

**ADULT LABOUR MARKET IMPLICATIONS OF ANTISOCIAL  
BEHAVIOUR IN CHILDHOOD AND ADOLESCENCE:  
FINDINGS FROM A UK LONGITUDINAL STUDY**

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**Abstract**

While antisocial behaviour in younger age groups is largely viewed as a public externality issue, there are also reasons for expecting less favourable life-course outcomes for those individuals who follow antisocial developmental pathways. Data from a UK longitudinal study of delinquent development in a cohort of working class boys are used to model the adult labour market implications of different antisocial developmental pathways to age 32. A series of probit estimations suggests that children identified as troublesome by peers and teachers at an early age, and who subsequently engaged in delinquent behaviour throughout their adolescence, had a significantly higher probability of experiencing long periods of time out of the workforce prior to age 32 and lengthy periods of unemployment and/or low paid work at both age 18 and at age 32. A Heckman selectivity model estimated on weekly earnings at age 32 does not provide evidence that antisocial development in children and adolescents is associated with a lower wage. However, the findings from a two-part model suggests that anti-social boys will have significantly lower levels of expected earnings from employment at 32 years - an effect that is almost entirely the result of lower rates of workforce participation. Whilst a full causal, structural model of labour outcomes is not developed, there is tentative evidence that relatively poor employment outcomes for antisocial boys are mediated through poor educational attainment at secondary school and a higher rates of criminal conviction in early adulthood.

## I. Introduction

Antisocial behaviour is a common feature of child and adolescent development. A recent review of longitudinal evidence has suggested that a large majority of adolescents will, at some point in their development, engage in antisocial behaviour, ranging from specific life-style behaviours including heavy drinking and illegal drug use through to delinquent acts imposing costs on others - criminal damage, theft, bullying and violence are all examples (Moffitt, 1993). While most adolescents cease their involvement in antisocial activities on maturation into adulthood, a small but significant minority – estimated to be less than 10% of the adolescent population – will follow a persistent course of antisocial development from an early age through into their adult years (Moffitt 1993; Nagin and Land, 1993; Nagin et al, 1995).

From an economic viewpoint it is tempting to view antisocial behaviour as primarily a public externality issue. Recent estimates point to the considerable costs that children identified with more serious antisocial tendencies can impose on public institutions and households over time (Knapp et al, 1999; Scott et al, 2001). Preventing the wider social costs incurred by child and adolescent antisocial behaviour has therefore been an important impetus behind a raft of public policy initiatives introduced in the UK targeting crime and other behaviours deemed to be socially damaging. These have included new government legislation targeting antisocial individuals over the age of 10 years (under the Crime and Disorder Act, 1998; Campbell, 2002) and a major resource commitment to crime reduction programmes (National Strategy for Neighbourhood Renewal, 2000). Specific measures have also been targeted at younger age groups including the further development of child and adolescent mental health and social care services and the introduction of a series of early intervention initiatives seeking to divert at-risk children away from antisocial developmental pathways (National Strategy for Neighbourhood Renewal, 2000).

Effective early interventions may have other important long-term economic and social implications. This paper specifically focuses on the adult employment and earnings prospects of antisocial children and adolescents. From a policy perspective employment outcomes and their association with childhood and adolescent development may be important for a number of reasons. Firstly, there may be significant welfare costs arising from any long-term effects on employment of antisocial development – not least given higher risks of poor schooling outcomes and criminal conviction amongst those with more serious behavioural problems. Children and adolescents may not necessarily be aware of the full ramifications of their current behaviour for future well-being, with the implication that children and juveniles are not in the best position to make decisions consistent with life-time welfare maximisation. Moreover, society may take the normative stance that children and adolescents simply discount the future consequences of their current actions too heavily. These concerns are certainly implicit within laws governing the minimum acceptable age for a range of consumption behaviours and activities that may have long-term deleterious effects including, among other things, smoking and the alcohol consumption.

Secondly, the social welfare function may also be broadened to include important equity considerations. A number of commentators, for example, have argued that the

fairness of observed market outcomes needs to be judged with reference to the equality of choice and opportunity sets faced by adults (Sen, 1984; LeGrand, 1991). Thus child and adolescent development characterised by severe antisocial tendencies may adversely affect adult opportunities and capabilities via poor school attendance, school exclusion and low qualifications, all of which may limit human capital investment, employment chances and earnings potential. Finally, and related to the issue of equity, unemployment and low paid work are viewed as at least partial contributors to the wider concept of “social exclusion” (Atkinson, 1998; Burchardt et al, 1999) which is now a key concern of UK government welfare policy (Social Exclusion Unit, 2001).

Against this background this paper reports on a study that utilises data from a longitudinal study of inner-London boys followed up to age 32. A series of econometric models are estimated which explore the strength of association between problem behaviour observed in children at an early age and the development of antisocial tendencies throughout adolescence and four measures of adult employment outcome:

1. extended periods of unemployment over a 5 year period of early adulthood.
2. a persistence of absence from work-force participation and/or a tendency to employment in low paid, unskilled jobs at ages 18 and 32.
3. wage/earnings capability at age 32; and
4. expected earnings at age 32 allowing for the effect of antisocial development on marginal wage rates and the probability of workforce participation in early adulthood.

The modelling standardises for childhood social circumstances and other characteristics at age 8-10 years, including a measure of intelligence, co-existing mental health and behavioural problems and exposure to severe social deprivation. The paper does not pursue a structural equation approach, and therefore the identification of causal pathways between child and adolescent problems and labour outcomes are not fully explored. However, the extent to which poor schooling outcomes and criminal convictions received in adulthood act as a mediating factors in determining employment participation at age 32 is tentatively examined.

A two-part model of work participation and earnings is used to predict differentials in expected earnings between children who follow different antisocial developmental pathways from age 8-10 through their adolescent years up to age 16. A distinction is made between boys who show signs of persistent antisocial tendencies – where troublesome behaviour is identified at an early age and continuing up to age 16 – and those showing potentially less damaging developmental pathways from childhood through adolescence.

## **II. Economic framework**

A priori there are a number of reasons for expecting antisocial development, particularly that of a persistent nature, to have at least an indirect influence on adult

employment outcomes. Children and adolescents with serious antisocial tendencies are more likely to have poorer schooling outcomes (Rutter et al, 1998). This includes poor school attendance as well as a higher risk of permanent school exclusion due to disruptive behaviour. The significance of these problems has been recognised by UK policy makers with a recognition that the educational system may need to be more appropriately adapted for dealing with children and adolescents presenting with severely troublesome behaviour (House of Commons Health Committee, 1997). Poor schooling may limit human capital accumulation, thereby suppressing earnings potential and the likelihood of employment (Becker, 1964). Alternatively, a lack of basic school qualifications and a record of exclusion and truancy may also act as an effective barrier to employment if employers use school qualifications as a screening instrument for detecting inherent ability (Arrow, 1973; Spence, 1973).

An increased risk of criminal conviction is an obvious feature of persistent delinquent and antisocial development. As with poor schooling outcomes the receipt of a juvenile or adult criminal conviction may affect employment chances via human capital accumulation, particularly if conviction is followed by periods spent in prison where skills previously acquired may depreciate or where opportunities for investing in human capital are limited. Criminal convictions may also serve as an effective device used by employers for signalling expectations regarding trustworthiness and reliability. The utilisation of criminal records is argued to be a significant barrier to employment in the UK where a third of the male population are estimated to have received a criminal conviction by age 30 and where recent changes to government legislation have made it easier for firms to access criminal records (Metcalf et al, 2001). This is perceived to pose a threat to the effectiveness of government supply-side employment policies such as the New Deal (Fletcher, 1999). These general conclusions are supported by empirical evidence which has shown that individuals possessing a criminal record are significantly less likely to gain employment (Nagin and Waldfogel, 1995) although this may depend on the reason for conviction and the extent to which trust is viewed as an important job characteristic (Waldfogel, 1994).

Children and adolescents who have a higher risk of developing a persistent tendency to antisocial behaviour in adulthood are also more likely to engage in heavy drinking and illegal drug use (West and Farrington, 1977; Farrington, 1995; Farrington, 2002). The effect of these life-style decisions on earnings and work-force participation can again be viewed within the human capital framework, with heavy drinking and drug use contributing to the health component of an individual's human capital stock (Grossman, 1972). Empirical investigation has shown that problem drinking and illegal drug use reduce employment participation (Mullahy and Sindelar, 1996; Buchmueller and Zuvekas, 1998) and earnings-related income (Mullahy and Sindelar, 1993). Individuals who develop a chronically antisocial life-style are also known to be at higher risk of experiencing mental health problems (Maughan and Rutter, 1998). Various studies have also found that adult mental health problems reduce earnings (Bartel and Taubman, 1986; Frank and Gertler, 1991; French and Zarkin, 1998) and workforce participation (Bartel and Taubman, 1979; Hamilton et al, 1997).

Finally, it is plausible that opting out of the workforce is a general characteristic of individuals who develop into adults with a chronically antisocial lifestyle. Criminologists have included exclusion from employment when identifying clusters of behavioural characteristics to define the presence of an "antisocial syndrome"

(Farrington, 1995). Assessing in this instance whether non-participation in work is purely attributable to preferences is difficult given the need to control for the confounding effects of the health and human capital determinants of employment outcomes.

### III. Empirical specifications

Each of three general (non-structural) empirical specifications directly relate to the four adult employment outcomes identified in the introduction:

*Extended periods of unemployment over a 5 year period of early adulthood and a persistence of absence from work-force participation and/or a tendency to employment in low paid, unskilled jobs at ages 18 and 32.*

Employment prospects defined in these terms are measured using two binary employment measures (defined later). Therefore each employment outcome for the  $i^{th}$  individual is specified as:

$$Z_i^* = \alpha_1 + \sum_{j=2}^k \alpha_j X_{ij} + \varepsilon_i \quad [1]$$

where  $Z^*$  is an index of the latent propensity of an individual towards a specific employment outcome and  $X_{ij}$  are observable childhood characteristics that affect  $Z_i^*$ , including antisocial development through time.  $\alpha_j$  are the parameters requiring estimation and  $\varepsilon_i$  is a random error term.

#### *Wage/earnings capability*

The future wage an individual can command,  $W_i^*$ , is modelled within a standard labour supply framework, where the marginal wage rate (expressed in terms of weekly earnings in the analyses presented here) are only observable for those who choose to work:

$$W_i^* = \beta_1 + \sum_{j=2}^K \beta_j X_{ji} + u_i \quad [2]$$

where  $X_{ij}$  again refer to childhood characteristics and antisocial development and  $u_i$  is the random error term. Moreover:

$W_i^*$  is observed for  $B^* > 0$

$W_i^*$  is not observed for  $B^* \leq 0$

where  $B^*$  is a latent index of the marginal net benefit of choosing to work expressed as:

$$B^* = \delta_1 + \sum_{j=2}^m \delta_j Q_{ji} + \omega_i \quad [3]$$

$\delta_j$  are the model parameters,  $Q_{ij}$  are childhood characteristics and antisocial tendencies and  $\omega_i$  are the random disturbances.

### *Expected earnings*

Expected earnings,  $E(W_i)$ , is defined as:

$$E(W_i | X_{ij}) = P_i \left( \gamma_1 + \sum_{j=1}^k \gamma_j X_{ji} \right) \quad [4]$$

where  $P_i$  is the probability of observing a positive wage ( $W_i > 0$ ) and  $\gamma_j$  are the parameters affecting the wage levels of those who choose to work. Therefore in this specification earnings for those who choose employment are again posited to be a function of antisocial development and other childhood characteristics, with expected earnings derived by weighting individual earnings for those in work by the probability of workforce participation. It is important to recognise the conceptual difference between the conditional wage  $W_i$  from eq [4] and wage/earnings capability  $W_i^*$  from eq [2], given that the latter is strictly a measure of the wage an individual can potentially command in the labour market *irrespective of whether work is actually chosen*.  $W_i$  will be an unbiased measure of  $W_i^*$  so long as there are no workforce selection processes to contend with. These issues have important implications for the choice of estimation procedures to be used when modelling expected earnings and wage/earnings capability.

## **IV. Data, variables and estimation methods<sup>1</sup>**

The study draws on data from the Cambridge Study in Delinquent Development (CSDD; West and Farrington, 1977; Farrington, 1995; Farrington, 2002). The CSDD is a prospective longitudinal study of the development of delinquency and antisocial behaviour in 411 boys who lived in a working class area of south London. The participants have been studied since 1961-62 when they were aged 8 years and at various points during childhood, adolescence and early adulthood. The last completed follow-up was at age 32.

The sample consisted of mainly of boys who were registered with six state primary schools within a one mile radius of a locally based research office (N=399). There were other schools located within the study catchment area. The schools included in the study were those that agreed to participate. A further group of boys (N=12) was recruited from a school for children with learning disabilities in order to make the sample representative of the population of 8 year old males living in the area at the time. Three-hundred-and-fifty-seven of the participants were white and brought up by parents of British origin, 12 had at least one parent of West Indian or African origin, 14 had at least one parent of Irish origin, 12 boys had Cypriot parentage and the remaining 16 boys had at least one parent from another European country or Australia. Most of the boys left school at age 15.

All employment measures were derived from data based on interviews with each subject at ages 18 and 32 :

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<sup>1</sup> All estimations carried out using Stata Statistical Software (StataCorp, 2000).

*Extended periods of unemployment over a 5 year period of early adulthood:* dummy dependent variable identifying subjects experiencing more than one year of unemployment over the five year period prior to age 32.

*A persistence of absence from work-force participation and/or a tendency to employment in low paid, unskilled jobs at ages 18 and 32:* dummy dependent variable identifying subjects who were:

- Either unemployed for more than 18 weeks over 1 year prior to age 18 AND unemployed for more than 12 months over a 5 year period prior to age 32.
- or unemployed for more than 18 weeks prior to age 18 AND current or most recent job was manual-unskilled at age 32.
- or employed in manual-unskilled job at age 18 AND unemployed for more than 12 months prior to age 32.
- or employed in manual-unskilled job at 18 AND current or most recent job was unskilled manual at age 32.
- *Wage/earnings capability<sup>2</sup> and expected earnings at age 32:* natural log of weekly earnings at age 32.

Boys with serious antisocial tendencies and conduct problems at an early age were identified using a prospective measure based on peer and a teacher ratings of each boy's behaviour at school at age 8-10. The ratings were used to construct a dummy variable taking on a value of 1 (0 if otherwise) if a boy was in the lowest quartile of the behavioural ratings distribution. A subject with this characteristic was, for convenience, labelled as a "troublesome boy" (Farrington, 1995).

Antisocial behaviour during adolescence was measured using a measure of adolescent delinquent development based on the criminal convictions received by each subject between 10 and 16 years of age (age 10 is the minimum age of criminal responsibility in England and Wales). These data were recovered by the CSDD from the central Criminal Record Office (West and Farrington, 1977). Previous studies have suggested that convictions are closely correlated with self-report measures of the frequency and seriousness of offending, and that self-report and official delinquency measures are broadly associated with the same group of predictors (Huizinga and Elliot, 1986; Farrington, 1995). Moreover, criminal convictions have also been shown to be highly correlated with the broader measures of antisocial behaviour. For example, previous work has shown that, at age 18 years, delinquency is significantly correlated with other types of antisocial behaviour including heavy gambling, heavy drinking, a variety of sexual partners, anti-establishment attitudes and high self-reported aggression (West and Farrington, 1977).

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<sup>2</sup> Previous work based on the CSDD data found that men with a conviction (either juvenile or adult) were significantly more likely to earn less than £120 per week at age 32, although findings are based on bi-variate comparisons without standardisation for potentially confounding individual characteristics (Farrington, 1989).

Four mutually exclusive developmental pathways through childhood and adolescence were identified by combining the troublesome boy measure with the convictions data:

- Boys who were troublesome at age 8-10 and who were convicted between the 10 and 16 years of age (*“troublesome delinquents”*)
- Boys who presented with troublesome behaviour at 8-10 years but were not convicted between 10 and 16 years of age (*“troublesome non-delinquents”*).
- Boys who were not identified as troublesome at age 8-10 but who still went on to receive a conviction between the 10 and 16 years of age (*“non-troublesome delinquents”*).
- Boys who were not identified as troublesome at age 8-10 and who also did not receive any convictions between 10 and 16 years of age (*“non-troublesome non-delinquents”*).

A set of prospectively measured childhood risk factors (identified at age 8-10) were also included in the modelling. These were: the boy “lacks concentration/is restless” (a measure of hyperactivity and attention deficit); the boy has “low verbal IQ” (a measure of intelligence/cognitive deficit); and the boy is exposed to “severe social handicap”. The first two measures were derived from tests carried out at school, with a boy defined as possessing each characteristic if he was located in the lowest quartile of the relevant test score distribution. The severe social handicap measure was included as a measure of relative childhood poverty. The CSDD identifies “severe” cases as boys who were exposed to at least 4 out of 7 components of a social handicap scale completed by a psychiatric social worker including: family in contact with social agencies; family categorised as being in social class V (unskilled manual job: the lowest social grouping using the Registrar General’s classification system); unsatisfactory housing; neglected interior of housing; inadequate family income; physical neglect of boy; and large family size. Today this “social handicap” measure could be interpreted as an indicator of childhood “social exclusion.”

Current evidence suggests that serious problems with antisocial behaviour in childhood and adolescence are closely correlated with attention deficit and hyperactivity, low IQ and measures of social deprivation and social exclusion (Maughan and Rutter, 1998; Scott, 1998). Ability/intelligence is related to educational attainment (Behrman and Taubman, 1989) which in turn may affect employment and earnings. Attention deficit and hyperactivity has been shown to be linked with poor social outcomes in adulthood (Nagin et al, 1995; Maughan and Rutter, 1998), while there is evidence that childhood poverty and deprivation are predictors of poor economic and social outcomes in later life (Gregg et al, 1999; Hobcraft, 2002). This suggests the need for the inclusion of these variables when attempting appropriately to specify a model of the relationship between antisocial development and adult employment outcomes.

To assess the extent to which any associations between antisocial development and employment outcomes are mediated via school attainment and future adult criminal convictions, two additional dummy variables were utilised. Poor schooling outcome was measured as those boys who either did not pass or study for any school-leaving



examinations. A dummy variable identifying boys who went on to receive adult criminal convictions was constructed from officially recorded convictions received by an individual between the ages of 17 and all years prior to age 32 (i.e. up to and including age 31).

Probit models (Amemiya, 1981; Dougherty, 2002) are used to estimate the average change in the probability of observing more than one year of unemployment over the five year period prior to age 32 and a chronic absence of work-force participation and/or low paid job status at ages 18 and 32. Based on eq [1], the probability,  $P_i$  of observing either of these outcomes is defined as:

$$P_i = f(Z_i) \quad [5]$$

where  $f(Z_i)$  is the standardised cumulative normal distribution. Maximum likelihood estimation is used to estimate  $\alpha_j$  in equation [1]. Average probability changes are evaluated at the mean of  $X_{ij}$ .

A model of wage/earnings capability controlling for sample selectivity was estimated using the approach recommended by Heckman (1976). This involves the estimation of a probit model to identify the determinants of work-force participation specified in eq [3] followed by a second stage estimation of equation [2] using the log of weekly earnings. The effect of self-selection into the workforce is controlled for using the inverse Mills ratio, defined as:

$$\lambda_i = \frac{f(v_i)}{F(v_i)} \quad [6]$$

where  $f(v_i)$  and  $F(v_i)$  are the density functions for  $\omega_i$  (from eq[3]) and the probability of an individual participating in the work-force respectively.  $\lambda$  is entered as a regressor at the second stage of the Heckman selectivity model to correct for omitted variable bias arising from the self-selection process. In this instance both the first-stage probit model of work-force participation and the second-stage semi-logarithmic model of weekly earnings are jointly determined using maximum likelihood estimation. For identification purposes the work-force participation and earnings equations include variables exclusive to each model: the number of children living with a subject is included in the work-force participation equation and part-time employment status in the earnings equation.

A two-part model is employed to estimate expected earnings as defined in eq [4]. Following Duan et al (1983), this involves estimating a probit model of work-force participation in order to derive the mean predicted probability of participation. The second part involves predicting mean earnings for those who are in paid employment. To account for non-normality in the earnings data, equation [8] is estimated using a generalised linear model (GLM) with a log-link function (McCullagh and Nelder, 1989; Manning and Mullahy, 2001). This offers some computational advantages over estimating a semi-logarithmic model using OLS which would require the implementation of an appropriate re-transformation, or “smearing” factor, when converting earnings predictions on a logarithmic scale back to their raw scale values (Duan et al 1983). GLM allows raw scale predictions to be derived more directly. Moreover, there is also greater freedom in choosing the appropriate error variance

distribution that most accurately fits the data at hand. A number of distributional families can be used when applying GLM. Manning and Mullahy (2001) recommend the implementation of a Park test (Park, 1966) when seeking an appropriate solution. This involves running the following OLS regression:

$$\log(Y_i - \hat{Y}_i)^2 = \mu_0 + \mu_1 \log(\hat{Y}_i) + v_i \quad [7]$$

where  $Y_i$  and  $\hat{Y}_i$  are actual and predicted earnings respectively and  $(Y_i - \hat{Y}_i)^2$  are the squared residuals derived from any one of the family of GLM estimators. Eq [7] was therefore estimated on a GLM model of weekly earnings. Based on the estimated size of  $\mu$ , the crucial test statistic in this instance, and following the recommendations of Manning and Mullahy, a GLM with an inverse Gaussian (Wald) distribution was employed. The two-part model is used to predict differences in expected weekly earnings at age 32 for boys who follow different antisocial developmental pathways.

## V. Descriptive analyses

Table 1 presents the frequencies for each of the explanatory and binary employment outcomes included in the analyses. Table 2 cross-tabulates the binary employment outcome measures with each of the antisocial development groupings. The highest proportion of poor employment outcomes across both measures are observed for “troublesome delinquent” boys, although higher rates of poor employment outcome are also observed for the “troublesome non-delinquent” and “non-troublesome delinquent” boys when compared to boys who showed no significant antisocial tendencies at an early age and through adolescence. Mean weekly earnings in 1985/86 (not inflated to current day equivalent values) for those in employment at age 32 were £171.49 (sd = £90.09). There were some moderate differences in mean weekly earnings between the different antisocial development groups (for those in work at age 32). For example, the difference in mean earnings between the “troublesome delinquents” and “non-troublesome non-delinquents” was around £22.00 per week (table 3).

## VI. Econometric results

Loss of observations was a problem for all the model estimations. This was due to the non-recording or unavailability of information on cohort members at various ages and sample attrition: at age 18 389 (95%) of the original cohort were re-interviewed whilst 378 males (94% of those still alive) were either re-interviewed or completed a questionnaire at age 32. Attrition is a general problem with longitudinal data, although the CSDD has been shown to have a lower attrition rate than most other studies of its type. The process of losing observations over time is problematic in criminological data because, as evidenced in previous research (Wolfgang et al, 1987), drop-outs tend to be more antisocial and delinquent. In the CSDD data uncooperative behaviour towards interviewers at age 32 (defined as a reluctance or refusal to be interviewed) was significantly associated with being convicted after age 21 and being involved in fights (Farrington et al, 1990). We consider the possible implications for attrition for the findings in this paper in the discussion section.

Table 4 reports the probit model results with respect to both binary employment

outcomes. “Non-troublesome non-delinquent” is the excluded dummy variable of antisocial development therefore acting as the baseline for comparison with the remaining antisocial variables. The probit model predicts a substantial positive incremental change in the probability of experiencing more than one year of unemployment over the five year period prior to age 32 for both the “troublesome delinquent” (probability increase of 0.18;  $p < 0.05$ ) and “non-troublesome delinquent” groups (probability increase of 0.13;  $p < 0.1$ ). The effect of being classified as a “troublesome non-delinquent” is less important and not statistically significant at conventional levels. Viewed in the context of a mean predicted probability of 0.14 for the excluded reference group, these effects are non-negligible. “Troublesome delinquent” is the only statistically significant antisocial variable in the probit model of absence of labour market success at ages 18 and 32: the average probability increase of observing this employment outcome is estimated to be 0.16 which is again substantial when viewed in the light of a 0.08 predicted probability for the reference group.

In both probit models low verbal IQ at age 8-10 is a significant predictor of poorer employment outcome at age 32.

Table 5 details both stages of the Heckman sample selection model. In the first-stage probit model individuals who were “troublesome delinquent” and who went on to be married at age 32 are significantly more likely to select into employment at that age. The estimated effects of the other antisocial variables on employment selection were not statistically significant. There was evidence of a sample selection bias when modelling earnings capability using data on observable weekly earnings in the work place at age 32: the null hypothesis that  $\rho = 0$  – i.e. that there is no self-selection process affecting the earnings model – is rejected at  $p < 0.01$ .

None of the antisocial variables have an estimated effect on log of weekly earnings that is statistically significantly different from zero, although it is worth noting that the positive coefficients on each antisocial measure – particularly noticeable for the “troublesome delinquents” – is somewhat counterintuitive. The observed positive association may have been a chance observation given the relative small number of individuals in work who fall into each of the antisocial groupings. There may have been some bias resulting from unobserved heterogeneity across cohort members. A RESET test (Ramsey, 1969) carried out on an ordinary least squares regression using log-transformed earnings and the same set of explanatory variables reported in table 5 did not support the presence of an omitted variable bias. A further plausible explanation for the observed positive (though statistically insignificant) earnings effect – particularly for the “troublesome delinquent” group – may be that antisocial boys on reaching their early 30s on average require higher wage offers in order to be induced into the workplace, other things equal.

Boys identified as severely socially handicapped at age 8-10 were predicted to have weekly earnings that were around 27% lower than the remainder of the cohort. In addition, boys who had relatively serious problems with regard to restless behaviour and poor concentration (the hyperactivity and attention deficit measure) were predicted to have weekly earnings at age 32 that were on average around 12% below other cohort members.

Table 6 presents the two-part model of expected earnings. Only those variables

achieving statistical significance at the 5% level are reported (as only these are used when generating the model predictions of expected earnings). Model reduction was carried out based on the sequential exclusion of those variables that did not meet the 5% significance cut-off criteria.<sup>3</sup> The variables found to be significant in the first and second parts of the model are, not surprisingly, broadly consistent with the findings from both stages of the Heckman selectivity model. Again, the “troublesome delinquent” measure is the only antisocial variable that predicts a reduced likelihood of workforce participation, though again there is no significant effect of antisocial behaviour in childhood and adolescence on earnings for those in work. Table 6 also presents two probit models of work force participation that sequentially include the measure of poor school outcome at age 15-16 and then receipt of adult convictions between from 17 and 32 years in order to assess the impact of their inclusion on the estimated coefficients for the “troublesome delinquent” variable. Likelihood ratio tests (reported in table 6) reject the hypothesis that poor school outcome and adult criminal convictions do not make independent contributions to the model of employment participation. Poor school outcome is estimated to be more strongly associated with employment selection at age 32 compared to receipt of adult convictions. The reduced size of the coefficient estimated on the “troublesome delinquent” variable on each sequential inclusion of the schooling and adult conviction variables suggest that they may be both broadly of equal importance in mediating the effect of childhood and adolescent antisocial development on employment participation.

The predictions from the probit (without the schooling and adult conviction variables) and the GLM estimations in the two-part model were combined to predict the expected earnings for the “troublesome delinquent” boys and the remainder of the cohort. The expected earnings differential between each group is computed as :

$$\hat{\pi}(\hat{Y}) - \hat{\pi}'(\hat{Y}') \quad [8]$$

where  $\hat{\pi}$  is the mean predicted probability of employment at age 32 for those boys in the reference group (i.e. all boys who were not included in the “troublesome delinquent” group) and  $\hat{\pi}'$  is the predicted mean probability of employment for the “troublesome delinquent” group.  $\hat{Y}$  and  $\hat{Y}'$  are the mean predicted earnings for the “troublesome delinquents” and the rest of the cohort who entered employment based on the imputation of mean values for significant predictors of weekly earnings from the GLM model: part-time employment status and severe social handicap - around 45% of the “troublesome delinquent group” who entered employment - were identified as severely socially handicapped at an early age compared to around 8% of the rest of the cohort .

Table 8 presents the predicted probabilities, predicted mean earnings for those in work and expected earnings differentials between the two groups of interest. “Troublesome delinquents” were predicted to have an expected weekly income from employment that was around 68% (a £50 per week difference) of the expected mean earnings for the remainder of the cohort group. The majority - around two-thirds - of these expected earnings differentials were due to the lower likelihood of work participation

<sup>3</sup> The estimated coefficients and their significance values were generally stable throughout the exclusion process.

directly associated with being a “troublesome delinquent”, with the remaining difference down to the higher proportion of the “troublesome delinquent” who gained employment experiencing severe social deprivation as a children and the depressing effect of this characteristic on weekly earnings.

## VII. Conclusions

Antisocial tendencies that persist from childhood and through adolescence were found to be strongly associated with a lower probability of employment participation at age 32, as evidenced by the Heckman selectivity and two-part models. This “snap-shot” measure of non-participation in the work force does not fully account for the chronicity of employment experiences in adulthood, which are argued to be of greater relevance when analysing important policy indicators such as social exclusion (Hills, 2002). Thus antisocial tendencies in and adolescents were also found to be strongly associated with long-term periods of unemployment in the late 20s and early thirties as well as a persistent absence of success in the labour market measured as lack of employment participation and/or low pay job status at ages 18 and 32. Beyond issues of social exclusion these outcomes could also be problematic given the adverse effect of lengthy periods of employment success on future employment chances and earnings (Gregg, 1998; Layard, 1999). Unemployment has also been put forward as a contributing factor to increased levels of crime, as evidenced in earlier analyses of the CSDD data and studies using area level data (Farrington et al, 1986; Carmichael and Ward, 2001).

Antisocial tendencies were not found to be associated with lower wages (measured in terms of weekly earnings) at age 32. This finding may have been partly as a result of a wage ceiling effect for this particular cohort which may have compressed earnings differentials between individuals following different antisocial pathways. Studies of younger cohorts drawn from different social backgrounds (the CSDD cohort were predominantly born into a working class environment) might yield different findings assuming higher levels of access to higher education and potential earnings growth for individuals not drawn into an antisocial lifestyle. Despite the apparent lack of any wage association the link between antisocial development and *expected* earnings from employment was not trivial and almost entirely due to lower predicted rates of workforce participation. As expected, both poor school-leaving outcomes and subsequent adult convictions appear to be important mediating factors behind these less favourable employment outcomes. Around 89% of the “troublesome delinquent” group did not study for or pass any school examinations, compared to 47% of the remainder of the cohort. Over 85% of “troublesome delinquents” went on to receive a criminal conviction between ages 17 and 32 compared to only 26% of the remaining boys. “Troublesome delinquent” boys received on average around 5 criminal convictions during their adult years prior to age 32.

Whilst the results highlight the connections between antisocial development at an early age and employment experiences in early adulthood, the study has some important limitations. As with all longitudinal studies of this type, sample attrition was a problem with some evidence that individuals who are more severely antisocial being less likely to be successfully followed up. This would suggest that the effects we estimate on employment outcomes for “troublesome delinquent” boys versus other cohort members are likely to be, if anything, conservative.

The sample was exclusively male and was not selected to be nationally representative of all boys aged 8-10 years at the time of recruitment. Therefore the findings will not necessarily apply to females following antisocial developmental pathways, nor to a more socially representative cohort. Repeat analyses of the type reported here on larger and more representative data sets may provide further insights into long-term employment outcomes across the genders, within more representative populations and may also help to deliver more statistically precise estimated effects (confidence intervals in this instance were rather wide).

The estimated long-term employment outcomes of antisocial tendencies in childhood and adolescence may be partly a function of the cohort studied – an unavoidable problem when using longitudinal data measured over an extended period of time. The boys followed up in the CSDD were aged 8 years in the early 1960s. Those who presented with significant behavioural problems at an early age and who continued with antisocial behaviour through later years are unlikely to have had access to social and therapeutic interventions targeting their problem behaviour. More recent developments in child and adolescent mental health services, social care arrangements and youth criminal justice services may imply different outcomes for problem children from later generations who were born into similar social circumstances. Moreover, long-term outcomes may be sensitive to employment conditions prevailing at the point of follow-up - in this instance when the boys reached age 32 during the mid-1980s. Changing demand for labour relative to its supply, long-term shifts in employment incentives governed by the social security system, or changes in legislation governing the extent to which employers can use information on criminal convictions may all serve to narrow or widen differences in employment participation rates between individuals with and without a history of persistent antisocial behaviour. No attempt was made to control for employment trends in the current study, but the results should be viewed in the light of the potential exogenous changes in the labour market and employment incentive environment.

These caveats aside the findings do imply that effective social policies diverting children and adolescents away from long-term antisocial development may offer long-term labour market benefits, as well as preventing some of the more widely publicised negative public externalities associated with delinquency and antisocial development. In line with existing evidence from the criminology and child psychology literatures the results also imply that interventions might be more socially productive if targeted at children who can be identified as being most at risk of developing more persistent antisocial tendencies. Current evidence suggests that children most at risk include those with serious behavioural problems at early age which in turn have been linked to the interaction between genetic characteristics and the environment within which a child is reared (Moffitt, 1993; Rutter et al, 1998; Farrington, 2002). The benefits and costs of early interventions, including their implications for long-term outcomes, need to be fully evaluated.

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**Table 1: Variable descriptives**

<i>Explanatory variables</i>	<b>Yes (%)</b>	<b>N</b>
<b>Childhood measures (10 yrs)</b>		
Low verbal IQ	103 (25.2)	408
Lacks concentration/restless	82 (20.0)	410
Severe social handicap	55 (13.4)	411
<b>Antisocial development measures (10 yrs up to 16 yrs)</b>		
Troublesome delinquent	39 (9.5)	398
Troublesome non-delinquent	48 (11.7)	398
Non-troublesome delinquent	42 (10.2)	398
Non-troublesome non-delinquent	269 (65.5)	398
<b>Binary employment outcomes</b>		
Unemployed for >12 months over 5 year period (32 yrs)	60 (14.6)	376
Absence of labour market success at age 18-19 & at 32 yrs	33 (8.0)	327

**Table 2: Childhood and adolescent antisocial development measures and adult employment outcomes**

	<b>% of troublesome delinquent</b>	<b>% of troublesome non-delinquent</b>	<b>% “non-troublesome delinquent</b>	<b>% non-troublesome non-delinquent</b>
<b>Unemployed for &gt;12 months over 5 year period (32 yrs)</b>	32.4	22.7	26.3	11.1
<b>Absence of labour market success at age 18 &amp; at 32 yrs</b>	25.0	16.7	11.4	6.8

**Table 3: Childhood antisocial development and earnings for those in work (full or part-time) at 32 yrs**

	<b>Mean (£)</b>	<b>Standard deviation (£)</b>	<b>N</b>
<b>Troublesome delinquent</b>	153.58	75.88	24
<b>Troublesome non-delinquent</b>	173.05	92.02	37
<b>Non-troublesome delinquent”</b>	155.26	54.40	30
<b>Non-troublesome non-delinquent</b>	175.26	106.83	228

All earnings in 1985 prices

**Table 4: Probit models of binary employment outcomes at age 32**

	<b>Unemployed for &gt;12 months over 5 year period prior to age 32)</b>			<b>Absence of work-force participation and/or employment in low paid jobs at age 18 and age 32</b>		
	<b>δ Pr*</b>	<b>Z test</b>	<b>95% CI</b>	<b>δ Pr*</b>	<b>Z test</b>	<b>95% CI</b>
<b>Troublesome delinquent</b>	0.182 <sup>++</sup>	2.34	0.002 to 0.362	0.160 <sup>++</sup>	2.38	-0.009 to 0.330
<b>Troublesome non-</b>						

<b>delinquent</b>	0.095	1.44	-0.050 to 0.241	0.088	1.48	-0.053 to 0.229
<b>Non-troublesome delinquent</b>	0.134 <sup>+</sup>	1.95	-0.021 to 0.290	0.026	0.48	-0.089 to 0.142
<b>Low verbal IQ</b>	0.124 <sup>+++</sup>	2.58	0.020 to 0.228	0.123 <sup>+++</sup>	2.99	0.029 to 0.217
<b>Lacks concentration/restless</b>	-0.007	-0.14	-0.102 to 0.088	-0.026	-0.72	-0.093 to 0.040
<b>Severe social handicap</b>	0.057	0.98	-0.067 to 0.181	0.049	1.03	-0.057 to 0.155
<b>N</b>	365			320		
<b>Predicted probability of outcome</b>	0.146			0.083		
<b>LR test (<math>\chi^2</math> ; 6 df)**</b>	24.07			22.45		

\* $\delta$  Pr – average change in probability of observing employment outcome due to change in value of explanatory variable

\*\* Test of overall significance of model

+Statistically significant at 10% level    ++ Statistically significant at 5% level    +++ Statistically significant at 1% level

**Table 5: Heckman sample selection model of log of weekly earnings at age 32**

<i>Selection into workforce</i>			
	<b>Coef.</b>	<b>Z test</b>	<b>95% CI</b>
<b>Troublesome delinquent</b>	0.817 <sup>+++</sup>	-3.14	-1.326 to -0.307
<b>Troublesome non-delinquent</b>	-0.307	-1.15	-0.830 to -0.217
<b>Non-Troublesome delinquent</b>	-0.350	-1.29	-0.879 to -0.078
<b>Low verbal IQ</b>	-0.275	-1.42	-0.654 to 0.105
<b>Lacks concentration/restless</b>	-0.042	-0.20	-0.453 to 0.368
<b>Severe social handicap</b>	-0.162	-0.68	-0.631 to 0.307
<b>Married</b>	0.715 <sup>+++</sup>	3.99	0.364 to 1.066
<b>Constant</b>	0.941 <sup>+++</sup>	5.68	0.616 to 1.267
<i>Log of weekly earnings</i>			
<b>Troublesome delinquent</b>	0.102	1.17	0.244
<b>Troublesome non-delinquent</b>	0.067	0.76	-0.106 to 0.240
<b>Non-troublesome delinquent</b>	-0.005	-0.08	-0.139 to 0.128
<b>Low verbal IQ</b>	-0.058	-0.80	-0.200 to 0.084
<b>Lacks concentration/restless</b>	-0.120 <sup>+</sup>	-1.80	-0.251 to 0.010
<b>Severe social handicap</b>	-0.267 <sup>+++</sup>	-4.07	-0.395 to -0.139
<b>Part-time work</b>	-0.471 <sup>++</sup>	-2.35	-0.862 to -0.079
<b>Constant</b>	5.134 <sup>+++</sup>	158.98	5.076 to 5.201
<b>Censored cases</b>	51		
<b>Uncensored cases</b>	316		
<b>atanh <math>\rho</math></b>	-0.461	-3.44	-0.724 to -0.198
<b>LR test (<math>\chi^2</math>; 7 df)**</b>	30.37 <sup>+++</sup>		
<b>Wald test if independent equations (<math>\chi^2</math>; 1 df)</b>	11.80 <sup>+++</sup>		

\*Inverse hyperbolic tangent of  $\rho$

\*\*Test of overall significance of sample selection model

+ Statistically significant at 10% level

++ Statistically significant at 5% level

+++ Statistically significant at 1% level

*21<sup>st</sup> January, 2003*



**Table 6: Two-part model of expected earnings at age 32**

	<i>1<sup>st</sup> part: Probit model of workforce participation excluding measure of poor schooling outcome</i>			<i>1<sup>st</sup> part: Probit model of workforce participation including poor schooling outcome</i>			<i>1<sup>st</sup> part: Probit model of workforce participation including poor schooling outcome and conviction as an adult</i>			<i>2<sup>nd</sup> part: Generalised linear model of weekly earnings for those in work at age 32 – estimated with log-link function and assumed inverse Gaussian error variance distribution</i>		
	Coef.	Z test	95% CI	Coef.	Z test	95% CI	Coef.	Z test	95% CI	Coef.	Z test	95% CI
<b>Troublesome delinquent</b>	-0.794 <sup>+++</sup>	-2.98	-1.242 to -0.257	-0.519 <sup>++</sup>	-2.01	-1.025 to -0.0139	-0.230	-1.08	-0.843 to -0.244	–	–	–
<b>Low verbal IQ</b>	-0.410 <sup>++</sup>	-2.17	-0.780 to -0.040	-0.231	-1.16	-0.621 to 0.159	-0.199	-0.99	-0.593 to 0.1953	–	–	–
<b>Severe social handicap</b>	–	–	–	–	–	–	–	–	–	-0.350 <sup>+++</sup>	-4.32	-0.509 to -0.191
<b>Married</b>	0.643 <sup>+++</sup>	3.57	0.290 to 0.996	0.644 <sup>+++</sup>	3.55	0.298 to 1.030	0.644 <sup>+++</sup>	3.41	0.274 to 1.015	–	–	–
<b>Part-time work</b>	–	–	–	–	–	–	–	–	–	-0.493 <sup>+++</sup>	-3.00	-0.815 to -0.171
<b>Poor schooling outcome</b>	–	–	–	-0.717 <sup>+++</sup>	-3.40	-1.130 to -0.303	-0.661 <sup>+++</sup>	-3.09	-1.081 to -0.0504	–	–	–
<b>Conviction as adult</b>	–	–	–	–	–	–	-0.444 <sup>++</sup>	-2.21	-0.837 to -0.050	–	–	–
<b>Constant</b>	0.964 <sup>+++</sup>	6.54	0.65 to 1.252	1.322 <sup>+++</sup>	6.88	0.939 to 1.686	1.435 <sup>+++</sup>	7.08	1.038 to 1.832	5.188 <sup>+++</sup>	159.47	5.12 4 to 5.251
<b>N*</b>	362			353			353			326		

\*Two-part model estimated on differing number of observations to Heckman selection model due to exclusion of variables with missing values.

Variables not included in two-part model (probit or GLM) - : “lacks concentration/restless”, “non-troublesome delinquent” “troublesome non-delinquent”.

Likelihood ratio test on probit model rejects the restriction of setting “poor schooling outcome” equal to zero ( $\chi^2$  test with 1 df = 13.81) <sup>+++</sup>. A further likelihood ratio test also rejects the restriction of setting “any adult convictions” equal to zero ( $\chi^2$  test with 1 df = 4.84) <sup>++</sup>.

+ Statistically significant at 10% level

++ Statistically significant at 5% level

+++ Statistically significant at 1% level

**Table 7: Expected weekly earnings at age 32 predictions from two-part model\***

	<b>Predicted probability of workforce participation</b>	<b>Predicted mean earnings for those in work (£)</b>	<b>Expected earnings at age 32 (£)</b>
<b>Troublesome delinquent</b>	0.709	149.25	105.82
<b>Rest of cohort</b>	0.904	171.84	155.34

\*Earnings in 1985 prices