Appendix A: Model Building and Selection

Model Building and Selection Strategy

This study followed the model building strategy outlined in Curran, et al. (2014). The first part of the process was to establish the appropriate functional form of the latent growth parts of the model for each time-varying variable. Once an appropriate set of latent variables are specified, autoregressive relationships were estimated for the residuals at each time point and were retained if there was no degradation in model fit. Fit was assessed using five commonly used indices of goodness of fit: robust CFI, robust TLI, SRMR, AIC, and BIC.

Each cross-lagged relationship was then tested against a baseline model with only equal-time point covariance. The purpose of this was firstly to identify whether the inclusion of cross-lagged regressions improved the model fit and, secondly, whether fixing these regressions to be equal at all pairs of lagged time points degraded model fit substantially. A full ALT-SR model was then estimated based on the best fitting parameters. Finally, a time-invariant regressor was added to the model to explore relationships between deprivation level and trends in CIN rates and expenditure.

Model building and selection

The results of the model building process are presented in table A1. Models 1-5 identified the best fitting LGM for expenditure over time. A random intercept only model was a very poor fit to the data (CFI = 0.609, TLI = 0.598, SRMR = 0.408, AIC = -90.53, BIC = -33.45) which was substantially improved with the addition of random slopes (CFI = 0.933, TLI = 0.925, SRMR = 0.063, AIC = -654.05, BIC = -587.96). The addition of a fixed quadratic component offered a further improvement to model fit across all indices (CFI = 0.938, TLI = 0.928, SRMR = 0.053, AIC = -662.90, BIC = -593.80). Allowing the quadratic curve to vary by local authority degraded model fit and was not retained (CFI = 0.918, TLI = 0.898, SRMR = 0.059, AIC = -624.02, BIC = -548.92). The addition of fixed autoregressive parameters also degraded model fit, and therefore these were not retained (CFI = 0.921, TLI = 0.905, SRMR = 0.062, AIC = -627.45, BIC = -555.36). Under Hu & Bentler's (1999) cut-off criteria, the final LGM for expenditure reached 'good' levels of fit under the SRMR measure of goodness of fit (SRMR = 0.053 < 0.08), but not under CFI or TLI (CFI = 0.938, TLI = 0.928). However, as stated, this cut-off criteria may be too restrictive (Neimand & Mai, 2018).

Models 6-8 outline the latent growth specification for CIN rates. In this case, a model with only random intercepts offered close to good fit (CFI = 0.94, TLI = 0.938, SRMR = 0.078, AIC = -1016, BIC = -960.46). The addition of random slopes further improved the model fit, meeting the criteria for good fit across all indices (CFI = 0.968, TLI = 0.964, SRMR = 0.068, AIC = -1058.64, BIC = -993.92). The inclusion of autoregressive parameters resulted in no notable degradation in model fit and was therefore retained (CFI = 0.969, TLI = 0.964, SRMR = 0.068, AIC = -1059.07, BIC = -991.41).

Models 9-15 determined the final combination of fixed or freed cross-lagged parameters among residuals in the ALT-SR models. Model 9 establishes a baseline fit for a parallel processes model that does not specify cross-lagged relationships between the two variables, only between their trajectories of local authorities and covariance at equal time points (CFI = 0.931, TLI = 0.923, SRMR = 0.06, AIC = -1681.09, BIC = -1531.07). Freely estimated regressions of residual CIN rates on lagged residual expenditure offered improvements in model fit across all measures but the BIC (CFI = 0.938,

TLI = 0.927, SRMR = 0.060, AIC = -1696.99, BIC = -1523.43). Fixing cross-lagged estimates to be equal across time resulted in minimal change in model fit from the freely-estimated model (CFI = 0.934, TLI = 0.926, SRMR = 0.060, AIC = -1689.86, BIC = -1536.90). As there was no clearly preferable model, two versions of model 14 were run to decide between fixed or freely estimated lagged regressions. Freely estimated lagged regressions between CIN rate and expenditure performed better than fixed estimates across all indices (Model 12: CFI = 0.948, TLI = 0.939, SRMR = 0.055, AIC = -1730.68, BIC = -1557.13; Model 13: CFI = 0.938, TLI = 0.930, SRMR = 0.059, AIC = -1702.20, BIC = -1549.24).

Table A: Model Building and Selection

		Robust CFI	Robust TLI	SRMR	AIC	BIC
Model	**Non-Safeguarding, Non-CLA Expenditure**					
1	Random Intercept Model (no autoregression)	0.609	0.598	0.408	-90.53	-33.45
2	RI-Random Slopes Model (no autoregression)	0.933	0.925	0.063	-654.05	-587.96
3	RI-RS-Fixed Quadratic Model (no autoregression)	**0.938**	**0.928**	**0.053**	**-662.90**	**-593.80**
4	RI-RS-Random Quadratic Model (no autoregression)	0.918	0.898	0.059	-624.02	-548.92
5	RI-RS-Fixed Quadratic Model (autoregressive residual variance)	0.921	0.905	0.062	-627.45	-555.36
	Children in Need Rates					
6	Random Intercept Model (no autoregressive residual variance)	0.940	0.938	0.078	-1016.35	-960.46
7	RI-Random Slopes Model (no autoregressive residual variance)	0.968	0.964	0.068	-1058.64	-993.92
8	RI-RS Model (autoregressive residual variance)	**0.969**	**0.964**	**0.068**	**-1059.07**	**-991.41**
	ALT-SR					
9	Combined LCM (equal time-specific covariance, no cross-lag)	0.931	0.923	0.060	-1681.09	-1531.07
10	Unidirectional regression: Expenditure → CIN (freely estimated)	**0.938**	**0.927**	**0.060**	**-1696.99**	**-1523.43**
11	Unidirectional regression: Expenditure → CIN (fixed)	0.934	0.926	0.060	-1689.86	-1536.90
12	Unidirectional regression: CIN → Expenditure (freely estimated)	**0.948**	**0.939**	**0.055**	**-1730.68**	**-1557.13**
13	Unidirectional regression: CIN → Expenditure (fixed)	0.938	0.930	0.059	-1702.20	-1549.24
14.1	Full ALT-SR (Free Spend → CIN Cross-Lag)	**0.964**	**0.955**	**0.054**	**-1777.58**	**-1580.49**
14.2	Full ALT-SR (Fixed Spend → CIN Cross-Lag)	0.959	0.952	0.054	-1768.97	-1592.47
15	Full ALT-SR with Standardised IMD Score Covariate	**0.963**	**0.953**	**0.052**	**-1911.11**	**-1702.25**

Bolded estimates reflect best model fit at model building stage.

Models 14.1 and 14.2 determined that freely estimated cross-lags between expenditure and CIN rates were marginally more preferable across all measures but BIC in the final ALT-SR model (Free: CFI = 0.964, TLI = 0.955, SRMR = 0.054, AIC = -1777.58, BIC = -1580.49; Fixed: CFI = 0.959, TLI = 0.952, SRMR = 0.054, AIC = -1768.97, BIC = -1592.47). As the question of whether early help and family support expenditure has improved in efficacy over the past decade is of substantive interest, freely estimated cross-lags were retained for the final model, though fixed estimates for both cross-lags are available in table 3 for comparability between models. Finally, model fit was estimated for the inclusion of a regression of latent variables on standardised IMD score. This did not substantially degrade CFI/TLI model fit, and increased model fit as measured by the SRMR, AIC, and BIC (CFI = 0.963, TLI = 0.953, SRMR = 0.052, AIC = -1911.11, BIC = -1702.25). The final ALT-SR model included random intercepts, random slopes, and a fixed quadratic growth curve for expenditure with no residual autocorrelation; a random intercepts, random slopes growth curve for CIN rate with residual autocorrelation; and freely estimated cross-lags between both variables.