591***
	(0.0338)	(0.0333)
Race	1.1018***	1.1129***
	(0.0409)	(0.0414)
Emotional stability	−0.0575*	−0.0692**
	(0.0281)	(0.0290)
Conscientiousness	−0.0413*	−0.0391
	(0.0264)	(0.0261)
Extraversion	−0.2656***	−0.2596***
	(0.0270)	(0.0272)
δ_1	−3.4306***	−3.3037***
	(0.1175)	(0.0885)
δ_2	−3.2416***	−3.1881***
	(0.1041)	(0.0730)
δ_3	−2.9825***	−3.0489***
	(0.1000)	(0.0737)
δ_4	−2.8250***	−2.9375***
	(0.1017)	(0.0853)

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model. The asterisks *** (**,*) indicate that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992).

TABLE A.12. Peer effects: results on the alternative definition of smoking dummy and the drunk dummy.

	Homogeneous		ES		CO	
	Smoke	Drunk	Smoke	Drunk	Smoke	Drunk
Endogenous effect						
	0.0471***	0.0409***				
	(0.0095)	(0.0136)				
Low-to-low (λ_{11})			0.0832***	0.0553***	0.0430***	0.0556***
			(0.0138)	(0.0167)	(0.0165)	(0.0181)
High-to-low (λ_{12})			0.0353*	0.0254	0.0537***	0.0486***
			(0.0197)	(0.0183)	(0.0185)	(0.0180)
Low-to-high (λ_{21})			0.0575***	0.0421**	0.0502***	0.0269
			(0.0183)	(0.0185)	(0.0182)	(0.0187)
High-to-high (λ_{22})			0.0263	0.0291	0.0492***	0.0516***
			(0.0181)	(0.0179)	(0.0148)	(0.0152)
Own effect						
Emotional stability	−0.0243***	−0.0343***	−0.0219***	−0.0327***	−0.0241***	−0.0336***
	(0.0059)	(0.0070)	(0.0063)	(0.0073)	(0.0060)	(0.0070)
Conscientiousness	−0.0135*	−0.0139*	−0.0140*	−0.0137*	−0.0141*	−0.0122*
	(0.0049)	(0.0057)	(0.0049)	(0.0057)	(0.0049)	(0.0059)
Extraversion	−0.0470***	−0.0248***	−0.0469***	−0.0252***	−0.0467***	−0.0249***
	(0.0049)	(0.0056)	(0.0048)	(0.0058)	(0.0049)	(0.0057)
Other own & contextual effects	Yes	Yes	Yes	Yes	Yes	Yes
Endogenous link formation	Yes	Yes	Yes	Yes	Yes	Yes
Group fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
σ_u^2	0.1217	0.1568	0.1225	0.1568	0.1220	0.1581

Note: We report the posterior mean of each parameter and the standard deviation in the parenthesis based on the SC-SAR(4) model. The asterisks ***(**,*) indicate that its 99% (95%, 90%) highest posterior density range does not cover zero. The MCMC sampling is running for 250,000 iterations with the first 100,000 iterations dropped for burn-in. All cases pass the convergence diagnostics provided by Geweke (1992) and Raftery and Lewis (1992). The alternative smoke dummy indicates whether student smoked at least once or twice a week over the past year. The drunk dummy indicates whether student has been drunk over the past year. In the heterogeneous peer effect case, "high" means personality trait score above school average, and "low" means personality trait score below the school average. A-to-B denotes the peer effect that B receives from A.

APPENDIX B: IDENTIFICATION OF THE EXTENDED SC-SAR MODEL

In this appendix, we will discuss and justify the parametric assumptions on the individual latent variables $z_{i,g}$ that we impose when estimating the extended SC-SAR model. Apart from the model specifications of the link formation in equation (4) and the outcome in equation (5), we need the following assumptions: (1) the variance of $z_{i,g}$ is normalized to one; (2) if $z_{i,g}$ is multidimensional, different dimensions should be independent of each other; (3) $z_{i,g}$ follows a known distribution, which is assumed to be normal; (4) the magnitude of the homophily coefficients of $z_{i,g}$ in equation (4) follow a descending order, that is, $|\eta_1| \geq |\eta_2| \geq \cdots \geq |\eta_{\bar{d}}|$.

Let us start with the least amount of parametric assumptions. Assume in the link formation of equation (4), we only have the specification of $\psi_{ij,g}$ and no distributional assumption on the error term. This link formation equation, which is similar to a standard dichotomous choice model, can be motivated from the behavior of utility maximization. For each individual i, he/she chooses $w_{ij,g} = 1$ if $v_{ij,g}(w_{ij,g} = 1) - v_{ij,g}(w_{ij,g} = 0) > 0$ and $w_{ij,g} = 0$ otherwise, where $v_{ij,g}$ stands for i's utility function from the link ij. We can express the above utility difference as

$$v_{ij,g}(w_{ij,g} = 1) - v_{ij,g}(w_{ij,g} = 0) = \mu_{ij,g}(C_g, S_g, \gamma) + \xi_{ij,g}(Z_g, \eta), \tag{B.1}$$

where the deterministic component $\mu_{ij,g}(C_g, S_g, \gamma)$ contains $c_{ij,g}\gamma_0 + \sum_{r=1}^{R} \gamma_r |s_{ir,g} - s_{jr,g}|$, the observed exogenous dyad-specific variables $c_{ij,g}$ and personalities $s_{ir,g}$. The error component $\xi_{ij,g}(Z_g, \eta)$ contains $\sum_{d=1}^{\bar{d}} \eta_d |z_{id,g} - z_{jd,g}|$ to capture homophily on basis of the latent variables $z_{i,g}$, and $\zeta_{ij,g}$ as a pure i.i.d. disturbance.

By the semiparametric identification results in Ichimura (1993), the dichotomous choice model for the network link implies the following single index equation:

$$\mathrm{E}(w_{ij,g}|C_g, S_g) = P(w_{ij,g} = 1|C_g, S_g) = 1 - F_{\xi_{ij,g}}(-\mu_{ij,g}), \tag{B.2}$$

where $F_{\xi_{ij,g}}(\cdot)$ is the unknown (nonparametric) distribution function of $\xi_{ij,g}$. The identification results in Ichimura (1993) show that the parameters in the linear index $\mu_{ij,g}$ are identified up to a scale and, therefore, a normalization on one parameter is needed.[1] As the index function is identified, the distribution function $F_{\xi_{ij,g}}$ can also be identified (estimated) from the data by a nonparametric kernel regression with the index $\mu_{ij,g}$ as the regressor. Since the disturbances are continuously distributed, by assuming that $\mu_{ij,g}$ can take on values which cover the support of the probability density $f_{\xi_{ij,g}}$, the moments of $\xi_{ij,g}$ can also be estimated from the data.

We can study the identification constraints on the coefficients η_d, $d = 1, \ldots, \bar{d}$ from the central moments of $\xi_{ij,g}$. We temporarily suppress the group subscript in the following discussion for simplicity. First, we consider a case where Z is one dimensional, that is, $\xi_{ij}(Z, \eta) = \eta_1|z_{i1} - z_{j1}| + \zeta_{ij}$. The variance of ξ_{ij} equals $\eta_1^2 \,\mathrm{Var}(|z_{i1} - z_{j1}|) + \sigma_\zeta^2$, where σ_ζ^2 is the variance of ζ_{ij}. The variance σ_ζ^2 is typically normalized to one because of the arbitrary scaling problem in discrete choice models. However, in order to identify η_1, we also need to normalize the variance of unobservable Z to one so that $\mathrm{Var}(|z_{11} - z_{21}|)$ is a known value. This normalization is required for every dimension of Z that we consider.

Next, we consider the case where Z has two dimensions, that is, $\xi_{ij}(Z, \eta) = \eta_1|z_{i1} - z_{j1}| + \eta_2|z_{i2} - z_{j2}| + \zeta_{ij}$. The variance of ξ_{ij} equals $(\eta_1^2 + \eta_2^2)\,\mathrm{Var}(|z_{i1} - z_{j1}|) + \sigma_\zeta^2$. When Z is multidimensional, we need an independence assumption between its different dimensions; otherwise, unknown correlations between the different dimensions will make our attempt to identify the coefficients η_d from the central moments of ξ_{ij} impossible. However, even with an independence across dimensions of Z, we still cannot separately identify η_1 and η_2 from $\mathrm{Var}(\xi_{ij})$. Thus, we need to check other identification conditions from higher order central moments of ξ_{ij}.

From the third-order central moment, we can obtain the value of $(\eta_1^3 + \eta_2^3)t + \mathrm{E}[(\zeta_{ij} - \mathrm{E}(\zeta_{ij}))^3]$, where $t = \mathrm{E}[(|z_{i1} - z_{j1}| - \mathrm{E}(|z_{i1} - z_{j1}|))^3]$. To identify η_1 and η_2, we need to know

[1]With a parametric assumption on $\xi_{ij,g}$, this normalization is not needed.

the values of t and $\mathrm{E}[(\zeta_{ij} - \mathrm{E}(\zeta_{ij}))^3]$. Thus, we should assume the unobservable Z comes from a known distribution, for example, a normal distribution, and ζ_{ij} comes from a known distribution, for example, a logistic distribution. So far from the second- and the third-order central moments, we obtain two polynomial equations involving η_1 and η_2; however, they are still not sufficient to pin down η_1 and η_2. More polynomial equations on η_1 and η_2 can be developed from the fourth and higher order central moments of ξ_{ij}. Eventually, the system of these polynomial equations can be used to solve for the values of η_1 and η_2. The only remaining problem is that the values of η_1 and η_2 can be arbitrarily switched. To avoid this problem, we require $|\eta_1| \geq |\eta_2|$. When Z has $\bar{d}$ dimensions, we will then require $|\eta_1| \geq |\eta_2| \geq \cdots \geq |\eta_{\bar{d}}|$. The implication of this constraint is that z_{i1} ($z_{i\bar{d}}$) represents the dimension of Z which has the greatest (smallest) influence on friendship formation. Using the same strategy, we can identify the coefficients η_d for Z in three or higher dimensions.

We next discuss the identification of the outcome interactions in equation (5). First, the group fixed effect in the extended SC-SAR model can be eliminated by a difference approach. The variables Y_g, $W_g Y_g$, X_g, $W_g X_g$, Z_g, $W_g Z_g$, and u_g are transformed to $Y_g^* = T_g Y_g$, $(W_{pq,g} Y_g)^* = T_g(W_{pq,g} Y_g)$, $X_g^* = T_g X_g$, $(W_g X_g)^* = T_g(W_g X_g)$, $Z_g^* = T_g Z_g$, $(W_g Z_g)^* = T_g(W_g Z_g)$, and $u_g^* = T_g u_g$, where T_g is a $(m_g - 1) \times m_g$ matrix

$$T_g = \begin{pmatrix} -1 & 1 & & & \\ & -1 & 1 & & \\ & & -1 & 1 & \\ & & & \ddots & \ddots \end{pmatrix}.$$

After transformation, we obtain

$$\begin{aligned} Y_g^* = {} & \lambda_{11}(W_{11,g} Y_g)^* + \cdots + \lambda_{22}(W_{22,g} Y_g)^* + X_g^* \beta_1 + (W_g X_g)^* \beta_2 \\ & + Z_g^* \delta_1 + (W_g Z_g)^* \delta_2 + u_g^*, \quad g = 1, \ldots, G. \end{aligned} \tag{B.3}$$

Taking the expectation of equation (B.3) conditional on W_g, we have

$$\begin{aligned} \mathrm{E}\big(Y_g^* | W_g\big) = {} & \lambda_{11} \mathrm{E}\big((W_{11,g} Y_g)^* | W_g\big) + \cdots + \lambda_{22} \mathrm{E}\big((W_{22,g} Y_g)^* | W_g\big) + \mathrm{E}\big(X_g^* | W_g\big) \beta_1 \\ & + \mathrm{E}\big((W_g X_g)^* | W_g\big) \beta_2 + \mathrm{E}\big(Z_g^* | W_g\big) \delta_1 + \mathrm{E}\big((W_g Z_g)^* | W_g\big) \delta_2, \end{aligned} \tag{B.4}$$

for $g = 1, \ldots, G$. Note that all terms in expectation in equation (B.4) can be identified from the data. In particular, we can identify $\mathrm{E}(Z_g^* | W_g) = \int_z Z_g^* P(Z_g | W_g)\, dZ_g = \int_z Z_g^* \frac{P(Z_g) P(W_g | Z_g)}{P(W_g)}\, dZ_g$ given that the parameters in $P(W_g | Z_g)$ are identified (estimated) from the link formation model. Similarly, we can identify $\mathrm{E}((W_g Z_g)^* | W_g) = \int_z (W_g Z_g)^* \times P(Z_g | W_g)\, dZ_g$.

Let $\mathbb{T} = [\mathrm{E}((W_{11} Y)^* | W), \ldots, \mathrm{E}((W_{22} Y)^* | W), \mathrm{E}(X^* | W), \mathrm{E}((WX)^* | W), \mathrm{E}(Z^* | W), \mathrm{E}((WZ)^* | W)]$ without the subscript g denote observations stacked across groups. The condition that $\mathbb{T}' \mathbb{T}$ has a full column rank will identify the parameters in equation (B.4).

Appendix C: Estimation details of the SC-SAR model

We estimate the unknown parameters in the extended SC-SAR model in equation (5) of the main text through the joint likelihood function of Y_g and W_g, which is given by

$$P(Y_g, W_g | X_g, S_g, C_g, \theta, \alpha_g) = \int_{Z_g} P(Y_g | W_g, X_g, S_g, Z_g, \theta, \alpha_g) \cdot P(W_g | C_g, S_g, Z_g, \theta) \cdot f(Z_g | \mu_{z,g})\, dZ_g, \tag{C.1}$$

where $\theta = (\gamma', \eta', \lambda', \beta', \delta', \sigma_u^2)$. Notice that in the link formation of equation (4), each network link is assumed to be independent conditioning on the observed variables C_g, S_g, and the latent variables Z_g. Therefore, the likelihood function of the network in equation (C.1) can be simplified as

$$P(W_g | C_g, S_g, Z_g, \theta) = \prod_{i}^{m_g} \prod_{j \neq i}^{m_g} P(w_{ij,g} | C_g, S_g, Z_g, \theta). \tag{C.2}$$

With the likelihood function of equation (C.1), we use a Bayesian estimation approach. There are two reasons why we choose the Bayesian approach instead of the classical approach. First, we require some identification constraints on the parameters of the SC-SAR model in the presence of latent variables (see discussion in Appendix B), which generally increases the difficulty of a classical numerical optimization. Using a Bayesian MCMC rejection sampling method such as the Metropolis–Hastings algorithm, the draws that violate the constraint will be easily recognized and rejected. Second, the Bayesian MCMC is effective in handling estimation of models with latent variables (Zeger and Karim (1991), Hoff, Raftery, and Handcock (2002), Handcock, Raftery, and Tantrum (2007)). During the posterior simulation, the unobserved correlated effects of the SC-SAR model, including latent variables $\{Z_g\}_{g=1}^G$, their prior means, $\{\mu_{z,g}\}_{g=1}^G$, and groups fixed effects $\{\alpha_g\}_{g=1}^G$, are simulated from the conditional posterior distributions along with the other model parameters to simplify the evaluation of the likelihood function.

We specify the prior distributions of θ, unobserved characteristics $\{z_{i,g}\}$, and group effects $\{\alpha_g\}$ as follows:

$$z_{i,g} \sim \mathcal{N}_{\bar{d}}(\mu_{z,g}, I_{\bar{d}}), \quad i = 1, \ldots, m_g; g = 1, \ldots, G, \tag{C.3}$$

$$\mu_{z,g} \sim \mathcal{N}_{\bar{d}}\big(0, \xi^2 I_{\bar{d}}\big), \quad g = 1, \ldots, G, \tag{C.4}$$

$$\omega = \big(\gamma', \eta'\big) \sim \mathcal{N}_{\bar{q}+R+\bar{d}}(\omega_0, \Omega_0) \quad \text{on the support } O_1, \tag{C.5}$$

$$\lambda = (\lambda_{11}, \lambda_{12}, \lambda_{21}, \lambda_{22}) \sim U_4(O_2), \tag{C.6}$$

$$\beta = \big(\beta_1', \beta_2'\big) \sim \mathcal{N}_{2k}(\beta_0, B_0), \tag{C.7}$$

$$\sigma_u^2 \sim \mathcal{IG}\left(\frac{\kappa_0}{2}, \frac{\nu_0}{2}\right), \tag{C.8}$$

$$\delta = (\delta_1', \delta_2') \sim \mathcal{N}_{2\bar{d}}(\delta_0, \Delta_0), \tag{C.9}$$

$$\alpha_g \sim \mathcal{N}(\alpha_0, A_0), \quad g = 1, \dots, G, \tag{C.10}$$

where $\mathcal{IG}$ represents an inverse Gamma distribution. The coefficients γ and η in the function $\psi_{ij,g}$ of equation (4) are grouped into ω with the support on O_1 where the identification constraint $|\eta_1| \geq |\eta_2| \geq \cdots \geq |\eta_{\bar{d}}|$ is held. For the endogenous effect λ, we employ a multivariate uniform distribution with a restricted parameter space O_2.[2] The other priors are the commonly used conjugate (uninformative) priors in the Bayesian literature. We choose hyperparameters $\xi^2 = 2$, $\omega_0 = 0$, $\Omega_0 = 100$, $\beta_0 = 0$, $B_0 = 100$, $\kappa_0 = 2.2$, $\nu_0 = 0.1$, $\delta_0 = 0$, $\Delta_0 = 100$, $\alpha_0 = 0$, $A_0 = 100$ to ensure that the prior densities are relatively flat over the range of the data.

Here, we list the set of derived conditional posterior distributions that serve as input to the Gibbs sampler:

(i-1) $P(z_{i,g}|Y_g, W_g, \theta, \alpha_g, Z_{-i,g})$, $i = 1, \dots, m_g$, $g = 1, \dots, G$.
By applying Bayes' theorem,

$$P(z_{i,g}|Y_g, W_g, \theta, \alpha_g, Z_{-i,g}) \propto \phi_{\bar{d}}(z_{i,g}; \mu_{z,g}, I_{\bar{d}}) \cdot P(Y_g, W_g|\theta, \alpha_g, Z_g), \tag{C.11}$$

where $\phi_{\bar{d}}(\cdot; \nu_{z,g}, I_{\bar{d}})$ is the multivariate normal density function. We simulate $z_{i,g}$ from $P(z_{i,g}|Y_g, W_g, \theta, \alpha_g, Z_{-i,g})$ using the Metropolis–Hastings (M-H) algorithm.

(i-2) $P(\mu_{z,g}|Y_g, W_g, \theta, \alpha_g, Z_g)$, $g = 1, \dots, G$.
By applying Bayes' theorem,

$$P(\mu_{z,g}|Y_g, W_g, \theta, \alpha_g, Z_g) \propto \mathcal{N}_{\bar{d}}\left(\frac{m_g \bar{Z}_g}{m_g + 1/\xi^2}, \frac{1}{m_g + 1/\xi^2}\right), \tag{C.12}$$

where $\bar{Z}_g = \frac{1}{m_g}\sum_{i=1}^{m_g} z_{i,g}$.

(ii) $P(\omega|\{W_g\}, \{Z_g\})$.
By applying Bayes' theorem, we have

$$P(\omega|\{W_g\}, \{Z_g\}) \propto \phi_{\bar{q}+R+\bar{d}}(\omega; \omega_0, \Omega_0) \cdot \prod_{g=1}^{G} P(W_g|Z_g, \phi) \cdot I(\omega \in O_1), \tag{C.13}$$

where $I(A)$ is an indicator function with $I(A) = 1$ if A is true and zero otherwise. We simulate ω from $P(\omega|\{W_g\}, \{Z_g\})$ using the M-H algorithm.

[2] The restricted parameter space O_2 reflects the stationarity condition required by the outcome equation of the SC-SAR model, which is the matrix $S_g = I_{m_g} - \lambda_{11} W_{11,g} - \cdots - \lambda_{22} W_{22,g}$, $g = 1, \dots, G$, is invertible, that is, $\det(S_g) > 0$, $g = 1, \dots, G$, where $\det(\cdot)$ stands for the determinant. With an invertible S_g, the outcome vector Y_g is guaranteed not to explode. Due to the restriction imposed on the support of prior distributions, we reject Metropolis–Hastings candidate values of λ which violate this stationarity condition during the posterior simulation.

(iii) $P(\lambda|\{Y_g\},\{W_g\},\beta,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\})$.

By applying Bayes' theorem, we have

$$P\big(\lambda|\{Y_g\},\{W_g\},\beta,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\}\big) \propto \prod_{g=1}^{G} P\big(Y_g|W_g,\lambda,\beta,\sigma_u^2,\delta,\alpha_g,Z_g\big)\cdot I(\lambda\in O_2). \tag{C.14}$$

We simulate λ from $P(\lambda|\{Y_g\},\{W_g\},\beta,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\})$ using the M-H algorithm.

(iv) $P(\beta|\{Y_g\},\{W_g\},\lambda,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\})$.

By applying Bayes' theorem, we have

$$P\big(\beta|\{Y_g\},\{W_g\},\lambda,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\}\big) \propto \phi_{2k}(\beta;\beta_0,B_0)\cdot\prod_{g=1}^{G} P\big(Y_g|W_g,\lambda,\beta,\sigma_u^2,\delta,\alpha_g,Z_g\big).$$

Since both $\phi_{2k}(\beta;\beta_0,B_0)$ and $P(Y_g|W_g,\lambda,\beta,\sigma_u^2,\delta,\alpha_g,Z_g)$ are normal density functions, we simplify the expression to

$$\begin{aligned} &P\big(\beta|\{Y_g\},\{W_g\},\lambda,\sigma_u^2,\delta,\{\alpha_g\},\{Z_g\}\big)\propto \mathcal{N}_{2k}(\beta;\hat\beta,\mathbf{B}),\\ &\hat\beta=\mathbf{B}\left(B_0^{-1}\beta_0+\sum_{g=1}^{G}\mathbf{X}_g'\big(\sigma_u^2I_{m_g}\big)^{-1}(S_gY_g-\mathbf{Z}_g\delta-l_g\alpha_g)\right),\\ &\mathbf{B}=\left(B_0^{-1}+\sum_{g=1}^{G}\mathbf{X}_g'\big(\sigma_u^2I_{m_g}\big)^{-1}\mathbf{X}_g\right)^{-1}, \end{aligned} \tag{C.15}$$

where $\mathbf{X}_g=(X_g,W_gX_g)$, $\mathbf{Z}_g=(Z_g,W_gZ_g)$, and $S_g=(I_{m_g}-\lambda_{11}W_{11,g}-\cdots-\lambda_{22}W_{22,g})$.

(v) $P(\sigma_u^2|\{Y_g\},\{W_g\},\lambda,\beta,\delta,\{\alpha_g\},\{Z_g\})$.

By applying Bayes' theorem, we have

$$\begin{aligned} &P\big(\sigma_u^2|\{Y_g\},\{W_g\},\lambda,\beta,\delta,\{\alpha_g\},\{Z_g\}\big)\\ &\quad\propto \mathcal{IG}\left(\sigma_u^2;\frac{\kappa_0}{2},\frac{\nu_0}{2}\right)\prod_{g=1}^{G}P\big(Y_g|W_g,\lambda,\beta,\sigma_u^2,\delta,\alpha_g,Z_g\big)\\ &\quad\propto \mathcal{IG}\left(\sigma_u^2;\frac{\kappa_0+\sum_{g=1}^{G}m_g}{2},\frac{\nu_0+\sum_{g=1}^{G}u_g'u_g}{2}\right), \end{aligned} \tag{C.16}$$

where $u_g=S_gY_g-\mathbf{X}_g\beta-\mathbf{Z}_g\delta-l_g\alpha_g$.

(vi) $P(\delta|\{Y_g\}, \{W_g\}, \lambda, \beta, \sigma_u^2, \{\alpha_g\}, \{Z_g\})$.

By applying Bayes' theorem, we have

$$P\big(\delta|\{Y_g\}, \{W_g\}, \lambda, \beta, \sigma_u^2, \{\alpha_g\}, \{Z_g\}\big) \propto \mathcal{N}_{2\bar{d}}(\delta; \delta_0, \Delta_0) \prod_{g=1}^{G} P\big(Y_g|W_g, \lambda, \beta, \sigma_u^2, \delta, \alpha_g, Z_g\big). \tag{C.17}$$

Similar to (v), we can further obtain

$$\begin{aligned} &P\big(\delta|\{Y_g\}, \{W_g\}, \lambda, \beta, \sigma_u^2, \{\alpha_g\}, \{Z_g\}\big) \propto \phi_{2\bar{d}}(\delta; \hat{\delta}, \mathbf{D}), \\ &\hat{\delta} = \mathbf{D}\left(\Delta_0^{-1}\delta_0 + \sum_{g=1}^{G} \mathbf{Z}_g'\big(\sigma_u^2 I_{m_g}\big)^{-1}(S_g Y_g - \mathbf{X}_g\beta - l_g\alpha_g)\right), \\ &\mathbf{D} = \left(\Delta_0^{-1} + \sum_{g=1}^{G} \mathbf{Z}_g'\big(\sigma_u^2 I_{m_g}\big)^{-1}\mathbf{Z}_g\right)^{-1}. \end{aligned} \tag{C.18}$$

(vii) $P(\alpha_g|Y_g, W_g, \lambda, \beta, \sigma_u^2, \delta, Z_g)$, $g = 1, \ldots, G$.

By applying Bayes' theorem, we have

$$P\big(\alpha_g|Y_g, W_g, \lambda, \beta, \sigma_u^2, \delta, Z_g\big) \propto \phi(\alpha_g; \alpha_0, A_0) \cdot P\big(Y_g|W_g, \lambda, \beta, \sigma_u^2, \delta, \alpha_g, Z_g\big). \tag{C.19}$$

Similar to (v), we can further obtain

$$\begin{aligned} &P\big(\alpha_g|Y_g, W_g, \lambda, \beta, \sigma_u^2, \delta, Z_g\big) \propto \mathcal{N}(\alpha_g; \hat{\alpha}_g, R_g), \\ &\hat{\alpha}_g = R_g\big(A_0^{-1}\alpha_0 + l_g'\big(\sigma_u^2 I_{m_g}\big)^{-1}(S_g Y_g - \mathbf{X}_g\beta - \mathbf{Z}_g\delta)\big), \\ &R_g = \big(A_0^{-1} + l_g\big(\sigma_u^2 I_{m_g}\big)^{-1} l_g'\big)^{-1}. \end{aligned} \tag{C.20}$$

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