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ABSTRACT

The Dynamics and Determinants of Bullying Victimisation*

We study the determinants and longitudinal evolution of nine types of adolescent (verbal, physical, indirect) bullying at school and domestically using the Understanding Society dataset during 2009-13. Family support is the most prominent protective factor against bullying. Applying joint maximum likelihood estimation (MLE) for dynamic discrete responses, we investigate potential simultaneous determination of bullying and family support. The estimates indicate that bullying disclosure might be uncommon. The probability of escaping/suffering victimisation is inversely/positively related to previous bullying intensity, respectively. Family income increases domestic indirect aggression but, reduces direct aggression and non-domestic bullying as does living in a high income region.

JEL Classification: C25, C35, J12, J13

Keywords: bullying, dynamic discrete response, simultaneity, unobserved heterogeneity

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1 Introduction

Preadolescence and adolescence are critical developmental periods regarding the formation of adult skills and human capital (Heckman, 2006; Van den Berg et al. 2014). Meanwhile, bullying is a widespread phenomenon adversely affecting human capital and socioeconomic outcomes over the life course. Bullying is an anti-social behaviour encompassing physical aggression, threats, teasing, and harassment (Olweus, 1993). Environmental influences such as the household, school, peer groups and the media are important determinants of bullying incidence. Adolescent maltreatment impacts on internalising mental health disorders leading to symptoms of withdrawal and depression (Vaillancourt et al., 2011; McDougall and Vaillancourt, 2015), as well as, externalising disorders such as aggression and delinquency (e.g. Currie and Tekin, 2012; Reijntjes et al., 2011). Crucially, bullying victimisation can impair cognitive abilities conducing to future reductions in productivity and wages (Brown and Taylor, 2008; Vartia, 2001; Kivimaki et al., 2003; Kaestner and Callison, 2011).[1]

We investigate the socioeconomic determinants of adolescent bullying victimisation. We find that the most effective protective factor is family support while economic disadvantage (low family income/regional income per capita) is a significant risk factor.

Our analysis combines three distinctive features. First, employing the youth self-completion questionnaire (preadolescents/adolescents aged 10-15 years) from the Understanding Society (UK Household Longitudinal Study, UKHLS), we study the evolution of different types of bullying at the school and household levels during 2009-2013. Initially, we investigate the socioeconomic determinants of adolescent victimisation using a general bullying measure. We then analyse the probability of victimisation at the school and household levels using aggregate measures of maltreatment. Further, we consider direct forms of aggression (physical, verbal) and other indirect forms of bullying at the school and household levels.[2]

[1] Bullying during adulthood can also have detrimental effects. For instance, Eriksen et al. (2016) find that workplace bullying negatively affects self-assessed health.

[2] The first half of the age range analysed corresponds to preadolescence and the other half to adolescence though this is only an approximate outline of young developmental periods and varies across individuals. Slightly abusing

Second, we employ dynamic ordered correlated random effects estimation controlling for initial conditions, as well as, fixed effects estimation incorporating threshold-specific heterogeneity to account for unobserved personality characteristics affecting individual assessments of bullying victimisation occurrence and intensity.

Third, to investigate whether bullying victimisation and family support are simultaneously determined, we perform joint maximum likelihood estimation (MLE) of dynamic discrete response random effects models. To the best of our knowledge, we are the first to extend existing cross-sectional joint MLE procedures (e.g. Miranda and Rabe-Hesketh, 2006) to the longitudinal case.

The present study contributes to a sizeable interdisciplinary literature. Studies such as Eriksen et al. (2014), Brown and Taylor (2008) and McDougall and Vaillancourt (2015) focus on school bullying and adverse consequences on human capital formation. Henningsen (2009) and Eriksen et al. (2014) identify family safety and the quality of the home environment as significant predictors of bullying victimisation, respectively.

We conclude that the principal factor reducing all forms of bullying incidence is the strength of family support as felt by the child (henceforth referred to as perceived family support). Since family support could be increased in the advent of bullying incidence, we undertake simultaneous estimation of the two outcomes. Simultaneous estimation of the determinants of bullying victimisation and perceived family support reveals that the latent factors determining the two outcomes are unrelated. This suggests that adolescents might not frequently talk to their families about victimisation experiences. Further, the exogeneity of perceived family support implies that what forms a significant deterrent of bullying victimisation is the provision of consistent and persistent family support across time and not the mere modification in the advent of a victimisation event.

The number of close friends and social website membership also act as protective factors particularly against non-domestic peer victimisation (see Hodges et al., 1999; Martin and Hueb-

the terminology, for succinctness we henceforth refer to our analysis as an adolescent victimisation study.

ner, 2007 for similar conclusions).

The significant correlation between the unobserved individual heterogeneity and initial conditions, in the cases of aggregate school bullying/physical home and other school bullying, indicates that some adolescents have a higher predisposition towards continuing victimisation. However, this could be due to unobserved characteristics such as physical appearance that we fail to incorporate in our analysis. Bullying displays significant persistence across time with previous period victims being at a higher risk compared to their unexposed counterparts. The impact of past bullying is greater in the case of high incidence compared to intermediate incidence victimisation. This is an alarming result indicating the inability of frequently bullied adolescents to escape victimisation.

Family income reduces non-domestic bullying occurrence and direct domestic aggression which is in agreement with studies such as Henningsen (2009), Eriksen et al. (2014) and Doidge et al. (2017). However, family income increases domestic indirect aggression possibly due to neglectful parenting. Further, residing in the wealthiest English regions in terms of GVA per capita (London, S.East, S.West, and East England) generally reduces the probability of non-domestic bullying particularly at the school level. Boys are more likely to be exposed to physical bullying at school and less prone to have their belongings stolen by their siblings at home. Regarding all remaining bullying forms, we do not find a significant gender effect on victimisation propensity which is in line with other studies such as Eriksen et al. (2014).

As far as we know, this is the first study employing nine distinct measures of domestic/non-domestic adolescent victimisation, exploring dynamics, controlling for initial conditions and unobserved heterogeneity and, estimating models of joint dynamic determination of bullying and family support.

The rest of the paper is organised as follows. Section 2 describes the data; Section 3 discusses the estimation methodology. Section 4 is devoted to the analysis of the estimation results and Section 5 concludes.

2 The Data

We use the first five waves of Understanding Society, the UKHLS spanning the period 2009-2013. Understanding Society is a longitudinal survey addressed to the members of approximately 40,000 households (at the first wave) in the United Kingdom on a yearly basis. Household members aged 10-15 years are asked to complete a short self-completion youth questionnaire. To study the longitudinal evolution of adolescent bullying victimisation, we consider youth respondents aged 10-15 years from the UKHLS general population samples for Great Britain present in 2009 (to facilitate initial conditions estimation) that have no missing values (to allow for lagged victimisation status) in any of the covariates included in the estimations. Bullying and the remaining verbal and physical maltreatment measures used as dependent variables in our models are only reported biennially starting in 2009 (i.e., in waves 1, 3 and 5). We therefore construct balanced panels of adolescents that consecutively participate in the survey in 2009, 2011 and 2013 to obtain a total of three biennial period observations (permitting inclusion of both dynamics and initial conditions). Matching individual youth respondents to the household level data files, we obtain the total household net income (without deductions), current household size and the number of children in household variables.[3]

Matching youth respondent files to their corresponding parental individual interview files is prohibitive in terms of sample attrition if one wishes to undertake a longitudinal analysis. Nevertheless, our set of explanatory variables controls for the family environment by including region of residence, parental school interest, perceived family support and, parental conversa-

[3]The number of children in household denotes the total number of children aged 15 or under in the household. The domestic victimisation questions concern bullying inflicted by siblings and given that these were not asked to those without siblings, the domestic bullying regression sample sizes are smaller.

tion/arguing frequency.[4,5,6]

2.1 Measuring Longitudinal Bullying Incidence

This study employs nine distinct measures of adolescent victimisation at the household and school levels. We use the seven self-reported victimisation questions available in the Understanding Society dataset. In addition, we construct two additional victimisation measures by combining all forms of household bullying (physical, verbal, fun and teasing, stealing by siblings) and school bullying (physical and other types). [7]

The baseline general bullying measure (GenBull), indicating self-reported bullying inflicted by other children/young people, is a three-point scale categorical variable increasing in bullying intensity taking the values (not true=1, somewhat true=2, certainly true=3)- see top frame of (Fig.1). The remaining victimisation questions correspond to household physical bullying by siblings (PhysHome), school physical bullying (PhysSchool), household verbal abuse by siblings (VerbalHome), household fun and teasing by siblings (FunTeaseHome), household stealing by siblings (StealHome) and, other ways of school bullying victimisation (OthSchool). The six aforementioned self-reported bullying victimisation questions are four-point scale categorical variables increasing in bullying intensity. They take the values (never, sometimes: 1-3 times in the last 6 months, quite a lot: more than 4 times in the last 6 months, a lot: a few times

[4]We employ the Great Britain (England, Scotland and Wales) general population sample which excludes Northern Ireland and the Ethnic Minority Boost sample since they were obtained using distinct sample selection mechanisms. Ethnic group membership (white UK/Ireland origin versus all other groups) does not have statistically significant effects in our estimations and due to the relatively high number of missing values it has been omitted.

[5]To obtain the log of real household net monthly income variable, we divide total household income by household size and use the CPI (all items index) deflator, from the Office of National Statistics (Consumer Price Indices - CPI indices: 1988 to 2015: 2005=100).

[6]"Parental school interest" is a binary variable obtained from the question "My parents are interested in how I do at school" and takes the value of one if the individual answered "always/nearly always" and zero otherwise (sometimes, hardly ever, never). Conversation frequencies (Not talking to Mum/Dad) are derived from questions "How often do you talk to your mother/father, about things that matter to you?" and arguing frequencies (Not arguing with Mum/Dad) use questions "How often do you quarrel with your mother/father?". The last four variables take the value of one if the response was "hardly ever, don't have a mother/father" and zero otherwise (most days, more than once a week, less than once a week).

[7]To test the internal consistency of the aggregated school and household measures we use Cronbach's reliability coefficient which is over the widely used 0.7 threshold (Cronbach, 1951). We do not report estimations using the aggregation of physical bullying at school and home as the reliability coefficient was around 0.22.

every week) and were collapsed into three-point scales [never=1, sometimes=2, (quite a lot/a lot)=3] by combining the last two categories to ensure that the less frequent highest bullying intensity category contains a sufficient number of observations for identification purposes (see Fig 2,3).[8, 9]

Physical bullying at home/school, verbal home abuse and general bullying are considered direct forms of aggression, whereas, fun and teasing/stealing at home and other forms of school bullying are labelled indirect aggression types (see Bijttebier and Vertommen, 1998; Naylor et al. 2001; Carbone-Lopez et al., 2010). For uniformity, we henceforth refer to the three categories of the general bullying variable (not true, somewhat true, certainly true) as (never, sometimes, quite a lot/a lot) since they are equivalent.

Figure 1 displays the frequencies of the aggregate bullying measures (GenBull, GenSchool and GenHome) across the three waves analysed spanning 2009-2013. The respective longitudinal evolution of the remaining bullying sub-categories at school and at home is given in Figures 2 and 3, correspondingly. Four features of Figures 1-3 are noteworthy. Firstly, the distributions display a long right tail indicating that the majority of adolescents in our samples are not subjected to victimisation. The only exception is physical bullying at home in 2009, 2011 (see top-left frame of Figure 3). Secondly, reported domestic bullying incidence is the highest while victimisation at school is higher than general bullying. This is also indicated by the Descriptive Statistics Table (see Table 7, Appendix) where the mean incidence of all domestic bullying forms is higher than the respective non-domestic means. Thirdly, though the proportion of non-victimised adolescents increases across time (suggesting that self-reported victimisation diminishes with age) this pattern is less clear regarding aggregate bullying within

[8]For the wording of the seven self-reported bullying victimisation questions and the constituent components of the two additional aggregate household and school variables (as appearing in the Youth Self-completion Questionnaires) see bottom of Table 2.

[9]The aggregate domestic (GenHome=PhysHome+VerbalHome+FunTeaseHome+StealHome) and school (GenSchool=PhysSchool+OthSchool) maltreatment measures were collapsed into three-point scale variables increasing in bullying intensity as follows. GenHome=1 if GenHome$\leq$ 6, GenHome=2 if GenHome$\in$ $[7, 9]$, GenHome=3 if GenHome $\geqslant$ 10 and, GenSchool=1 if GenSchool=2, GenSchool=2 if GenSchool$\in$ $[3, 4]$, GenSchool=3 if GenSchool$>$4.

the household (see the bottom frame of Fig.1). In fact, closer inspection of Fig.3 reveals a general trend for a longitudinal increase in other types of bullying (stealing and making fun) by siblings.

Lastly but not least, Figures 1-3 indicate non-negligible persistence of initial and successive period responses. This becomes clearer observing the main diagonal elements of the transition probability matrices for the three aggregate bullying measures (see Table 1 where rows and columns reflect initial and final values, respectively). Conclusively, our estimation strategy must account for initial conditions and dynamics.

Figure 1: Aggregate Bullying Measures

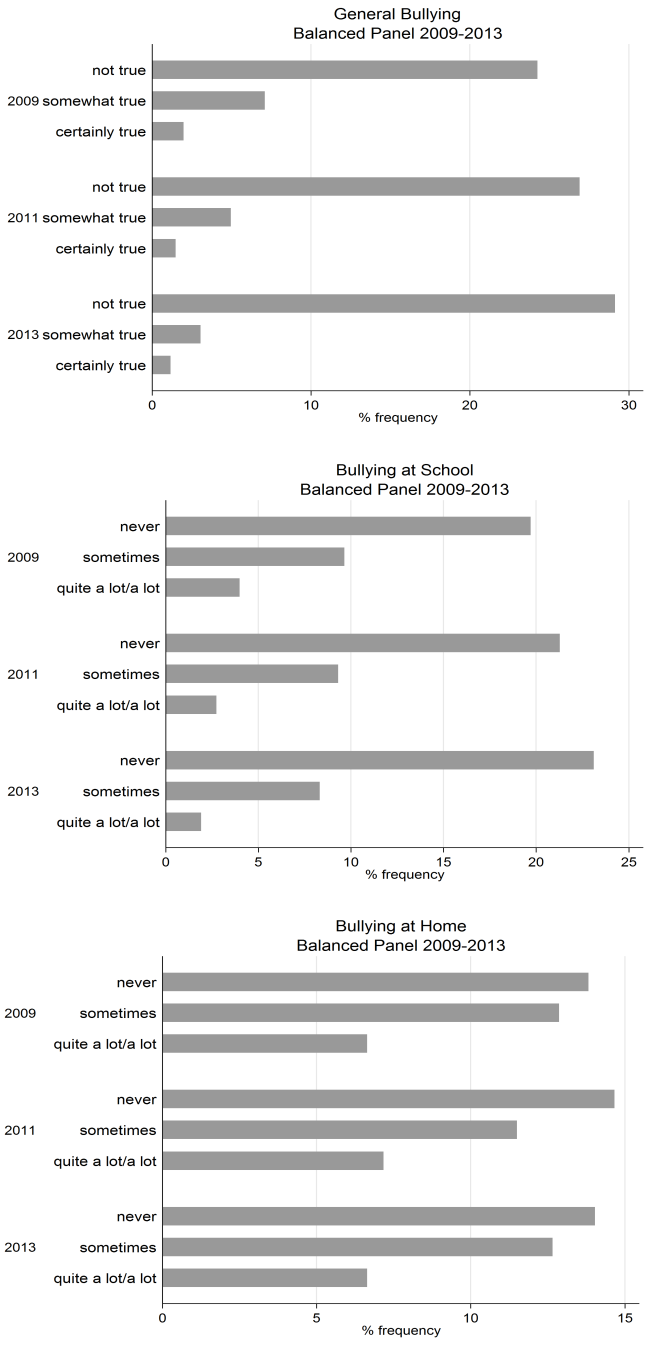


Figure 2: Bullying at School

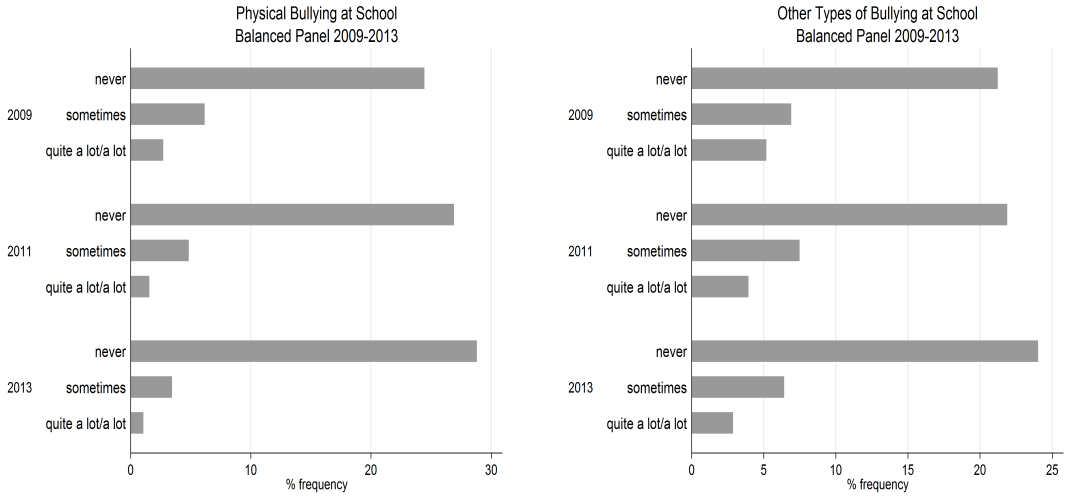
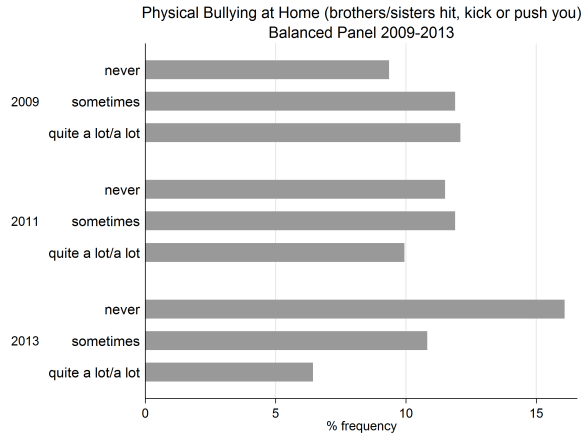
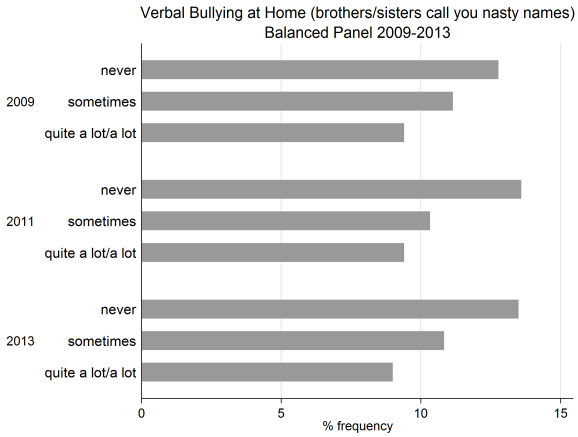
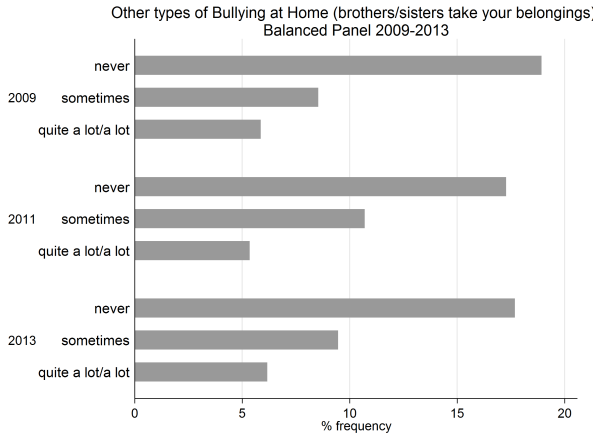


Figure 3: Bullying at Home







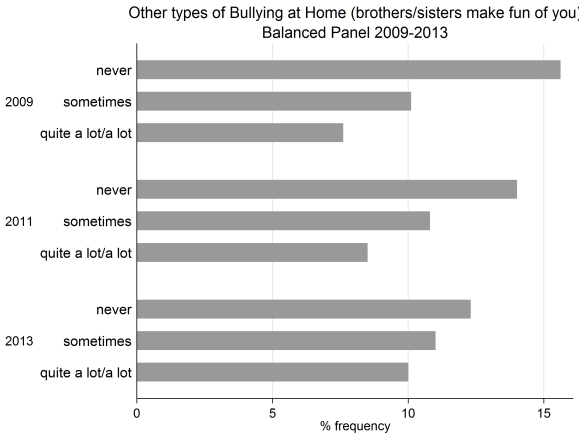


Table 1: Transition matrices (2009-2013), balanced panels

Gen Bullying	Bullied:Never	Bullied:Sometimes	Bullied:Quite a lot/a lot	Total
Bullied:Never	577	39	4	620
	93.06	6.29	0.65	100
Bullied:Sometimes	87	42	17	146
	59.59	28.77	11.64	100
Bullied:Quite a lot/a lot	15	16	11	42
	35.71	38.1	26.19	100
Total (t> 2009)	679	97	32	808
	84.03	12.0	3.96	100
Gen School	Bullied:Never	Bullied:Sometimes	Bullied:Quite a lot/a lot	Total
Bullied:Never	399	86	8	493
	80.93	17.44	1.62	100
Bullied:Sometimes	117	91	20	228
	51.32	39.91	8.77	100
Bullied:Quite a lot/a lot	18	35	28	81
	22.22	43.21	34.57	100
Total (t> 2009)	534	212	56	802
	66.58	26.43	6.98	100
Gen Home	Bullied:Never	Bullied:Sometimes	Bullied:Quite a lot/a lot	Total
Bullied:Never	161	86	23	270
	59.63	31.85	8.52	100
Bullied:Sometimes	92	91	48	231
	39.83	39.39	20.78	100
Bullied:Quite a lot/a lot	19	52	60	131
	14.5	39.69	45.8	100
Total (t> 2009)	272	229	131	632
	43.04	36.23	20.73	100

Notes: Source: University of Essex, ISER, Understanding Society: Waves 1-5. GenBull: Other children or young people pick on me or bully me. GenHome: Brothers/sisters hit, kick or push you. Brothers/sisters call you nasty names. Brothers/sisters make fun of you. Brothers/sisters take your belongings. GenSchool: How often do you get physically bullied at school? How often do you get bullied in other ways at school?.

3 Estimation Methodology

3.1 Dynamic Correlated Random Effects (CRE)

Self-reported bullying incidence is initially modelled using dynamic correlated random effects ordered probit models on balanced samples of adolescents aged between 10-15. Since bul-

lying victimisation is inflicted by another party and it is not an optional choice, these models should be interpreted as reduced-form specifications. The dynamic latent variable specification is given by

$$y_{it}^{*} = \mathbf{x_{it}}\boldsymbol{\beta} + \gamma y_{it-1} + \varepsilon_i + \eta_{it};\ i = 1, ..., N; t = 2, ..., T \tag{1}$$

where y_{it}^{*} is a latent ordered response variable capturing individual bullying victimisation propensity, $\mathbf{x_{it}}$ is a vector of contemporaneous explanatory variables for the *i*th individual in the *t*th time period and the vector $\boldsymbol{\delta} = (\boldsymbol{\beta}, \gamma)$ represents the set of the unknown parameters to be estimated. The composite error term $v_{it} = \varepsilon_i + \eta_{it}$ captures the unobserved heterogeneity underlying individual bullying propensity and is decomposed into an individual-specific time-invariant component $\{\varepsilon_i\}_{i=1,2...,N}$ and an individual time-specific effect η_{it} assumed to be serially uncorrelated and normally distributed $\eta_{it} \sim N(0, \sigma_{\eta}^{2})$, independently of ε_i.

Including y_{it-1} in equation (1) raises the question of how we treat y_{i1} *i.e.* the initial conditions problem (Heckman 1981a,b) which is subsequently addressed in subsection 3.2. Reported bullying status $y_{it} = j$ for $j \in \{1, ..., J\}$ is observed if latent bullying incidence falls in an interval between μ_{j-1} and μ_j :

$$y_{it} = j \quad if \quad \mu_{j-1} < y_{it}^{*} \leq \mu_j \tag{2}$$

where $\mu_0 = -\infty$, $\mu_j \leq \mu_{j+1}$ and $\mu_J = \infty$. Under the normality assumption of η_{it}, the probability p_{itj} of observing outcome *j* for response y_{it}, conditional on the set of cutpoints $\boldsymbol{\mu} = \{\mu_1, \mu_2, ..., \mu_{J-1}\}$, $\mathbf{x_{it}}$ and ε_i is

$$Pr(y_{it} = j \mid \boldsymbol{\mu}, \mathbf{x_{it}}, \varepsilon_i) = \Phi\left(\mu_j - \mathbf{x_{it}}\boldsymbol{\beta} - \mathbf{y_{it-1}}\boldsymbol{\gamma} - \varepsilon_i\right) - \Phi\left(\mu_{j-1} - \mathbf{x_{it}}\boldsymbol{\beta} - \mathbf{y_{it-1}}\boldsymbol{\gamma} - \varepsilon_i\right) \tag{3}$$

where Φ is the standard normal *cdf* and $\mathbf{y_{it-1}}$ is a vector of $J-1$ lagged indicators, $\mathbf{1}\left[\mathbf{y_{it-1}} = j\right]$, $j = 2, ..., J$.

Note that $\mathbf{x_{it}}$ is not inclusive of a constant term which is absorbed into the cutpoints pro-

vided that we cannot separately identify a global intercept and the cutpoints $\boldsymbol{\mu}$ *i.e.* only $(\mu_j - \varepsilon_i)$ is identified. Further, in a random effects framework we cannot disentangle ε_i from individual-specific cutpoint shifts (see Contoyannis et al., 2004; Jones and Schurer, 2011). The sample log likelihood function for the random effects ordered choice model is obtained by integrating out the fixed effect, $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$, and corresponds to

$$lnL(\boldsymbol{\beta}, \boldsymbol{\mu}, \sigma_\varepsilon^2) = \sum_{i=1}^{N} ln \int_{-\infty}^{+\infty} \frac{exp(-\frac{\varepsilon_i^2}{2\sigma_\varepsilon^2})}{\sqrt{2\pi}\sigma_\varepsilon} \left\{ \prod_{t=1}^{T} Pr(y_{it} = j \mid \boldsymbol{\mu}, \mathbf{x_{it}}, \varepsilon_i) \right\} d\varepsilon_i. \tag{4}$$

3.2 Initial Conditions in Dynamic CRE: Disentangling the True Dependence of Sustained Bullying

The presence of ε_i in equation (3) invalidates the assumption of exogeneity of bullying incidence in 2009 (y_{i1}) since the beginning of the sample is unlikely to coincide with the initiation of the stochastic process determining bullying victimisation propensity. State dependence and individual heterogeneity offer "diametrically opposite" explanations of bullying victimisation persistence (see Hsiao, 2003, p.216). Considering otherwise identical adolescents, it is possible that those who have experienced bullying in the past will amend their behaviour which in turn determines future victimisation propensity: this is an entirely behavioural effect. To explain how past or persistent bullying victimisation relates to outcomes over time, the literature is grouped into (a) academic functioning (b) physical health and neurobiology (c) social relationships (d) self-perceptions (e) mental health (internalising disorders) and (f) mental health (externalising disorders)- McDougall and Vaillancourt (2015).[10]

Crucially, concerning social relationships sustained victimisation in early and middle adolescence predicts relationship problems and fewer friends at school which in turn could prolong bullying duration. Importantly, new and continuing victims reported talking to someone

[10]Regarding academic functioning, continuous bullying translates into poor academic performance, as well as, intensified perceptions of being at risk in school (see McDougall and Vaillancourt, 2015, p.301). Concerning physical health and neurobiology longitudinal studies show that victimisation in early adolescence is associated with heightened depression symptoms across time, subsequently predicting blunted cortisol (Vaillancourt et al., 2011).

about the incidence of bullying with a lower frequency as opposed to escaped victims which could lead to increasing victimisation persistence (see Smith et al., 2004).

With respect to self-perceptions, peer victimisation negatively affects feelings about self-worth, with the imminent risk of victims coming to believe that that deserve the abuse. Internalising mental health disorders can also prolong victimisation via symptoms of loneliness, withdrawal, emotional problems, somatisation, anxiety, and depression (McDougall and Vaillancourt, 2015). Considering externalising mental health disorders Reijntjes et al. (2011) find that peer victimisation relates to increasing difficulties of an externalising nature (such as aggression causing retaliation, becoming bullies themselves, delinquency, misconduct and inattention issues).

Alternatively, adolescents may differ in specific unobservables affecting victimisation propensity, while not being influenced by previous bullying experience. These latent characteristics could be individual and personality/behavioural traits (sensitivity, dominance, emotional stability, self-reliance, social boldness), genetic factors and individual circumstances such as sexual preferences and attractiveness.[11,12] If such unobservables are correlated over time, and are not appropriately controlled for, past victimisation may turn out to be the overriding determinant of future bullying propensity since it acts as proxy for the temporally persistent unobservables. This is what Heckman (1981a, 1981b) terms as "spurious state dependence" as opposed to "true (structural) state dependence". Wooldridge (2005) proposes specifying the distribution of ε_i conditional on the initial condition (and the exogenous variables), as opposed to Heckman's (1981b) proposal to obtain the joint distribution of the observed sequence of the outcome variable.

[11]Weight and height could be used to construct of a body mass index and proxy attractiveness but are only reported in 2010 and 2012. We are thus unable to include BMI, given the high variability of these measurements during the developmental adolescent period and noting that weight can vary endogenously in response to bullying.

[12]The UKHLS includes the youth self-reported behavioural screening Strengths and Difficulties Questionnaire (SDQ). We omit the five SDQ subscales (emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, prosocial behaviour) as they are bound to be endogenously determined. In fact, the general bullying measure is a component of the peer relationship problems SDQ subscale. We study the impact of bullying on the SDQ subscales and their joint determination in Chrysanthou and Vasilakis (2018).

We use Wooldridge's (2005) solution to the initial conditions problem as it is less computationally intensive. Adopting the Mundlak (1978) and Chamberlain (1984) specification we induce a correlation between ε_i and the time means of the non-redundant (time-varying) covariates taking the form of $\varepsilon_i = \overline{\mathbf{x}}_\mathbf{i}\boldsymbol{a} + \xi_i$, where $\xi_i \sim iidN(0, \sigma_\xi^2)$ and is independent of $(\mathbf{x_{it}}, \eta_{it})$ for all (i, t) in equation (1).[13] The model for the unobserved individual effect, ξ_i , in its simplest form is

$$\xi_i = \vartheta_0 + \vartheta_1 y_{i1} + \zeta_i \tag{5}$$

where ζ_i is $N(0, {\sigma_\zeta}^2)$ and independent of the initial condition, the covariates and η_{it}. As we cannot separately identify ϑ_0 from the cutpoints ($\boldsymbol{\mu}$), we adopt the usual normalisation setting $\vartheta_0 = 0$.

The ordered choice log likelihood function in (4) is modified accordingly so that the explanatory variables at time t are $\mathbf{q_{it}} \equiv (\boldsymbol{x_{it}}, \mathbf{y_{it-1}}, \mathbf{y_{i1}}, \overline{\mathbf{x}}_\mathbf{i})$ where $\mathbf{y_{it-1}}$ and $\mathbf{y_{i1}}$ denote respectively the vectors of the $J-1$ lagged, $\mathbf{1}\left[\mathbf{y_{it-1}} = j\right]$, and initial conditions set of indicators, $1\left[\mathbf{y_{i1}} = j\right],\ j = 2, ..., J$. Finally, $\overline{\mathbf{x}}_\mathbf{i} = (T-1)^{-1} \sum_{t=2}^{T} \mathbf{x_{it}}$ as suggested by Rabe-Hesketh and Skrondal (2013).[14] Adding time-constant covariates in $\mathbf{x_{it}}$ solely increases the explanatory power since it is not possible to separately identify their partial effects from their partial correlation with the unobserved effect. Due to minimal within variation, we cannot include individual-specific time means of the regional control for London/South East/South West/East of England (as opposed to residing in the rest of Great Britain). Household monthly income, number of children in the household, parental school interest and perceived family support are outcomes of parental socioeconomic attributes, choices and behaviour. Accordingly, our estimations do not include within means of the aforementioned time-varying covariates.

[13] Arulampalam and Stewart (2009) show that, none of the Heckman (1981b) and Wooldridge (2005) solutions dominates the other and, given the Mundlak (1978) and Chamberlain (1984) CRE device is used the estimators provide similar results.

[14] In terms of relative bias and RMSE, this version performs similarly to the specification of the conditional distribution of the unobserved effect used in Wooldridge (2005) except in the case of an AR(1) process assumed for $\boldsymbol{x_{it}}$ with short panels (see Rabe-Hesketh and Skrondal, 2013).

3.2.1 Investigating the Potential Simultaneous Determination of Bullying Incidence and Family Support

Perceived family support is derived from the question "Do you feel supported by your family, that is the people who live with you?". The resulting binary variable takes the value of one if the individual responded "I feel supported by my family in most or all the things I do" (as opposed to "I feel supported in some of the things I do"/"I do not feel supported").[15]

We can think of two channels rendering perceived family support endogenously determined. Primarily, parents could plausibly increase the intensity of family support in the advent of a victimisation incident at the expense of their offspring. Note however that empirical evidence suggests that a non-negligible fraction of victimised adolescents do not inform their parents (e.g. Bijttebier and Vertommen, 1998; Naylor and Cowie, 1999; Naylor et al., 2001; Smith and Shu, 2000). Further, authors such as Smith and Shu (2000) find that the proportion of victims that do not inform anyone increases with age and is higher among male adolescents.

On the other hand, authors such as Smith et al. (2004) find that new and continuing victims reported communicating bullying incidence to someone with a lower frequency, as opposed, to escaped victims indicating that unobserved individual attributes might exert some influence. This is the second potential family support endogenising source.

To investigate whether bullying and family support are simultaneously determined, we additionally undertake joint maximum likelihood estimation (MLE) of both outcomes. The model is formed as a binary system of latent responses

$$y_{it}^{*} = \mathbf{x_{it}}\boldsymbol{\beta} + \boldsymbol{y_{it-1}}\boldsymbol{\gamma} + \tau s_{it} + \mathbf{y_{i1}}\boldsymbol{\vartheta_1} + \overline{\mathbf{x}}_{\mathbf{i}}\boldsymbol{a} + \lambda\zeta_i + \eta_{it};\ i = 1, ..., N; t = 2, ..., T \tag{6}$$

$$y_{it} = j \quad if \quad \mu_{j-1} < y_{it}^{*} \leq \mu_j, \mu_0 = -\infty,\ \mu_j \leq \mu_{j+1},\ \mu_J = \infty$$

[15]The Descriptive Statistics (Table 7, Appendix) indicate that approximately 0.77-0.8 percent of adolescents in the estimation samples feel supported in most/all things by their families. We grouped answers reporting feeling supported in some things and not feeling supported together since the proportion not feeling supported is very low.

$$s_{it}^{*} = \mathbf{z_{it}}\boldsymbol{\pi} + \theta_0 + \overline{\mathbf{z}}_{\mathbf{i}}\boldsymbol{\psi} + \zeta_i + \omega_{it};\ i = 1, ..., N; t = 2, ..., T \tag{7}$$

$$s_{it} = \mathbf{1}\left[s_{it}^{*} > 0\right];\ i = 1, ..., N; t = 2, ..., T$$

where y_{it}^{*} is a latent ordered response variable for bullying victimisation and s_{it}^{*} is a latent binary response variable for perceived family support.

Equation (6) employs Wooldridge's (2005) auxiliary model incorporating the Mundlak (1978) and Chamberlain (1984) specification, ($\mathbf{x_{it}}$, $\mathbf{z_{it}}$) denote vectors of contemporaneous covariates, ζ_i is a shared random effect inducing dependence between $u_{1it} = \lambda\zeta_i + \eta_{it}$, $u_{2it} = \zeta_i + \omega_{it}$ and λ is a factor loading (free parameter)- see Miranda and Rabe-Hesketh (2006). The reduced form does not include dynamics since the lagged and initial values of family support were statistically insignificant in the joint binary system estimates.[16] Assuming a bivariate normal distribution for (u_{1it}, u_{2it}) and that $(\zeta_i, \eta_{it}, \omega_{it})$ are $iidN(0, 1)$, the respective residual covariance matrix Ω corresponds to

$$\Omega \equiv Cov\left[(u_{1it}, u_{2it})'\right] = \begin{pmatrix} \lambda^2 + 1 & \lambda \\ \lambda & 2 \end{pmatrix} \tag{8}$$

giving a correlation coefficient

$$\rho = \frac{\lambda}{\sqrt{2\left(\lambda^2 + 1\right)}}. \tag{9}$$

If ζ_i had been observed, the joint log-likelihood function to be maximised would have simply been

[16] Note that we fail to obtain convergent results in the joint ML estimates of (GenSchool, PhysHome, OthSchool) when including dynamics and initial values in the reduced form for family support. This is possibly due to collinearity problems between the highly significant initial conditions in these three models (see columns 3, 4 and 9 in Table 2) and the shared random effect ζ_i (see Puhani, 2000; Wooldridge, 2014).

$$lnL = \sum_{i=1}^{N}\sum_{t=2}^{T} ln\left[Pr(y_{it} = j \mid \boldsymbol{\mu},\, \mathbf{x_{it}},\, \boldsymbol{y_{it-1}},\, s_{it},\, \boldsymbol{y_{i1}},\, \overline{\mathbf{x}}_{\mathbf{i}},\, \zeta_i)\right] + \sum_{i=1}^{N}\sum_{t=2}^{T} ln\left[\Phi\left\{(2s_{it}-1)\left(\mathbf{z_{it}}\boldsymbol{\pi} + \theta_0 + \overline{\mathbf{z}}_{\mathbf{i}}\boldsymbol{\psi} + \zeta_i\right)\right\}\right] \quad (10)$$

where $Pr(y_{it} = j \mid \boldsymbol{\mu},\, \mathbf{x_{it}},\, \boldsymbol{y_{it-1}},\, s_{it},\, \overline{\mathbf{x}}_{\mathbf{i}},\, \boldsymbol{y_{i1}},\, \zeta_i)$ denotes the probability of observing outcome j for response y_{it} conditional on $\boldsymbol{\mu} = \{\mu_1, \mu_2, ..., \mu_{J-1}\}$, $(\mathbf{x_{it}},\, \boldsymbol{y_{it-1}},\, s_{it}, \overline{\mathbf{x}}_{\boldsymbol{i}},\, \boldsymbol{y_{i1}})$ and ζ_i.

Calculating the log-likelihood requires integrating out the unobserved ζ_i and the resulting integrals, as in equation (4), are evaluated using the mean-variance adaptive quadrature method (see Rabe-Hesketh et al., 2005).[17] After estimation, a simple t-test can be used to test the null hypothesis that $\rho = 0$.[18] Perceived family support, s_{it}, is exogenous if $\rho = 0$ in which case consistent parameter estimates can be obtained by fitting a single equation model for equation (6) using the log likelihood function provided in equation (4).

3.3 Fixed Effects CMLE with Heterogeneous Thresholds

Alternatively, fixed effects (FE) estimation of dynamic discrete response models leaves the conditional distribution of ε_i unrestricted but given fixed-T asymptotics, we cannot obtain consistent ML estimates of $\boldsymbol{\delta}$ due to the presence of ε_i in equation (3) i.e. the incidental parameters problem, see Heckman (1981b).[19] In the particular case of the logistic model, a consistent estimator of $\boldsymbol{\beta}$ can be obtained from collapsing y_{it} into a binary variable and using conditional maximum likelihood (CML) (Andersen, 1970; Chamberlain, 1980). The well known CML fixed-

[17] The joint likelihood models were estimated using the gsem command, and the single equation CRE ordered probits using the xtoprobit command in Stata. In both cases, we performed quadrature checks to ensure parameter invariance to quadrature point variation.

[18] We use the nlcom command in Stata giving standard errors, test statistics and significance levels for nonlinear combinations of parameter estimates (employing the delta method).

[19] Carro (2007) and Carro and Traferri (2012) offer a modified FE MLE for dynamic binary and ordered-choice models respectively though effective bias reduction requires T≥8. Honore and Kyriazidou (2000) propose a fixed-T consistent (though not $\sqrt{N}$-consistent) estimator for dynamic discrete response with continuous exogenous covariates requiring further restrictive assumptions.

effects (FE) logit employs a set of sufficient statistics, $\sum_{t=1}^{T} y_{itj}$, to eliminate the individual-specific effect from the likelihood function. However, this approach discards individuals for which $0 < \sum_{t=1}^{T} y_{itj} < T$ does not hold, translating into a considerable loss of observations since a significant proportion of individuals in our samples have not been subjected to bullying across all periods under analysis. Further, time-invariant (and near time-invariant) covariates cannot be included.[20,21]

We employ a CML FE logit (Chamberlain, 1980) for each of the $J-1$ thresholds into which the ordered categorical dependent variable can be dichotomised. Following Jones and Schurer (2011), we implement this approach while accounting for threshold-specific time-invariant heterogeneity by permitting individual cutpoints to differ across individual-specific, but time-invariant attributes such that $\mu_{ij} = \mu_{ij-1} + \tilde{\mu}_{ij}$ where $\tilde{\mu}_{ij}$ is an individual threshold-specific effect and $\tilde{\mu}_{ij} > 0, \forall i$.[22]

The individual threshold-specific effects, $\tilde{\mu}_{ij}$, denote differences in reporting behaviour that are a function of latent personality attributes influencing the assessment of bullying victimisation occurrence and intensity. In other words, while all adolescents share the same ordering of bullying incidence, individual-specific thresholds vary by $\tilde{\mu}_{ij}$. For example, for a given level of bullying incidence, pessimists might be more prone to report a higher frequency of bullying occurrence (see Jones and Schurer, 2011).

With reference to equation (1), defining $\alpha_{ij} = \mu_{ij} - \varepsilon_i$ where μ_{ij} is an individual specific threshold assumed to be increasing in categories ($\mu_{ij-1} < \mu_{ij}\ \forall i, j$) reported bullying status is determined by

$$y_{it} = j \quad if \quad \mu_{ij-1} < y_{it}^{*} \leq \mu_{ij} \tag{11}$$

[20] Ferrer-i-Carbonell and Frijters (2004) suggest the use of a single but distinct, cut-off point per individual. In practice this estimator is implemented by selecting the individual mean (or median) of y_{it} as dichotomizing cut-off point. However, these procedures determine the dichotomizing cut-off point endogenously, as it depends on the dependent variable providing inconsistent parameter estimates (Baetschmann et al., 2015).

[21] Mukherjee et al. (2008) offer an alternative CML estimator that involves replacing each observation in the sample by $J-1$ copies of itself, dichotomising each of the individual $J-1$ copies at a different cut-off (see Baetschmann et al., 2015). We are unable to implement this estimator due to an insufficient number of observations.

[22] Alternatively, one can estimate $J-1$ random effects specifications under the assumption that the threshold-specific individual unobserved heterogeneity, α_{ij}, is independent of $\mathbf{x_{it}}$.

where $\mu_{i0} = -\infty$, $\mu_{ij} \leq \mu_{ij+1}$ and $\mu_{iJ} = \infty$ for $j \in \{1, ..., J\}$. The corresponding probability that an adolescent reports bullying victimisation status $y_{it} = j$ becomes

$$Pr(y_{it} = j \mid \mathbf{x_{it}}, \alpha_{ij}) = \Lambda\left(\alpha_{ij} - \mathbf{x_{it}}\boldsymbol{\beta}\right) - \Lambda\left(\alpha_{ij-1} - \mathbf{x_{it}}\boldsymbol{\beta}\right), \ \alpha_{ij} = \mu_{ij} - \varepsilon_i \tag{12}$$

where it is assumed that the idiosyncratic error component is distributed as standard logistic $\eta_{it} \sim \Lambda(0, \frac{\pi^2}{3})$ and Λ is the logistic *cdf*. This estimator conditions out the threshold-specific individual unobserved heterogeneity.

Initially, we estimate the baseline CRE ordered probit specifications accounting for initial conditions. It is however possible that unobserved individual factors influence both the observed explanatory variables and bullying incidence. To test the robustness of our results in the presence of individual-specific time-invariant endogeneity, we also estimate $J - 1$ CMLE FE logit models accounting for individual threshold-specific effects (heterogeneous threshold FE, henceforth). In the latter case we report the directly comparable average partial effects (APEs) treated in subsection 3.4 that follows.[23]

3.4 Average Partial Effects (APEs)

Given the nonlinear nature of the models employed, the estimated parameters are only informative concerning the direction and relative impact of the covariates. To obtain a clear quantitative interpretation of the effects of the explanatory variables on the probability of bullying victimisation we estimate APEs. In the case of CRE ordered probit models we estimate the expected value of expression (13) with respect to the distribution of $(\mathbf{y_{i1}}, \overline{\mathbf{x}}_i)$. We calculate either first differences of the expected value of (13) for discrete variables in $\mathbf{x_{it}}$ and $\mathbf{y_{it-1}}$ or derivatives for continuous variables in $\mathbf{x_{it}}$. The CRE partial effects are averaged over the distribution of unobserved heterogeneity and calculated using the population averaged parameters $\boldsymbol{b_\xi} = \boldsymbol{b}/\sqrt{(1 + \sigma_\zeta^2)}$, where $\boldsymbol{b}$ denotes the vector of estimated parameters (see Wooldridge, 2005).

[23] Since APEs correspond to estimated probabilities, the APEs from the CRE probit models are directly comparable to the respective CMLE FE logit APEs.

$$\Phi\left(\mu_j - \mathbf{x_{it}}\boldsymbol{\beta} - \mathbf{y_{it-1}}\boldsymbol{\gamma} - \boldsymbol{y_{i1}}\boldsymbol{\vartheta_1} - \overline{\mathbf{x}}_\mathbf{i}\boldsymbol{a}\right) - \Phi\left(\mu_{j-1} - \mathbf{x_{it}}\boldsymbol{\beta} - \mathbf{y_{it-1}}\boldsymbol{\gamma} - \mathbf{y_{i1}}\boldsymbol{\vartheta_1} - \overline{\mathbf{x}}_\mathbf{i}\boldsymbol{a}\right) \tag{13}$$

In the FE CMLE models the APEs of discrete and continuous variables in $\mathbf{x_{it}}$ are obtained by taking either first differences of (14) or derivatives, respectively. In this case, we need to introduce an assumption regarding the distribution of the unobserved effect α_{ij}. As Jones and Schurer (2011) we approximate $\hat{\alpha}_{ij}$ (for each j of the $J-1$ thresholds into which the dependent variable is dichotomised) using the analytical expression in (14) and also report homogeneous threshold partial effects assuming that $\hat{\alpha}_{ij} = 0$:

$$\Lambda\left(\hat{\alpha}_{ij} + \mathbf{x_{it}}\hat{\boldsymbol{\beta}}_\boldsymbol{j}\right), \hat{\alpha}_{ij} \simeq \Lambda^{-1}\left(\overline{y}_{ij}\right) - \overline{\mathbf{x}}_\mathbf{i}\hat{\boldsymbol{\beta}}_\boldsymbol{j}. \tag{14}$$

As the APEs are functions of the estimated parameters, they are subject to sampling variability. Accordingly, we provide bootstrapped standard errors using 1,500 bootstrap replications by resampling with replacement accounting for individual-level clustering.

4 Estimation Results

This Section analyses the baseline CRE ordered probit estimates and the corresponding APEs, the joint ML results accounting for potential simultaneity of bullying and family support and, the estimated APEs in the cases of the CMLE FE models using heterogeneous and homogeneous thresholds.

4.1 State Dependence in Bullying Victimisation

Firstly, we consider the dynamic CRE ordered probit estimates accounting for initial conditions (in Table 2). The estimates provide a clear indication that, even after controlling for the unobserved effect, the most powerful predictor of bullying victimisation (in terms of coefficient

magnitude) is high past victimisation incidence.

Observing the first row of Table 2, being bullied quite a lot/a lot in the past period (as opposed to not being subjected to victimisation) significantly augments the probability of present period victimisation in all cases except in the aggregate and other school bullying measures. On the other hand, less frequent previous period bullying victimisation (bullied sometimes) enters estimations with markedly lower magnitudes and less prominent effects regarding statistical significance. Hence, the lower the previous period bullying intensity the higher the probability of escaping victimisation. This is an alarming result highlighting the inability of frequently bullied adolescents to escape victimisation.

Concerning aggregate school/other forms of school bullying and physical home bullying, initial period victimisation status has a more powerful impact (compared to past victimisation) in terms of both statistical significance and magnitude. This is more accentuated in the case of high initial period bullying incidence (quite a lot/a lot) indicating a substantial correlation between unobserved heterogeneity and initial period victimisation. It is plausible that unobserved behavioural traits and physical appearance precondition these bullying forms.

The APEs reported in Table 3 indicate the magnitude of the association between past bullying incidence and the probability of bullying victimisation. We compute APEs for all three outcomes of the respective bullying measure (no bullying, intermediate bullying, high bullying incidence).

High past period bullying (bullied quite a lot/a lot) reduces the likelihood of no bullying incidence by over 40 percent regarding physical school and general bullying, over 27 percent in the case of general home, fun/tease and steal home and, at least 17.5 percent concerning physical and verbal home bullying (see first row of Table 3). Intermediate past period bullying incidence (bullied sometimes) also lowers the probability of no bullying occurrence with lower magnitudes, as opposed to high previous period intensity, and varying statistical significance (see second row of Table 3).

Regarding the estimated APEs for intermediate and high bullying incidence (see the middle

and lower part of Table 3, correspondingly) previous period bullying occurrence increases the probability of victimisation. The estimated APEs are generally of greater magnitude in the case of high (quite a lot/a lot) past period bullying (compared to sometimes) where in the cases of general bullying, general home, physical school, verbal home, fun/tease and steal home the effects are either close/above 20 percent (see the lowest part of Table 3).

Hence, the probability to escape/suffer victimisation is inversely/positively related to previous period bullying intensity, correspondingly.

4.2 Observed Heterogeneity

Residing in the wealthiest English regions in terms of GVA per capita "London, S.East, S.West and the East of England", significantly reduces the victimisation probability in the cases of general and physical school bullying (see Table 2).[24] A closer inspection of the joint-ML estimates (in Table 4) indicates that living in "London, S.East, S.West, and East England" additionally reduces the incidence of all remaining school-level bullying forms. This is in agreement with investigations such as Menacker et al. (1990) concluding that adolescents attending schools located in economically disadvantaged regions face a greater risk of school-level bullying victimisation. Alternatively, Carbone-Lopez et al. (2010) proxying school-level poverty (by student percentage receiving free/reduced cost lunches) find that it increases indirect male school-level bullying.[25]

[24]We employ the first-level NUTS to group the wealthiest regions in terms of GVA per capita. London and the South East are above the national GVA per head average while the East of England and South West follow and deviate by a maximum of 9.5 percent below the average during the period analysed. Scotland deviates by a maximum of 6 percent below the national average, but we opted to aggregate the best performing English regions instead due to geographical proximity- see https://www.ons.gov.uk/economy/grossvalueaddedgva/bulletins/regionalgrossvalueaddedincomeapproach/previousReleases. Estimating all models by adding Scotland to the regional control gives almost identical results (available upon request) concerning the remaining variables. The modified regional control behaves similarly except in two cases: it becomes statistically significant in the single equation CRE ordered probit model for aggregate school bullying, whereas, its impact in the other school bullying joint MLE structural form estimates becomes marginally insignificant with a p-value of 0.102.

[25]Carbone-Lopez et al. (2010) include in their estimations school climate factors (student perceptions of school problems) while Eriksen et al. (2014) instrument victimisation by the fraction of classroom peers from troubled homes. In our study, using the question "How often do other pupils at school misbehave or cause trouble in your classes" we find that a higher proportion of peer misbehaviour at school augments all bullying forms, being this im-

Similarly, higher household income per capita reduces general bullying victimisation incidence but, increases domestic indirect aggression (stealing and fun/teasing by siblings)-see Tables (2,4). However, household income reduces high incidence direct domestic aggression (physical and verbal bullying) in the FE CML estimates of Tables 5 and 6. These results are consistent with Doidge et al. (2017) concluding that economic disadvantage factors jointly predict physical abuse but not emotional abuse or neglect.[26]

Economic disadvantage can increase adolescent victimisation via a range of mechanisms, including insufficient parental capacity to provide for the needs of their dependent children (food, medical care, better schooling) and exacerbated parental stress which could reduce incentives to invest time and money in child-rearing (see Doidge et al., 2017, p.15). On the other hand, job market participation and hours of work might influence the amount of time dedicated to children. Long working hours, contributing to a certain extent to higher household income, are likely to raise exposure to poor parenting skills producing the positive income association with indirect domestic aggression.[27]

Referring to Table 2, the number of children in the household increases domestic bullying though it fails to be statistically significant in the cases of verbal abuse and fun/teasing by siblings. On the other hand, the number of close friends significantly reduces victimisation in the cases of general bullying, aggregate/physical school bullying and fun/teasing at home (Hodges et al., 1999 and Martin and Huebner, 2007 provide evidence and discuss the protective role of friendship against peer victimisation). Parental school interest also has the expected negative association though it only has a significant impact regarding domestic abuse (aggregate, fun/teasing and stealing).

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pact stronger in the case of non-domestic bullying (school-level/general bullying)- the estimates are available upon request. However, peer school misbehaviour judgement is likely to be simultaneously determined with bullying incidence and since its inclusion does not alter our conclusions we omitted it from the set of controls.

[26]Note that Doidge et al. (2017) study child maltreatment mostly inflicted by parents (emotional/physical abuse/neglect by parents, sexual abuse by family member/other person, witnessing domestic violence among adults).

[27]As explained in Section 2, matching youth respondents to their respective parental interview files (including employment details) is prohibitive in terms of sample attrition given the longitudinal nature of our analysis.

The estimates reveal two distinct gender-related effects. Male adolescents are more likely to be physically bullied at school, while their female counterparts face a higher risk of having their belongings stolen at home (see Tables 2-4). Similarly, Crick and Grotpeter (1995), Bijttebier and Vertommer (1998) and Carbone-Lopez et al. (2010) find that boys are more likely to engage in overt physical/verbal aggression of their peers while girls tend to be more relationally aggressive (frequently via intentional group exclusion). These outcomes could be due to sex differences regarding the nature and perception of relationships. In fact, female early adolescent play involves more sharing and discussion (Lever, 1978) while male adolescent play and relationships revolve around dominance and status (Hartup, 1983; Naylor and Cowie, 1999).

Lastly but not least, perceived family support reduces the victimisation probability across all bullying measures thus, becoming the most prominent victimisation determinant after high previous period bullying incidence. Referring to Table 3, the estimated APEs of perceived family support on victimisation probability are generally significant across all specifications, and their magnitude is only second to previous period bullying status. Adolescents feeling supported by their families are more likely not to be subjected to bullying victimisation with the probability being over 13 percent in the cases of aggregate home/school, verbal home, and other school bullying forms (see top part of Table 3). On the other hand, adolescents feeling supported by their families are less likely to experience either intermediate/high incidence bullying victimisation as indicated by the respective estimated APEs in the middle/bottom parts of Table 3.

The outcome that the estimated family support APEs are notably greater concerning the probability of no bullying victimisation, underscores the importance of the family environment as a protective factor against victimisation which is in agreement with studies such as Henningsen (2009) and Eriksen et al. (2014). In fact, Ttofi et al. (2014) note that family support, particularly the quality of the supportive relationship, confers emotional resilience against bullying victimisation possibly acting as a buffer against decreasing levels of self-esteem associated with victimisation.

Table 2: Adolescent Bullying, 2009-2013, CRE Ordered Probits, Balanced Panels

	(1) GenBull	(2) GenHome	(3) GenSchool	(4) PhysHome	(5) PhysSchool	(6) VerbalHome	(7) FunTeaseHome	(8) StealHome	(9) OthSchool
Bullied:Quite a lot/a lot(t-1)	1.5544***	1.0121***	0.5843	0.5798**	1.5666***	0.6788**	0.8569***	0.8133***	0.3875
	(0.3809)	(0.3317)	(0.4004)	(0.2947)	(0.3521)	(0.3268)	(0.2737)	(0.2908)	(0.3665)
Bullied:Sometimes(t-1)	0.8723***	0.2789	0.0754	0.0920	0.7858***	0.3367	0.4999***	0.4774***	0.3454
	(0.2429)	(0.2233)	(0.2497)	(0.2000)	(0.2837)	(0.2120)	(0.1714)	(0.1848)	(0.2365)
Bullied:Quite a lot/a lot(2009)	0.2813	0.2704	1.3204***	0.6656**	0.2161	0.5112	0.2242	0.3143	1.0909***
	(0.4217)	(0.3309)	(0.4878)	(0.3053)	(0.4382)	(0.3432)	(0.2729)	(0.2662)	(0.4231)
Bullied:Sometimes(2009)	0.3719	0.3216	0.9490***	0.3594*	0.3506	0.4031*	0.0458	0.0092	0.5179*
	(0.2959)	(0.1969)	(0.3052)	(0.2039)	(0.3028)	(0.2169)	(0.1675)	(0.1763)	(0.2727)
Male	0.0024	-0.0703	0.0757	0.0416	0.3437***	0.0080	-0.0682	-0.3208***	-0.0146
	(0.1337)	(0.1054)	(0.1350)	(0.1143)	(0.1278)	(0.0982)	(0.0990)	(0.1102)	(0.1238)
Ln(Real House Net Monthly Income p.capita)	-0.2895*	0.1172	0.0126	-0.0734	0.0771	-0.0584	0.2451**	0.1882*	-0.0716
	(0.1727)	(0.1222)	(0.1446)	(0.1319)	(0.1620)	(0.1128)	(0.1196)	(0.1128)	(0.1346)
Belong to Social Website	0.0669	-0.1235	-0.0128	0.0017	0.3267	-0.1983	0.0427	0.6712**	-0.0522
	(0.3317)	(0.3065)	(0.3574)	(0.2622)	(0.3121)	(0.2880)	(0.3027)	(0.3069)	(0.3612)
Close Friends Number	-0.0323*	-0.0174	-0.0337**	-0.0129	-0.0548***	-0.0102	-0.0272**	-0.0036	-0.0200
	(0.0178)	(0.0130)	(0.0165)	(0.0143)	(0.0187)	(0.0126)	(0.0128)	(0.0145)	(0.0161)
Number of Children in Household	0.0512	0.1343**	0.1026	0.2510***	0.1114*	0.0722	0.0486	0.1878***	0.0578
	(0.0723)	(0.0547)	(0.0710)	(0.0642)	(0.0619)	(0.0565)	(0.0566)	(0.0525)	(0.0642)
London, S.East, S.West, East England	-0.2539**	-0.0492	-0.2030	-0.1122	-0.2999**	-0.0899	-0.0119	0.0667	-0.1809
	(0.1277)	(0.1028)	(0.1295)	(0.1141)	(0.1255)	(0.0965)	(0.0953)	(0.1052)	(0.1203)
Parental School Interest	-0.0620	-0.2420*	-0.0085	-0.0703	-0.1293	-0.1338	-0.2394*	-0.2846**	-0.0469
	(0.1583)	(0.1433)	(0.1630)	(0.1466)	(0.1621)	(0.1318)	(0.1337)	(0.1396)	(0.1578)
Perceived Family Support	-0.4914***	-0.4195***	-0.5465***	-0.2562*	-0.3000**	-0.4516***	-0.2925**	-0.2771**	-0.4952***
	(0.1541)	(0.1247)	(0.1679)	(0.1395)	(0.1517)	(0.1213)	(0.1192)	(0.1341)	(0.1609)
cut1	0.2566	0.4033	0.4286	0.8324*	1.6534***	-0.0535	0.4757	1.1361***	-0.1398
	(0.4761)	(0.3833)	(0.4450)	(0.4366)	(0.5743)	(0.3701)	(0.3816)	(0.3669)	(0.4087)
cut2	1.3437***	1.6146***	2.0701***	2.0532***	2.7594***	0.9118**	1.4666***	2.2103***	0.9781**
	(0.4876)	(0.3900)	(0.5151)	(0.4463)	(0.6333)	(0.3810)	(0.3924)	(0.3927)	(0.4425)
Log Likelihood	-333.233	-596.078	-541.165	-648.378	-346.197	-642.468	-663.988	-580.970	-568.658
Sample Size	808	632	802	684	810	652	666	648	810
Wald (Global Significance)	188.448	123.913	110.813	125.848	162.714	121.847	122.316	108.940	116.882
Intra-Class Correlation	0.128	0.092	0.374	0.243	0.139	0.032	0.049	0.096	0.296
Intra-Class Correlation (p-value)	0.245	0.299	0.012	0.052	0.233	0.427	0.377	0.271	0.040

Notes: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: University of Essex, ISER, Understanding Society: Waves 1-5. Standard errors (in parentheses) are adjusted for individual level (within person) clustering. CRE: Correlated Random Effects. All estimations include individual specific (within) means, for T>2009, of (Belong to Social Website, Close Friends) and a time dummy for 2013.

GenBull: Other children or young people pick on me or bully me. **GenHome**: Brothers/sisters hit, kick or push you. Brothers/sisters call you nasty names. Brothers/sisters make fun of you. Brothers/sisters take your belongings. **GenSchool**: How often do you get physically bullied at school? How often do you get bullied in other ways at school? **PhysHome**: Brothers/sisters hit, kick or push you. **PhysSchool**: How often do you get physically bullied at school? **VerbalHome**: Brothers/sisters call you nasty names. **FunTeaseHome**: Brothers/sisters make fun of you. **StealHome**: Brothers/sisters take your belongings. **OthSchool**: How often do you get bullied in other ways at school?

Table 3: Adolescent Bullying, 2009-2013, APE, Ordered Probits, Balanced Panels

	(1) GenBull	(2) GenHome	(3) GenSchool	(4) PhysHome	(5) PhysSchool	(6) VerbalHome	(7) FunTeaseHome	(8) StealHome	(9) OthSchool
No Bullying Incidence, Bullying=1									
Bullied:Quite a lot/a lot(t-1)	-0.4100***	-0.3161***	-0.1546	-0.1750*	-0.4267***	-0.2272***	-0.2751***	-0.2732***	-0.1055
	(0.1285)	(0.0824)	(0.1241)	(0.0955)	(0.1325)	(0.0765)	(0.0697)	(0.0855)	(0.1109)
Bullied:Sometimes(t-1)	-0.1883***	-0.0916	-0.0184	-0.0271	-0.1714**	-0.1121**	-0.1648***	-0.1593***	-0.0913
	(0.0678)	(0.0606)	(0.0635)	(0.0594)	(0.0783)	(0.0563)	(0.0508)	(0.0580)	(0.0692)
Male	-0.0004	0.0231	-0.0183	-0.0123	-0.0614***	-0.0027	0.0230	0.1074***	0.0037
	(0.0234)	(0.0353)	(0.0335)	(0.0348)	(0.0227)	(0.0331)	(0.0330)	(0.0363)	(0.0305)
Ln(Real House Net Monthly Income p.capita)	0.0494	-0.0385	-0.0030	0.0217	-0.0136	0.0196	-0.0827**	-0.0624	0.0181
	(0.0307)	(0.0408)	(0.0351)	(0.0390)	(0.0287)	(0.0383)	(0.0400)	(0.0386)	(0.0352)
Belong to Social Website	-0.0112	0.0402	0.0031	-0.0005	-0.0520	0.0651	-0.0144	-0.2126**	0.0133
	(0.0592)	(0.0949)	(0.0874)	(0.0763)	(0.0582)	(0.0884)	(0.1034)	(0.0846)	(0.0922)
Close Friends Number	0.0055	0.0057	0.0082*	0.0038	0.0097***	0.0034	0.0092**	0.0012	0.0051
	(0.0035)	(0.0044)	(0.0043)	(0.0045)	(0.0036)	(0.0044)	(0.0045)	(0.0050)	(0.0045)
Number of Children in Household	-0.0088	-0.0442**	-0.0248	-0.0741***	-0.0197*	-0.0242	-0.0164	-0.0623***	-0.0146
	(0.0132)	(0.0183)	(0.0163)	(0.0181)	(0.0107)	(0.0187)	(0.0192)	(0.0178)	(0.0155)
London, S.East, S.West, East England	0.0429**	0.0162	0.0490	0.0332	0.0524**	0.0302	0.0040	-0.0221	0.0456
	(0.0218)	(0.0339)	(0.0322)	(0.0338)	(0.0222)	(0.0317)	(0.0346)	(0.0346)	(0.0297)
Parental School Interest	0.0107	0.0795*	0.0021	0.0207	0.0236	0.0447	0.0798*	0.0955**	0.0119
	(0.0279)	(0.0474)	(0.0389)	(0.0440)	(0.0325)	(0.0454)	(0.0447)	(0.0485)	(0.0406)
Perceived Family Support	0.0940***	0.1373***	0.1403***	0.0750*	0.0571*	0.1489***	0.0975**	0.0931**	0.1335***
	(0.0316)	(0.0403)	(0.0403)	(0.0406)	(0.0299)	(0.0383)	(0.0397)	(0.0457)	(0.0436)
Intermediate Bullying Incidence, Bullying $\in$(1,2]									
Bullied:Quite a lot/a lot(t-1)	0.2123***	0.0244	0.0938	0.0272**	0.2254***	0.0106	-0.0072	0.0632***	0.0516
	(0.0442)	(0.0212)	(0.0643)	(0.0126)	(0.0470)	(0.0095)	(0.0169)	(0.0154)	(0.0478)
Bullied:Sometimes(t-1)	0.1263***	0.0263	0.0120	0.0055	0.1141**	0.0136*	0.0172**	0.0539***	0.0459
	(0.0434)	(0.0181)	(0.0416)	(0.0121)	(0.0495)	(0.0078)	(0.0078)	(0.0189)	(0.0340)
Male	0.0003	-0.0068	0.0120	0.0025	0.0417**	0.0004	-0.0033	-0.0410***	-0.0019
	(0.0155)	(0.0107)	(0.0219)	(0.0073)	(0.0166)	(0.0048)	(0.0052)	(0.0146)	(0.0157)
Ln(Real House Net Monthly Income p.capita)	-0.0326	0.0113	0.0020	-0.0045	0.0092	-0.0027	0.0117*	0.0231	-0.0093
	(0.0202)	(0.0123)	(0.0228)	(0.0081)	(0.0194)	(0.0056)	(0.0066)	(0.0147)	(0.0180)
Belong to Social Website	0.0074	-0.0105	-0.0020	0.0001	0.0360	-0.0057	0.0022	0.1034**	-0.0068
	(0.0383)	(0.0250)	(0.0552)	(0.0175)	(0.0351)	(0.0113)	(0.0207)	(0.0482)	(0.0452)
Close Friends Number	-0.0036	-0.0017	-0.0053*	-0.0008	-0.0065***	-0.0005	-0.0013	-0.0004	-0.0026
	(0.0023)	(0.0013)	(0.0028)	(0.0010)	(0.0024)	(0.0007)	(0.0008)	(0.0019)	(0.0023)
Number of Children in Household	0.0058	0.0129**	0.0162	0.0154***	0.0133*	0.0034	0.0023	0.0231***	0.0075
	(0.0087)	(0.0056)	(0.0107)	(0.0049)	(0.0071)	(0.0028)	(0.0029)	(0.0071)	(0.0080)
London, S.East, S.West, East England	-0.0286*	-0.0048	-0.0321	-0.0070	-0.0355**	-0.0043	-0.0006	0.0082	-0.0237
	(0.0148)	(0.0101)	(0.0212)	(0.0074)	(0.0154)	(0.0050)	(0.0052)	(0.0128)	(0.0156)
Parental School Interest	-0.0071	-0.0199*	-0.0013	-0.0041	-0.0158	-0.0051	-0.0074	-0.0318**	-0.0061
	(0.0183)	(0.0110)	(0.0254)	(0.0086)	(0.0217)	(0.0053)	(0.0049)	(0.0146)	(0.0208)
Perceived Family Support	-0.0613***	-0.0306***	-0.0874***	-0.0126**	-0.0381*	-0.0086	-0.0084	-0.0315**	-0.0648***
	(0.0212)	(0.0092)	(0.0242)	(0.0064)	(0.0200)	(0.0067)	(0.0051)	(0.0149)	(0.0201)
High Bullying Incidence, Bullying$>$2									
Bullied:Quite a lot/a lot(t-1)	0.1978**	0.2917***	0.0607	0.1478*	0.2013**	0.2165***	0.2823***	0.2100***	0.0539
	(0.0937)	(0.0942)	(0.0624)	(0.0872)	(0.0969)	(0.0773)	(0.0814)	(0.0795)	(0.0643)
Bullied:Sometimes(t-1)	0.0620**	0.0653	0.0064	0.0216	0.0573*	0.0985**	0.1476***	0.1055***	0.0455
	(0.0267)	(0.0434)	(0.0221)	(0.0478)	(0.0309)	(0.0502)	(0.0477)	(0.0409)	(0.0358)
Male	0.0001	-0.0163	0.0064	0.0097	0.0197***	0.0023	-0.0197	-0.0663***	-0.0018
	(0.0080)	(0.0249)	(0.0118)	(0.0277)	(0.0071)	(0.0285)	(0.0282)	(0.0229)	(0.0149)
Ln(Real House Net Monthly Income p.capita)	-0.0168	0.0273	0.0011	-0.0172	0.0045	-0.0169	0.0709**	0.0392	-0.0088
	(0.0110)	(0.0289)	(0.0124)	(0.0311)	(0.0095)	(0.0330)	(0.0347)	(0.0243)	(0.0173)
Belong to Social Website	0.0038	-0.0297	-0.0011	0.0004	0.0160	-0.0594	0.0122	0.1092***	-0.0065
	(0.0213)	(0.0742)	(0.0332)	(0.0608)	(0.0332)	(0.0852)	(0.0874)	(0.0383)	(0.0477)
Close Friends Number	-0.0019	-0.0041	-0.0028*	-0.0030	-0.0032**	-0.0029	-0.0079**	-0.0008	-0.0025
	(0.0012)	(0.0032)	(0.0016)	(0.0036)	(0.0013)	(0.0038)	(0.0038)	(0.0032)	(0.0022)
Number of Children in Household	0.0030	0.0312**	0.0086	0.0587***	0.0064*	0.0209	0.0141	0.0392***	0.0071
	(0.0046)	(0.0133)	(0.0058)	(0.0147)	(0.0038)	(0.0162)	(0.0165)	(0.0115)	(0.0076)
London, S.East, S.West, East England	-0.0143*	-0.0114	-0.0169	-0.0262	-0.0169**	-0.0259	-0.0034	0.0140	-0.0220
	(0.0074)	(0.0239)	(0.0113)	(0.0267)	(0.0076)	(0.0270)	(0.0296)	(0.0220)	(0.0144)
Parental School Interest	-0.0037	-0.0595	-0.0007	-0.0166	-0.0078	-0.0396	-0.0724*	-0.0637*	-0.0058
	(0.0097)	(0.0377)	(0.0137)	(0.0358)	(0.0110)	(0.0411)	(0.0430)	(0.0350)	(0.0199)
Perceived Family Support	-0.0327***	-0.1067***	-0.0529***	-0.0624*	-0.0190*	-0.1404***	-0.0891**	-0.0616*	-0.0687***
	(0.0117)	(0.0352)	(0.0179)	(0.0356)	(0.0106)	(0.0397)	(0.0388)	(0.0316)	(0.0250)
Sample Size	808	632	802	684	810	652	666	648	810

Notes: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: University of Essex, ISER, Understanding Society: Waves 1-5. Bootstrapped standard errors (in parentheses) accounting for individual-level clustering (1,500 replications).

4.3 Joint ML and CML FE Estimates

The joint ML estimations (in Table 4) offer no support for simultaneous determination of bullying victimisation and perceived family support. To provide a structural interpretation of the joint ML estimates, and not merely achieve functional form identification, the bullying victimisation models contain perceived family support while the entire family interaction environment (talk/argument frequencies) enters explicitly only in the reduced form models of family support determination (see Table 4).

In fact, the reduced form estimates provide insight into the mechanisms through which suboptimal family interaction affects support feelings: not talking to mum/dad and persistently arguing with mum significantly diminish perceived family support in turn, indirectly augmenting victimisation occurrence (see Table 4). This confirms that the critical risk factors associated with maltreatment relate to parental attributes associated with parenting skills and affective responses to children and their changing developmental needs and circumstances (Doidge et al., 2017, p.15).

The underlying assumption of our structural identification strategy is that the family interaction environment is a direct determinant of perceived family support and does not directly affect bullying incidence. To verify this, we additionally estimate single equation bullying victimisation models inclusive of both perceived family support and all of the family interaction environment variables. The respective results (available upon request) reinforce our argument since they indicate that family support significantly reduces bullying victimisation while the addition of family interaction environment variables does not have an impact.[28]

The error correlation (defined in eq.9) among the shared random effects of the structural and reduced form equations (eq.6 and 7, respectively) is statistically insignificant across all of the joint ML estimates for the nine forms of bullying victimisation (refer to the bottom of Table 4). Conclusively then, the unobserved individual factors underlying bullying victimisation

[28]Note that, excluding parental school interest from the structural equation in Table 4 does not have a notable impact on the estimates nor does it affect our conclusions.

are not related to the latent factors determining perceived family support. Therefore, our preferred estimates correspond to the single equation CRE ordered probit specifications reported in Table 2. Nevertheless, it is worth noting that perceived family support does remain highly statistically significant and enters all joint ML estimations (excluding physical school bullying and fun/tease at home) with sizeable negative effects (see Table 4).

Table 4: Adolescent Bullying, 2009-2013, Joint Maximum Likelihood, Balanced Panels

	(1) GenBull	(2) GenHome	(3) GenSchool	(4) PhysHome	(5) PhysSchool	(6) VerbalHome	(7) FunTeaseHome	(8) StealHome	(9) OthSchool
Bullied: Random Effects Ordered Probit									
Bullied:Quite a lot/a lot(t-1)	1.5570***	1.2006***	1.1746***	1.0226***	1.6542***	0.6925***	0.9303***	0.8937***	0.7732***
	(0.3255)	(0.1998)	(0.2124)	(0.1861)	(0.3012)	(0.1766)	(0.1661)	(0.1942)	(0.1980)
Bullied:Sometimes(t-1)	0.9095***	0.3281**	0.4661***	0.2814*	0.9105***	0.3174**	0.5568***	0.4873***	0.6199***
	(0.2161)	(0.1402)	(0.1372)	(0.1469)	(0.1999)	(0.1511)	(0.1401)	(0.1344)	(0.1461)
Bullied:Quite a lot/a lot(2009)	0.1280	0.1144	0.4522**	0.2278	-0.0084	0.4713***	0.1732	0.1868	0.5358***
	(0.3251)	(0.1856)	(0.2010)	(0.1702)	(0.2932)	(0.1726)	(0.1682)	(0.1749)	(0.1867)
Bullied:Sometimes(2009)	0.2082	0.2229	0.5048***	0.1164	0.2043	0.3534**	-0.0165	0.0114	0.2568*
	(0.2324)	(0.1363)	(0.1381)	(0.1494)	(0.1967)	(0.1464)	(0.1337)	(0.1370)	(0.1486)
Male	0.0013	-0.0524	0.0909	0.0770	0.3036**	-0.0230	-0.0584	-0.2763***	0.0135
	(0.1346)	(0.1001)	(0.1069)	(0.0997)	(0.1231)	(0.1013)	(0.0988)	(0.0997)	(0.1056)
Ln(Real House Net Monthly Income p.capita)	-0.2649	0.1670	0.0186	-0.0018	0.0854	-0.0341	0.2572**	0.2032*	-0.0576
	(0.1657)	(0.1160)	(0.1165)	(0.1110)	(0.1490)	(0.1147)	(0.1201)	(0.1066)	(0.1155)
Belong to Social Website	-0.0831	-0.1113	-0.0270	0.0090	0.3272	-0.2115	0.0280	0.6268**	-0.0903
	(0.3124)	(0.3263)	(0.3034)	(0.2550)	(0.3003)	(0.2967)	(0.3188)	(0.3196)	(0.3323)
Close Friends Number	-0.0276	-0.0185	-0.0267*	-0.0161	-0.0473**	-0.0112	-0.0283**	-0.0022	-0.0158
	(0.0209)	(0.0131)	(0.0148)	(0.0142)	(0.0185)	(0.0129)	(0.0124)	(0.0142)	(0.0147)
Number of Children in Household	0.0044	0.1373***	0.0761	0.2017***	0.1004*	0.0785	0.0341	0.1941***	0.0458
	(0.0663)	(0.0518)	(0.0521)	(0.0522)	(0.0562)	(0.0556)	(0.0561)	(0.0509)	(0.0519)
London, S.East, S.West, East England	-0.2481**	-0.0368	-0.1769*	-0.0669	-0.2548**	-0.0888	0.0079	0.0660	-0.1801*
	(0.1209)	(0.0988)	(0.0985)	(0.0967)	(0.1185)	(0.0975)	(0.0949)	(0.0980)	(0.0982)
Parental School Interest	-0.0110	-0.2197	-0.0449	-0.0317	-0.2117	-0.1520	-0.2158	-0.2343	-0.0290
	(0.1804)	(0.1478)	(0.1405)	(0.1425)	(0.1599)	(0.1422)	(0.1437)	(0.1465)	(0.1480)
Perceived Family Support	-0.5946**	-0.5085***	-0.4866*	-0.3938*	-0.1458	-0.3513*	-0.2975	-0.4309**	-0.4806*
	(0.3024)	(0.1899)	(0.2858)	(0.2254)	(0.2592)	(0.2132)	(0.2015)	(0.2013)	(0.2749)
λ	0.0731	0.0314	0.0777	0.0954	-0.1486	-0.1259	-0.0233	0.0702	0.0265
	(0.2789)	(0.1152)	(0.2539)	(0.1478)	(0.2271)	(0.1556)	(0.1348)	(0.1187)	(0.2371)
bullied_cut1	-0.0456	0.4641	0.4147	0.7494*	1.5705***	0.0358	0.5128	1.1092***	-0.0537
	(0.4566)	(0.3751)	(0.3776)	(0.4034)	(0.5085)	(0.3802)	(0.3864)	(0.3561)	(0.3842)
bullied_cut2	0.9866**	1.6918***	1.7257***	1.8784***	2.6076***	1.0192***	1.4980***	2.1603***	0.9169**
	(0.4648)	(0.3779)	(0.3868)	(0.4038)	(0.5218)	(0.3865)	(0.3875)	(0.3577)	(0.3960)
var(ζ_i)	0.7183**	1.0617**	0.7827**	1.1346**	0.8013**	1.1442**	1.0747**	1.0250**	0.7970**
	(0.3054)	(0.4600)	(0.3258)	(0.4646)	(0.3296)	(0.4744)	(0.4456)	(0.4427)	(0.3251)
Perceived Family Support: Random Effects Binary Probit									
Male	0.3546**	0.2912	0.4024**	0.3822*	0.3903**	0.3069	0.2734	0.3139	0.3734**
	(0.1715)	(0.2165)	(0.1795)	(0.2136)	(0.1799)	(0.2151)	(0.2073)	(0.2116)	(0.1758)
Ln(Real House Net Monthly Income p.capita)	0.0764	0.0030	0.1337	-0.0166	0.1051	0.0310	0.0346	-0.0085	0.0997
	(0.1841)	(0.2419)	(0.1914)	(0.2234)	(0.1907)	(0.2422)	(0.2361)	(0.2375)	(0.1883)
Belong to Social Website	-0.2848	0.1117	-0.3329	0.0569	-0.3260	0.0545	-0.3346	0.0943	-0.3072
	(0.3989)	(0.4166)	(0.4067)	(0.3870)	(0.4142)	(0.4079)	(0.4857)	(0.4179)	(0.4063)
Close Friends Number	0.0122	0.0265	0.0146	0.0194	0.0151	0.0227	0.0198	0.0270	0.0120
	(0.0192)	(0.0217)	(0.0191)	(0.0213)	(0.0195)	(0.0217)	(0.0212)	(0.0219)	(0.0192)
Number of Children in Household	-0.1400	-0.0789	-0.1328	-0.0959	-0.1352	-0.0738	-0.0756	-0.0823	-0.1420
	(0.0904)	(0.1145)	(0.0920)	(0.1103)	(0.0916)	(0.1136)	(0.1130)	(0.1126)	(0.0919)
London, S.East, S.West, East England	0.0392	-0.1585	-0.0518	-0.0732	-0.0339	-0.1367	-0.1213	-0.1363	-0.0198
	(0.1664)	(0.2145)	(0.1730)	(0.2086)	(0.1731)	(0.2142)	(0.2074)	(0.2089)	(0.1715)
Parental School Interest	1.2640***	1.5026***	1.2740***	1.5041***	1.2661***	1.4716***	1.4764***	1.5312***	1.2333***
	(0.1990)	(0.2587)	(0.2042)	(0.2521)	(0.2023)	(0.2532)	(0.2439)	(0.2563)	(0.2023)
Not Talking to Mum	-0.5889*	-1.1742***	-0.6071*	-1.1641***	-0.6210*	-1.1693***	-1.1724***	-1.1979***	-0.6096*
	(0.3438)	(0.4048)	(0.3566)	(0.3854)	(0.3547)	(0.3979)	(0.3799)	(0.3949)	(0.3521)
m(Not Talking to Mum)	0.2945	1.0556*	0.3474	0.9777*	0.3370	0.9128	0.9581*	1.0880**	0.3299
	(0.4561)	(0.5689)	(0.4793)	(0.5386)	(0.4833)	(0.5571)	(0.5386)	(0.5535)	(0.4727)
Not Talking to Dad	-0.5570*	-0.7161*	-0.5867**	-0.7546**	-0.5806**	-0.7664**	-0.7207**	-0.6736*	-0.5746**
	(0.2875)	(0.3736)	(0.2935)	(0.3612)	(0.2907)	(0.3622)	(0.3517)	(0.3656)	(0.2896)
m(Not Talking to Dad)	-0.0378	-0.1407	-0.0150	0.0156	-0.0247	-0.0223	-0.0501	-0.1678	-0.0019
	(0.3603)	(0.4521)	(0.3688)	(0.4366)	(0.3692)	(0.4416)	(0.4288)	(0.4445)	(0.3649)
Not Arguing with Mum	0.1307	0.1884	0.1923	0.1271	0.1901	0.1686	0.0078	0.1417	0.1895
	(0.2469)	(0.2842)	(0.2557)	(0.2734)	(0.2571)	(0.2869)	(0.2878)	(0.2768)	(0.2532)
m(Not Arguing with Mum)	0.9720***	1.1615***	0.9379**	1.0957**	0.9048**	1.1011***	1.2365***	1.1928***	0.9499**
	(0.3399)	(0.4243)	(0.3710)	(0.4267)	(0.3559)	(0.4199)	(0.4205)	(0.4151)	(0.3756)
Not Arguing with Dad	0.3428	0.1249	0.2809	0.2697	0.2843	0.1962	0.4082	0.1761	0.2766
	(0.2794)	(0.3414)	(0.2788)	(0.3160)	(0.2819)	(0.3399)	(0.3336)	(0.3302)	(0.2753)
m(Not Arguing with Dad)	-0.5145	-0.4444	-0.5635	-0.4523	-0.5687	-0.5071	-0.6345	-0.4249	-0.4974
	(0.3463)	(0.4361)	(0.3589)	(0.4173)	(0.3616)	(0.4319)	(0.4188)	(0.4255)	(0.3547)
Log Likelihood	-597.831	-780.484	-800.420	-854.256	-614.628	-846.098	-867.729	-778.373	-829.146
Sample Size	752	594	746	642	752	614	626	610	754
Error Correlation	0.052	0.022	0.055	0.067	-0.104	-0.088	-0.016	0.049	0.019

Notes: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Standard errors (in parentheses) are adjusted for individual level (within person) clustering. GSEM: Generalised Structural Equation Modeling. All estimations, in both equations, include individual specific (within) means, for T>2009, of (Belong to Social Website, Close Friends) and a time dummy for 2013. m(Not Arguing with Mum/Dad), m(Not Talking to Mum/Dad) denote within means for T>2009. The reduced form for Perceived Family Support additionally includes a constant and a normalised (to unity) factor loading.

Finally, employing CML FE estimation to eliminate the time-invariant unobserved heterogeneity, we aim to investigate whether perceived family support remains a significant deterrent of bullying incidence. The CML APEs employing heterogeneous/homogeneous thresholds for intermediate or high bullying incidence are given in Tables 5 and 6, respectively.

Perceived family support generally enters with negative APEs across the CML FE estimates and remains an important deterrent of bullying victimisation. However, statistical significance is less widespread compared to the baseline CRE APEs given in Table 3. Our preferred heterogeneous-threshold APEs (in Table 5) reveal that family support significantly reduces domestic bullying (except stealing), general bullying and non-physical bullying incidence at school.

The CML FE estimates reinstate the protective role of friendship and, unlike the baseline CRE models, also reveal the importance of belonging to a social website network as a buffer against peer victimisation (see Hodges et al., 1999; Martin and Huebner, 2007). Social website membership has a statistically significant impact in reducing non-domestic victimisation while the number of close friends acts as a buffer both domestically/non-domestically against intermediate/high bullying incidence (see Tables 5 and 6).

Table 5: Adolescent Bullying, 2009-2013, CMLE, APE, FE Logit (Heterogeneous Thresholds)

	(1) GenBull	(2) GenHome	(3) GenSchool	(4) PhysHome	(5) PhysSchool	(6) VerbalHome	(7) FunTeaseHome	(8) StealHome	(9) OthSchool
Heterogeneous Thresholds,Bullying >1: Intermediate/High Bullying Incidence									
Ln(Real House Net Monthly Income p.capita)	-0.1498	-0.0035	0.0371	-0.0545	0.0674	0.0766	-0.0246	-0.0372	-0.0032
	(0.1003)	(0.0842)	(0.0768)	(0.0689)	(0.0997)	(0.0785)	(0.0753)	(0.0857)	(0.0736)
Belong to Social Website	-0.1963***	0.0111	-0.0197	-0.0402	-0.1062*	-0.0321	0.0250	0.0700	0.0171
	(0.0717)	(0.0575)	(0.0522)	(0.0528)	(0.0597)	(0.0550)	(0.0510)	(0.0538)	(0.0518)
Close Friends Number	-0.0108	-0.0084*	-0.0089**	-0.0042	-0.0045	-0.0057	-0.0121***	-0.0029	-0.0097**
	(0.0074)	(0.0047)	(0.0036)	(0.0047)	(0.0045)	(0.0043)	(0.0042)	(0.0039)	(0.0039)
Number of Children in Household	0.0942	0.0798	0.1095*	0.1306**	0.0402	0.0463	0.0576	-0.0061	0.1034
	(0.0696)	(0.0508)	(0.0611)	(0.0548)	(0.0639)	(0.0588)	(0.0565)	(0.0521)	(0.0640)
Parental School Interest	-0.1059	-0.0044	-0.0633	0.0208	-0.0119	0.0018	-0.0064	-0.0935	-0.0591
	(0.0777)	(0.0632)	(0.0669)	(0.0746)	(0.0714)	(0.0709)	(0.0660)	(0.0613)	(0.0645)
Perceived Family Support	-0.1236*	-0.1040	-0.0882	0.0231	0.0380	-0.1995***	-0.1372**	-0.0880	-0.1169*
	(0.0714)	(0.0678)	(0.0693)	(0.0736)	(0.0661)	(0.0635)	(0.0610)	(0.0601)	(0.0687)
Sample Size	375	498	534	540	384	495	528	537	534
Heterogeneous Thresholds, Bullying >2: High Bullying Incidence									
Ln(Real House Net Monthly Income p.capita)	-0.0860	-0.1624	-0.0079	-0.2459***	0.2050	-0.1382	0.0328	0.0003	-0.0525
	(0.1645)	(0.1280)	(0.1203)	(0.0944)	(0.2395)	(0.1014)	(0.0986)	(0.1005)	(0.1119)
Belong to Social Website	-0.1346	-0.0389	-0.1965**	-0.0919	-0.2551**	-0.0219	-0.0284	-0.0064	-0.1707**
	(0.1192)	(0.0643)	(0.0865)	(0.0589)	(0.1179)	(0.0642)	(0.0550)	(0.0730)	(0.0814)
Close Friends Number	-0.0043	-0.0023	-0.0055	0.0006	-0.0121	-0.0015	0.0013	0.0028	-0.0054
	(0.0145)	(0.0046)	(0.0086)	(0.0046)	(0.0099)	(0.0047)	(0.0045)	(0.0059)	(0.0086)
Number of Children in Household	0.0040	0.0663	0.1490	0.1029**	0.2266	0.0890	0.1302**	-0.0020	0.0638
	(0.1347)	(0.0616)	(0.0985)	(0.0518)	(0.2923)	(0.0633)	(0.0557)	(0.0778)	(0.0914)
Parental School Interest	-0.0599	-0.0851	0.1154	-0.0812	0.1612	-0.0080	-0.0630	-0.1721**	0.0403
	(0.1543)	(0.0749)	(0.0872)	(0.0642)	(0.1447)	(0.0605)	(0.0640)	(0.0749)	(0.0786)
Perceived Family Support	0.0046	-0.2309***	-0.0225	-0.1709***	0.0304	-0.1638***	-0.1348**	-0.0801	-0.0295
	(0.1337)	(0.0731)	(0.0926)	(0.0593)	(0.1335)	(0.0618)	(0.0625)	(0.0741)	(0.0953)
Sample Size	129	357	237	480	138	441	456	318	261

Notes: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: University of Essex, ISER, Understanding Society: Waves 1-5. Bootstrapped standard errors (in parentheses) accounting for individual-level clustering (1,500 replications).

Table 6: Adolescent Bullying, 2009-2013, CMLE, APE, FE Logit (Homogeneous Thresholds)

	(1) GenBull	(2) GenHome	(3) GenSchool	(4) PhysHome	(5) PhysSchool	(6) VerbalHome	(7) FunTeaseHome	(8) StealHome	(9) OthSchool
Homogeneous Thresholds,Bullying >1: Intermediate/High Bullying Incidence									
Ln(Real House Net Monthly Income p.capita)	-0.0598	-0.0037	0.0390	-0.0544	0.0721	0.0833	-0.0261	-0.0338	-0.0034
	(0.0386)	(0.0690)	(0.0619)	(0.0597)	(0.0725)	(0.0652)	(0.0625)	(0.0553)	(0.0599)
Belong to Social Website	-0.0841	0.0120	-0.0207	-0.0400	-0.1121*	-0.0350	0.0264	0.0614	0.0180
	(0.0630)	(0.0543)	(0.0484)	(0.0495)	(0.0577)	(0.0524)	(0.0481)	(0.0484)	(0.0475)
Close Friends Number	-0.0043	-0.0091*	-0.0093***	-0.0042	-0.0048	-0.0063	-0.0128***	-0.0026	-0.0103***
	(0.0044)	(0.0047)	(0.0036)	(0.0043)	(0.0041)	(0.0041)	(0.0043)	(0.0033)	(0.0039)
Number of Children in Household	0.0376	0.0863**	0.1153**	0.1304***	0.0430	0.0504	0.0612	-0.0055	0.1094*
	(0.0490)	(0.0437)	(0.0510)	(0.0420)	(0.0510)	(0.0498)	(0.0507)	(0.0381)	(0.0568)
Parental School Interest	-0.0477	-0.0047	-0.0661	0.0209	-0.0127	0.0019	-0.0068	-0.0907	-0.0630
	(0.0435)	(0.0598)	(0.0637)	(0.0675)	(0.0635)	(0.0672)	(0.0621)	(0.0587)	(0.0617)
Perceived Family Support	-0.0536	-0.1119*	-0.0920	0.0232	0.0412	-0.2195***	-0.1521**	-0.0844	-0.1253*
	(0.0497)	(0.0662)	(0.0677)	(0.0678)	(0.0621)	(0.0737)	(0.0649)	(0.0581)	(0.0669)
Sample Size	375	498	534	540	384	495	528	537	534
Homogeneous Thresholds,Bullying >2:High Bullying Incidence									
Ln(Real House Net Monthly Income p.capita)	-0.0583	-0.0849*	-0.0073	-0.1032**	0.0340	-0.1219**	0.0282	0.0003	-0.0521
	(0.0733)	(0.0499)	(0.0733)	(0.0422)	(0.0534)	(0.0596)	(0.0632)	(0.0724)	(0.0695)
Belong to Social Website	-0.0961	-0.0209	-0.1670*	-0.0409	-0.0284	-0.0194	-0.0241	-0.0060	-0.1740**
	(0.0875)	(0.0404)	(0.0885)	(0.0371)	(0.0813)	(0.0523)	(0.0448)	(0.0587)	(0.0756)
Close Friends Number	-0.0029	-0.0012	-0.0050	0.0003	-0.0020	-0.0013	0.0011	0.0026	-0.0054
	(0.0091)	(0.0029)	(0.0067)	(0.0024)	(0.0058)	(0.0038)	(0.0035)	(0.0049)	(0.0067)
Number of Children in Household	0.0027	0.0347	0.1375**	0.0432	0.0376	0.0786	0.1118***	-0.0019	0.0632
	(0.0697)	(0.0478)	(0.0622)	(0.0473)	(0.0587)	(0.0586)	(0.0402)	(0.0576)	(0.0686)
Parental School Interest	-0.0421	-0.0468	0.1157	-0.0366	0.0359	-0.0071	-0.0519	-0.1741**	0.0396
	(0.1074)	(0.0510)	(0.0812)	(0.0395)	(0.0767)	(0.0499)	(0.0545)	(0.0796)	(0.0665)
Perceived Family Support	0.0031	-0.1397	-0.0205	-0.0810	0.0052	-0.1564**	-0.1067*	-0.0780	-0.0293
	(0.0951)	(0.0878)	(0.0717)	(0.0560)	(0.0595)	(0.0632)	(0.0604)	(0.0632)	(0.0772)
Sample Size	129	357	237	480	138	441	456	318	261

Notes: ***, **, and * indicate statistical significance at the 1%, 5% and 10% levels respectively. Source: University of Essex, ISER, Understanding Society: Waves 1-5. Bootstrapped standard errors (in parentheses) accounting for individual-level clustering (1,500 replications).

5 Conclusions

We investigate the determinants and dynamics of adolescent bullying victimisation exploiting the Understanding Society (UKHLS) dataset. We analyse the longitudinal evolution of nine distinct types of verbal, physical and indirect abuse at the school and household levels during 2009-2013. We employ dynamic CRE ordered probit models accounting for initial conditions and, fixed effects models incorporating threshold-specific individual unobserved heterogeneity. Further, we apply a joint ML estimator for dynamic discrete response extending existing cross-sectional methods.

In summary, our analysis indicates that the most powerful protective factor is family support while economic disadvantage (low family income/regional income per capita) is an im-

portant risk factor.

There is presence of state dependence in bullying victimisation status. Bullying appears to be persistent across time notably in the case of high past victimisation incidence. This is an alarming outcome highlighting the inability of frequently bullied adolescents to escape victimisation. Concerning aggregate school victimisation, physical domestic abuse and other school bullying, the substantial correlation between initial conditions and unobserved heterogeneity signifies that some adolescents have a higher tendency towards continuing victimisation. This might be due to the failure of our analysis to incorporate unobserved factors such as physical appearance.

Family income reduces non-domestic bullying and direct domestic aggression which is in accordance with other studies (e.g. Henningsen, 2009; Eriksen et al., 2014). However, family income increases indirect domestic victimisation incidence possibly reflecting neglectful parenting due to long working hours. In addition, living in the wealthiest English regions in terms of GVA per capita (London, S.East, S.West, and East England) generally lowers the probability of non-domestic bullying particularly at the school level. Hence, as suggested by other investigations (e.g. Menacker et al., 1990) adolescents attending schools in economically disadvantaged regions face a higher risk of bullying victimisation.

Boys are more likely to be subjected to physical bullying at school and less probable to have their belongings stolen by their siblings at home. These outcomes might be explained by heterogeneity in adolescent play and relational patterns since unlike their more relationally aggressive female peers, male adolescents develop relationships based on dominance and status (see Hartup, 1983; Crick and Grotpeter, 1995; Bijttebier and Vertommer, 1998). Regarding all remaining bullying forms, gender does not seem to affect victimisation propensity differentially. Social website membership and the number of close friends are important preventive factors particularly against non-domestic peer victimisation (see Hodges et al., 1999; Martin and Huebner, 2007).

In agreement with other studies, the principal protective factor against bullying incidence

is family support. Provided that family support and adolescent abuse might be jointly determined, we perform simultaneous estimation of both outcomes. Joint maximum likelihood estimation reveals that the unobserved attributes associated with perceived family support do not tend to occur with the latent determinants of bullying incidence. This outcome suggests that victimised adolescents might not frequently be informing their parents. Further, it highlights that continuing and consistent family support (as opposed to mere support modification in response to bullying occurrence) is a significant protective factor against adolescent victimisation.

Bullying cannot be ignored since high previous incidence leads to continuous victimisation. As noted by Heckman (2012) "health economists should consider the costs and benefits of preventing rather than treating" and our study offers clear guidance for anti-bullying policy design. Prevention efforts should be directed towards addressing parental skills deficits (via parental educational programs), raising public awareness concerning the importance of family support as a protective factor against both domestic and non-domestic victimisation and, intensifying school-level interventions at economically disadvantaged regions.

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A Appendix

Table 7: Descriptive Statistics

	GenBull		GenHome		GenSchool	
	mean	se	mean	se	mean	se
Bullied:Quite a lot/a lot(t-1)	0.052	(0.379)	0.207	(0.333)	0.101	(0.393)
Bullied:Sometimes(t-1)	0.181	(0.244)	0.366	(0.224)	0.284	(0.246)
Bullied:Quite a lot/a lot(2009)	0.059	(0.422)	0.199	(0.332)	0.120	(0.481)
Bullied:Sometimes(2009)	0.213	(0.297)	0.386	(0.198)	0.289	(0.303)
Male	0.475	(0.135)	0.468	(0.105)	0.471	(0.137)
Ln(Real House Net Monthly Income p.capita)	1.879	(0.175)	1.842	(0.122)	1.880	(0.146)
Belong to Social Web-site	0.907	(0.326)	0.908	(0.307)	0.906	(0.358)
Close Friends Number	7.089	(0.018)	7.136	(0.013)	7.092	(0.017)
Number of children in household	1.975	(0.074)	2.093	(0.055)	1.970	(0.072)
London, S.East, S.West, East England	0.448	(0.128)	0.446	(0.103)	0.444	(0.129)
Parental School Interest	0.811	(0.160)	0.799	(0.143)	0.809	(0.164)
Perceived Family Support	0.787	(0.155)	0.772	(0.125)	0.794	(0.168)
Mean Bullying Incidence	1.199		1.777		1.404	
NT	808		632		802	
	PhysHome		PhysSchool		VerbalHome	
	mean	se	mean	se	mean	se
Bullied:Quite a lot/a lot(t-1)	0.330	(0.296)	0.064	(0.358)	0.282	(0.328)
Bullied:Sometimes(t-1)	0.357	(0.201)	0.165	(0.288)	0.322	(0.212)
Bullied:Quite a lot/a lot(2009)	0.363	(0.307)	0.081	(0.445)	0.282	(0.343)
Bullied:Sometimes(2009)	0.357	(0.204)	0.185	(0.310)	0.334	(0.217)
Male	0.480	(0.114)	0.472	(0.130)	0.475	(0.098)
Ln(Real House Net Monthly Income p.capita)	1.845	(0.132)	1.880	(0.163)	1.843	(0.112)
Belong to Social Website	0.909	(0.263)	0.907	(0.312)	0.908	(0.288)
Close Friends Number	7.167	(0.014)	7.090	(0.019)	7.115	(0.013)
Number of Children in Household	2.115	(0.064)	1.973	(0.063)	2.100	(0.056)
London, S.East, S.West, East England	0.450	(0.114)	0.447	(0.126)	0.451	(0.096)
Parental School Interest	0.803	(0.147)	0.811	(0.164)	0.802	(0.131)
Perceived Family Support	0.776	(0.140)	0.796	(0.153)	0.770	(0.121)
Mean Bullying Incidence	1.832		1.204		1.870	
NT	684		810		652	
	FunTeaseHome		StealHome		OthSchool	
	mean	se	mean	se	mean	se
Bullied:Quite a lot/a lot(t-1)	0.242	(0.275)	0.168	(0.290)	0.137	(0.356)
Bullied:Sometimes(t-1)	0.314	(0.172)	0.289	(0.185)	0.216	(0.233)
Bullied:Quite a lot/a lot(2009)	0.228	(0.274)	0.176	(0.267)	0.156	(0.413)
Bullied:Sometimes(2009)	0.303	(0.168)	0.256	(0.176)	0.207	(0.270)
Male	0.471	(0.099)	0.469	(0.110)	0.474	(0.125)
Ln(Real House Net Monthly Income p.capita)	1.846	(0.120)	1.841	(0.112)	1.881	(0.135)
Belong to Social Website	0.908	(0.303)	0.910	(0.307)	0.907	(0.361)
Close Friends Number	7.221	(0.013)	7.082	(0.015)	7.074	(0.016)
Number of Children in Household	2.099	(0.057)	2.093	(0.053)	1.969	(0.065)
London, S.East, S.West, East England	0.444	(0.095)	0.448	(0.105)	0.444	(0.120)
Parental School Interest	0.800	(0.133)	0.802	(0.140)	0.807	(0.159)
Perceived Family Support	0.770	(0.119)	0.775	(0.134)	0.790	(0.161)
Mean Bullying Incidence	1.883		1.648		1.414	
NT	666		648		810	

Source: University of Essex, ISER, Understanding Society: Waves 1-5. Estimation samples shown (t> 2009). **GenBull**: Other children or young people pick on me or bully me. **GenHome**: Brothers/sisters hit, kick or push you. Brothers/sisters call you nasty names. Brothers/sisters make fun of you. Brothers/sisters take your belongings. **GenSchool**: How often do you get physically bullied at school? How often do you get bullied in other ways at school? **PhysHome**: Brothers/sisters hit, kick or push you. **PhysSchool**: How often do you get physically bullied at school? **VerbalHome**: Brothers/sisters call you nasty names. **FunTeaseHome**: Brothers/sisters make fun of you. **StealHome**: Brothers/sisters take your belongings. **OthSchool**: How often do you get bullied in other ways at school?