

DNA RETENTION POLICY: RESULTS OF ANALYSIS RELATING TO THE PROTECTIONS OF 'THE SCOTTISH MODEL'

Summary

The Coalition Agreement¹ contains a commitment to introduce a policy framework for managing the DNA database which affords 'the protections of the Scottish model of DNA retention.' The Crime and Policing Analysis Unit (CPA) of the Home Office has undertaken an analysis of the salient aspects of the Scottish retention model. This paper presents the results.

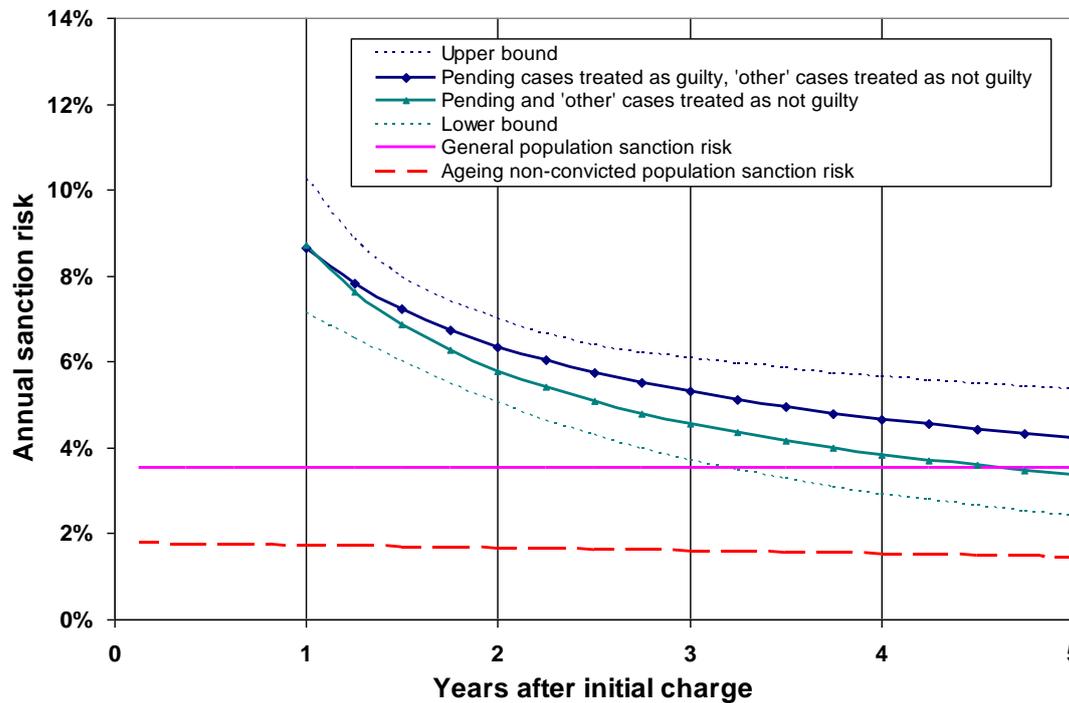
The analysis considered the length of time for which the offending risk of a group of individuals who might be subject to the retention policy is above the level observed in the general population. This was taken to provide an initial indication of the retention period which might be *prima facie* justified on this restricted criterion. Factors such as the costs of retention and the non-quantifiable effects on individual privacy would be expected to point towards a shorter, rather than longer, retention period, especially where statistical error gave a range of possible retention periods to be considered. Due to a lack of suitable information, it was not possible to consider these factors formally as part of the analysis.

The methodological approach was based on the estimation of 'hazard rate curves', which describe how the risk of different CJS disposals varies over time following some initial CJS event. These hazard curves were estimated on the basis of data obtained from the Police National Computer. The risk estimates described by the hazard curves were then compared with an estimate of the relevant risk in some comparable general population.

Figure S1 presents the results of the analysis undertaken for the scenario where DNA profiles are retained when an individual has been charged with but not found guilty of a qualifying offence. A qualifying offence for this particular scenario is defined as one which appears on the existing Crime and Security Act (2010) offence list, with the addition of robbery. It shows hazard curves describing the risk of receiving a conviction or caution following the initial charge, estimated under differing treatments of pending cases, as well as upper and lower bounds (95 per cent confidence intervals) for those curves. It compares those curves against risks estimated for two possible comparable general population definitions. The results suggest that the earliest that offending risk in the charged group falls to the level present in a comparable general population is just over three years after the initial charge. This is based on a comparison of the lower bound hazard curve for the charge group and the risk estimated for all individuals in the general population (age- and gender-adjusted). The results also suggest that offending risk in the charge group might not fall to the level estimated for a comparable general population over relevant timescales. There is some statistical uncertainty associated with the results, as demonstrated by the distance between the upper and lower bounds, due to the relatively small available data sample.

¹ http://www.cabinetoffice.gov.uk/media/409088/pfg_coalition.pdf

Figure S1 Charge-to-sanction hazard rates and comparable general population sanction risks for proposed offence list



Similar analysis was undertaken for the larger group of individuals who were arrested for a qualifying offence but with no further action. The results were similar, with hazard rates estimated to fall to the comparator level at least three years following the initial arrest, and not over relevant timescales for some scenarios. The results of the arrest-based analysis were subject to less statistical uncertainty due to much higher available sample sizes.

Comparative analysis was also undertaken to explore the implications of different factors on relative policy treatments. The results suggested that, if temporary retention was assumed to occur on charge with no conviction, relative sanction risks were higher, four years after the initial arrest, in the group charged with serious offences than in the group charged with other offences. If temporary retention was assumed to occur on arrest with no further action, there was no clear difference in relative sanction risk four years after the initial arrest between those arrested for serious offences and those arrested for other offences. The analysis found that sanction risk following a fixed penalty notice appeared more similar to that following arrest or charge with no conviction (and relatively lower) than to that following a proven offence. Sanction risks following a first caution or non-custodial conviction were relatively similar four years after the initial offence; sanction risks following a second caution or non-custodial sentence (or combination of the two) were relatively higher. Finally, in all cases where a comparison could be made, relative risks in the juvenile sample were higher than in the adult sample.

It should be noted that the results are sensitive to the choice of general population comparator group.

Introduction

The Coalition Agreement² contains a commitment to introduce a policy framework for managing the DNA database which affords ‘the protections of the Scottish model of DNA retention’. This paper presents the results of analyses undertaken by the Home Office Crime and Policing Analysis Unit (CPA) on the salient aspects of the Scottish retention model. These analyses are based on data on arrests and convictions obtained from the Police National Computer (PNC). They consider the offending behaviour of individuals in the time period following different types of criminal justice system (CJS) event (e.g. arrest with no further action, caution or conviction) and for different types of individual and offence.

1. Conceptual approach adopted in the CPA analysis

The broad conceptual approach to examining the issues relevant to DNA retention policy was to consider how the offending-related behaviour of individuals who might be subject to a particular policy compares with individuals who would not be subject to the policy but who are otherwise similar. For instance, the behaviour of individuals with no previous convictions, who are arrested and charged with an offence but not convicted, might be compared with that of other individuals who have not previously been charged or received a conviction.

A significant difference in behaviour between groups of individuals could be said to provide a *prima facie* case for having differential policy treatment of them. Where behaviour is different but changes over time, differential treatment could be said to be *prima facie* justified for as long as behaviour is significantly different. This might be specifically relevant to the question of whether DNA retention should be temporary, and if so, for how long. However, this approach would be considering only offending risk as a possible basis for the case for differential treatment. There might be other justifications for differential (or, indeed, similar) treatment.

Individuals’ behaviour can be measured in terms of the risk of subsequent contact with the CJS – whether in terms of arrest, caution, conviction or some other outcome. Measuring behaviour in terms of the risk of future CJS disposal³ specifically has the advantage of a direct link with the harm associated with offending, and hence supports the assessment of policies with public protection objectives. That link is closer for some disposals than others. For example, convictions have a proven link with an offence, and hence harm, whereas a Fixed Penalty Notice (FPN) requires no proof or acceptance of guilt. An arrest (which is not a disposal) need not necessarily imply any actual offending has taken place. No disposal measures the full extent of an individual’s offending, however, since not all offences he might commit are likely to be reported to the police or brought to justice.

² http://www.cabinetoffice.gov.uk/media/409088/pfg_coalition.pdf

³ ‘Disposal’ is a general term to refer to proven convictions for an offence, cautions, warnings, fixed penalty notices and other outcomes imposed on an offender following an offence.

Evidence that offending risk is significantly higher in one group than in another is insufficient on its own to justify a differential DNA retention policy. The costs and benefits of retention should be taken into account, and some of these are not easily quantified. If such a policy is to be justified on cost-benefit grounds, three conditions (at least) would need to hold:

1. There are benefits to be gained from retaining DNA profiles, in terms of the likely impact on detection rates, crime and, ultimately, harm, or some other form of social value (e.g. justice) – otherwise, no retention is justified in the first place;
2. The benefits of retaining the profiles of one group of individuals are higher than those of retaining the profiles of the general population (however defined) – otherwise, there is no case for singling out any particular group, just because they come into contact with the CJS. This is the relative risk issue already mentioned;
3. The benefits of retaining DNA profiles outweigh the costs, in terms of, for example, database maintenance but also factors such as individual privacy.

Assuming condition 1 holds, if offending risks in one group of individuals and the general population are equal, the incremental benefits of DNA retention for that group are zero. If retention costs are positive, then a cost-benefit approach will tend to set a retention period at a point where there is a positive increment in offending risk between the retained group and the general population. That is, these other factors will tend to point towards a shorter retention period, rather than a longer one. The length of time for which the offending risk of one group of individuals is above the level observed in the general population only gives an indication of the retention period which might be justified if retention costs are zero.

An 'optimal' retention period would be based on the full costs and benefits of DNA retention. However, the evidence currently does not exist in a form which would permit the estimation of the marginal value of retaining the DNA profiles of different individuals, in terms of the impact on crime or (e.g.) justice.⁴ There is also no available evidence of the cost of retention in terms of its impact on individual privacy. Therefore, this analysis was not able to estimate optimal retention periods for DNA retention.

⁴ The ACPO Criminal Records Office (ACRO) has undertaken research which demonstrates that retained DNA profiles can contribute to the resolution of criminal cases (ACRO, 2009). However, it was not able to quantify the additional contribution that profiles can make, or to say for how long retention is justified. Further, strong evidence is currently lacking of the impact case resolution has on crime, or of the benefit case-resolution has in terms of justice or other social values.

2. Aspects of DNA retention policy considered in the CPA analysis

For the purposes of this analysis, the Scottish model of DNA retention⁵ can be characterised as follows:

- Indefinite retention of DNA profiles of adults and juveniles on conviction for any offence;
- Temporary retention of DNA profiles of adults and juveniles on charge (but not conviction) for qualifying violent and sexual offences for three years (extendable by two years on application).

This compares with the legislative regime introduced with the Crime and Security Act 2010, whereby temporary retention was permitted on arrest (with no further action) for any offence for six years.

In addition, the European Court of Human Rights, in its *S and Marper* judgement⁶, found a case in favour of treating juveniles more leniently than adults in terms of their contact with the CJS and any subsequent retention of their DNA.

This suggested that issues that might usefully be considered in the current analysis were as follows:

- Retention periods for those arrested for or charged with an offence, but not sanctioned;⁷
- Retention periods for those receiving different CJS disposals, for instance, cautions;
- Comparison of behaviour of juveniles and adults;
- The definition of qualifying offences.

Further details of the methodologies to explore these issues are given below.

3. Methodological approach

Hazard rates

The basic approach adopted in this work was to describe the behaviour over time of a given sub-population of interest in terms of a 'hazard rate'. This approach has been used previously in the academic literature concerning offending behaviour over time (e.g. Kurlycheck *et al*, 2006; Blumstein and Nakamura, 2009; Soothill and Francis, 2009). The hazard rate for conviction can be estimated as follows:

⁵ Police, Public Order and Criminal Justice (Scotland) Act 2006. Details of the Scottish framework were provided as part of the 2008 consultation on DNA and fingerprint evidence (<http://www.scotland.gov.uk/Publications/2008/09/22154244/15>).

⁶ *S and Marper v United Kingdom* 30562/04 [2008] ECHR 1581 (4 December 2008)

⁷ The more general term 'sanction' is used rather than 'conviction' to reflect the fact that some CJS disposals do not require proof of guilt (e.g. cautions) or acceptance of guilt (e.g. FPNs).

$$h(t|G) = \frac{\text{Number of individuals in group } G \text{ convicted at time } t}{\text{Number of individuals in group } G \text{ not convicted up to time } t} \quad (1)$$

where $h(t|G)$ is the hazard rate for any given group, G , at any time, t . The hazard rate is therefore the probability that an event (in this case, conviction) occurs in the proportion of the group for whom the event has not occurred up to that point. As the event occurs to more and more individuals over time, those individuals are no longer relevant to the calculation of future risk and they are removed from the denominator in (1). This measure is therefore particularly suited to the analysis of policies which are designed to manage risks over time.

A policy of temporary DNA retention on (e.g.) arrest or charge might be applied to the first such event with no sanction or to any such event with no sanction. The former would imply that DNA would be retained on arrest or charge for a maximum length of time equal to the retention period, unless there was an intervening conviction which precipitated indefinite retention. The latter would mean that the retention 'clock' would be 'reset' on subsequent arrests or charges. 'Clock-resetting' is a possible policy option and hence is relevant to the assessment of the appropriate retention period for any particular policy scenario. Therefore, hazard rates are correctly estimated taking account of the effects of resetting. In practice this means removing individuals from the denominator in (1) after a 'reset' as well as after a subsequent sanction.

Resetting has effects on the estimates of hazard rates obtained, and these effects depend on factors which might be the subject of policy scenarios. An example would be the definition of a qualifying offence, which affects how frequently an individual might experience the event in question, and hence how often a reset might occur. Resetting could therefore make it more difficult to isolate the impacts on the analysis of specific variations in the details of the retention policy. For this reason, hazard rates were calculated with and without the effects of clock-resetting, depending on the question being considered (see below).

In some cases, individuals in the initial arrest cohort considered in this analysis had been re-arrested subsequently, but the outcome of that re-arrest was still pending. Therefore, different hazard rates were also calculated assuming the outcomes of these cases were either sanctions ('guilty') or no sanction ('not guilty').

Comparative measures of general population risk

To provide an indication of the period of time that estimated hazard rates in group G might diverge, implying a possible (*prima facie*) argument for differential retention of DNA profiles, the annual probability that the same event occurs in a comparable, general population was calculated. A comparable population was defined primarily in terms of the age and gender composition of the cohort under consideration. Because the evidence suggests that age is a key driver of offending risk (and, in particular, that offending risk rises steeply to a peak at around 18 years of age before then

declining (Soothill *et al*, 2002)), the hazard rate for the comparable population is also likely to change over time.

It is to be expected that conviction rates for individuals with no prior convictions will be lower than for individuals who are proven offenders, at least on average.⁸ It might be argued that the comparative general population group should have the same convictions profile as the group of individuals who are the subject of the specific policy scenario in question. For instance, the behaviour of individuals with no prior convictions who are arrested and charged with a qualifying offence should arguably be compared only with the behaviour of individuals in the general population who also have not been convicted previously, or even charged. If this is the case,⁹ a comparative risk estimate which does not exclude individuals with prior convictions is likely to be too high, because it will be inflated by the effects of the previously-convicted group, and the relative seriousness of the behaviour of the policy scenario group will be under-estimated. Due to data limitations, however, the proportion of the general population with prior convictions can only be estimated with some difficulty, and it is generally not currently possible to identify individuals with no prior arrests. The implications of this are considered below.

Power curves

The data available for the current analysis to estimate hazard curves were limited in terms of the period of time they covered (see below). In particular, suitable data on arrests and charge were only available for a period of approximately four years (see Section 6). Hazard rates beyond four years were therefore estimated by fitting a power curve to the observed data and extending the curve to later years. This extrapolation can only be done with error and hence introduces some uncertainty into results outside of the four-year data period. Analysis of reconviction rates, for which more data are available, suggests the power curve is likely to remain a reasonable approximation for at least seven years. Extrapolating beyond seven years introduces increasing amounts of uncertainty, since the point at which the power and hazard curves diverge is not known.

Results reported below relating to a time within the four-year data period are also those obtained from the fitted power curves. Using calculated hazard

⁸This might be expected, but it does not have to be the case: for instance, if a subset of proven offenders who had already permanently 'desisted' was compared with a subset of individuals with no previous convictions who were 'late onset' offenders, then the future conviction risk of the former might be lower than that of the latter.

⁹ There is no single 'correct' definition of the population against which the behaviour of any particular sub-group should be compared for this analysis. It would seem appropriate that a policy of DNA profile retention should target those people who represent a higher risk of future offending. Elevated risk is by implication taken to be indicated by a CJS event such as arrest or charge, since it is at this point that DNA retention is proposed. However, future offending risks vary across the population in relation to factors other than prior CJS contact (e.g. age). A retention policy for individuals who come into contact with the CJS which is based only on comparing their offending risks with those of others in the same cohort could therefore result in a policy which selects a group of individuals with different levels of risk. Some of these individuals could then have lower risks than other individuals from different cohorts who are not selected simply because they have not had contact with the CJS.

rates rather than observed hazard rates in this way has the advantage of increasing the accuracy of results within the four-year period by reducing the impacts of both random noise and distortions caused by seasonal or one-off events. The residual impact of these factors was estimated using a statistical technique called boot-strapping. This involved generating 1,000 alternative data sets from the observed data¹⁰, fitting a power curve to each data set and calculating the 95 per cent confidence interval of these power curves. This approach avoids many of the assumptions of simpler techniques and enables the impact of sampling error on the extrapolated results to be estimated.

Real relative risks

A second approach to dealing with the potential uncertainty introduced by the limited availability of data was to evaluate proposals by comparing risks, for the policy group and the general population, estimated at a point four years after the initial event relevant to each scenario.

If the ratio between the two risks is 1:1, then this indicates that they are (or are close to) equal. The extent to which the ratio is higher than this gives a measure of the divergence between the two risks (and hence, on the basis of the argument presented in Section 1, a continuing *prima facie* case for differential treatment).

This approach was adopted because it ensured that all results were being compared on the basis of real, rather than forecast or extrapolated, data, since four years was the minimum amount of real data available for any policy scenario under consideration. The disadvantage was that it did not take account of the trajectory of offending risk, and whether or not risks were likely to approach equalisation near to the four-year point.

However, two points can be made in relation to this weakness. First, the uncertainties in estimating the hazard curves and comparator population risks were such that the time period taken for risks to be equalised was not likely to be estimated robustly enough, at least in some cases, for it to be regarded as a reliable *point estimate*. Second, even if it were, this would only be an estimate of a retention period based only on conviction risk, and as suggested above, the information does not currently exist to estimate optimal retention periods on the basis of a comparison of costs and benefits. In that respect, therefore, risk ratios could be seen as an indicator of what differential treatments (in terms of relative retention periods) might be appropriate based on this evidence. However, the exact relativities adopted in practice would need to be a matter of judgement.

4. Data

The previous discussion indicates that data requirements for the current analysis included data relating to the offending behaviour of individuals following arrest, charge and sanction. Data were also needed for the

¹⁰ Each alternative data set is the same size as the original but the random selection is done with replacement, so some individuals might appear multiple times whilst others might not appear at all.

estimation of conviction risks in the general population. Data on offending behaviour following arrest, charge and sanction were obtained from the PNC. Two versions of the PNC database were accessed.

Arrest-to-sanction data

The operational version of the PNC is a hierarchical database, maintained by the National Policing Improvement Agency, and used by the police to share information on people, vehicles, crime and property. This version was used to identify all individuals arrested between April and July 2006. Before April 2006, PNC arrest data were heavily weeded, which made the remaining arrest data incomplete in ways it was not possible to specify. April 2006 is therefore the earliest date available for consistent PNC information on arrest and charge. July 2006 was set as the end of the sample selection period to account for the time taken for arrests to be resolved in a definite outcome (i.e. as no further action, charged but not guilty, caution or conviction). Statistics on the time from ‘offence to completion’ for cases passing only through magistrates’ courts suggest a mean duration of over three months, with a significant ‘tail’ extending beyond 12 months (Ministry of Justice, 2009). Time taken in crown courts, where more serious offences are tried, is likely to be even longer. An end date of July 2006 would allow a follow up period of at least four years, which was considered sufficient to limit the impact that pending cases might have on the analysis. As described above, pending cases were dealt with by constructing different hazard curves on the assumption that they were resolved either as no further action or disposal.

Table 1 Characteristics of the arrest-to-sanction data

<i>Arrests</i>						
People	Mean age	Males (%)	Arrest dates/ person	Offence codes/ event date	Total arrests	Total cases
84,256	29	73	2.0	1.3	167,833	222,118
<i>Outcomes (n=222,118)</i>						
No further action	Fixed penalty notice	Caution/ warning	Charged – guilty	Charged – not guilty	Charged – pending	Other
97,165	484	17,228	41,231	24,695	10,300	31,015

Table 1 provides information on the characteristics of the arrest-to-sanction data. The arrest data obtained covered all 84,256 people with no previous sanctions who were arrested during the period April to July 2006. Variables in the dataset were age, gender, the date of each arrest from April 2006 to June 2010, the associated offence codes and any CJS outcomes.¹¹ There was a

¹¹ It is important to recognise the restricted scope of the variables recorded in the PNC research database relating to individuals. These are limited to age, gender, perceived ethnicity, CJS contact type, offence type and sentence type. No other information is provided which might potentially be useful in explaining variations in offending behaviour, such as educational attainment, psychological profile, parental background and so on. This significantly limits the type of analysis that can be done, and explains why it was not considered appropriate to adopt (for instance) multivariate and similar analytical approaches for either the arrest- or sanction-based work.

total sample of almost 170,000 arrest events and over 220,000 individual 'cases' (arrest-offence combinations). 75,000 resulted in a charge, of which just 10,000 were pending at the end of the sampling period.

Effective sample sizes varied according to the scenario under consideration; for instance, a restricted list of qualifying offences limited the relevance of some arrest and charge events. This produced a maximum sample size of just fewer than 65,000 arrest events for the scenario which considered the sanction behaviour of individuals arrested for offences which were not on the 'CSA+'¹² list, with some individuals appearing more than once because they had multiple eligible arrests within the selection period. The scenario which considered individuals who were arrested for offences on the 'CSA+' produced a sample of size of just over 23,000, with the 'Scottish list at arrest' scenario generating just over 26,000. The smallest arrest sample was obtained for the scenario considering behaviour following retention on charge, with 7,794 eligible adult arrests. A sample of 1,323 juveniles for the same scenario was considered too small to permit reliable comparisons. The smallest charge sample was 2,229 for the 'CSA+' scenario.

Sanction-to-sanction data

The research version of the PNC is an anonymous relational database, maintained by the Ministry of Justice, and used to support research across the CJS into offending behaviour. This version was used to identify 346,620 individuals (71 per cent male, mean age 26) who received their first conviction, caution or equivalent during 2005, and 136,914 (80 per cent male, mean age 24) who received their second.¹³ Each individual in the first group averaged 1.9 dates on which they received a conviction or caution (or equivalent) dates up to the end of 2009, and each date was associated with an average 1.3 offence codes. Each individual in the second group averaged 3.0 dates and 1.4 offence codes per date during the same period. As was the case for arrests, effective sample sizes varied according to the scenario under consideration. A maximum sample size of 191,248 was obtained for the sanction-to-sanction analysis of adult behaviour following a proven offence; the smallest sample size was 3,816 for the analysis of the behaviour of juveniles following their second conviction.

General population comparator data

General population comparator hazard rates were based on a combination of data from the PNC research database and population statistics from the Office for National Statistics (ONS). Dividing the number of people in each age-gender group who received a caution, conviction or equivalent in 2008 (PNC) by the mid-year population estimate for the same group (ONS) produced annual sanction likelihoods. These were then weighted according to the gender and age profile of the portion of the sample who did not receive a proven offence during the follow-up period. The age profile used was that pertaining either at initial arrest (charge) or at a point four years later – the limit of the data used in the analysis – depending on the scenario. Using the

¹² This and other scenarios discussed here are described in more detail in Section 6 and footnote 18.

¹³ The research PNC does not currently include data on arrests or charges.

four-year profile was particularly relevant to cases relating to juvenile samples whose rates of offending change much more significantly with age than adults'. 2008 was chosen as the reference year because it was the mid-point of the four-year data period.

The approach described above was based on statistics including individuals with previous convictions, who, as argued above, are likely to have conviction rates which are higher than individuals with no previous convictions. Therefore, comparator rates were also generated for the subset of the population with no prior cautions or convictions. Historical information on this issue is not readily available, so figures were estimated as follows. First, the research version of the PNC database stretches back far enough that it could be used to calculate the number of individuals under the age of 19 who had committed a prior proven offence by the end of 2008. This, combined with ONS population statistics, permitted the calculation of the size of the 'innocent' population of each age to 18. The size of the population with no convictions in each age older than 18 was then assumed to be equal to the estimate of the not-guilty population of the previous age, less the number of first-time proven offenders for that age group in 2008 (from the research PNC), and adjusted by the relative total population sizes of the two age groups, as follows:

$$N_a^I = (N_{a-1}^I - FTE_{a-1}) \times (N_a^T / N_{a-1}^T) \quad (2)$$

where, for ages greater than 18, and at the start of any given year, $N_a^{I,T}$ is the size of the total (*T*) and innocent (*I*) populations of age *a*, and FTE_a is the number of 'first-time entrants to the CJS' (individuals receiving their first conviction or caution) of age *a* in that year.

The approach therefore assumed that rates of first-time offending in the 19-plus age groups were similar, historically, to first-time offending rates in the same age groups in 2008. Clearly, to the extent that offending rates have changed over time, this would be expected to generate some error in the resulting estimates. This error might not be significant for younger age groups, whose estimates were based on years relatively recent to 2008, giving little scope for changes to have occurred. The error might be more significant for older age groups whose peak age of offending was some time in the past. However, the overall effect on the general population comparator is likely to be minor, given the relatively small proportion of first-time entrants from older age groups.¹⁴ If the current estimates of first-time offending rates for the 35 to 60 age groups were to be doubled, the overall, general population first-time offending rate estimate would rise from an initial 1.75 per cent per annum (see Figure 2) to an initial 1.9 per cent per annum, or by less than nine per cent, suggesting this estimate is not very sensitive to possible errors generated by this aspect of the methodology.

¹⁴ For instance, in 2008, there were nearly four-times as many first-time entrants to the CJS aged between seven and 25 as aged between 35 and 60.

5. Results

How does the risk of sanction following arrest and charge compare with sanction risk in the general population?

The first piece of analysis considered individuals with no prior sanctions who were arrested for a qualifying offence, between April and July 2006, but not sanctioned for it.¹⁵ The initial focus is on individuals who were then charged but not found guilty, as this is the CJS event which can precipitate temporary retention under the Scottish model. A qualifying offence was defined as the existing Crime and Security Act (2009) (CSA) list with the addition of robbery.¹⁶ Hazard curves were constructed assuming that pending cases were either guilty or not guilty. Cases classed as 'other' in the dataset were treated as not guilty. The resulting hazard rate estimates, including the effects of 'clock-resetting', were compared against the estimate of the annual risk of sanction for the general population, adjusted to have the same age and gender profile as the arrestee cohort.

These results are presented in Figure 1, which presents two hazard curves. The first (with diamond markers) is estimated assuming that pending cases are guilty. The other (with triangular markers) is estimated assuming that pending cases are treated as not guilty. Hazard rates are not presented for the period up to one year following initial charge due to variability in the estimates caused by small sample sizes. The dotted lines marked 'Upper bound' and 'Lower bound' are the 95 per cent confidence limits of the power curves obtained from the bootstrapping exercise described above (the confidence intervals for the two curves overlap, so only the extremes are shown). The curves are estimated assuming a policy of 'clock-resetting', so describe how sanction risk changes over the five years following the initial or latest charge (not guilty). The hazard rates at particular time points can then be compared against the estimate of sanction risk in the equivalent general population, which in this case is assumed not to vary over time.

The main hazard curves in Figure 1 show that the central estimate of the point at which the rate of sanction (i.e. convictions and cautions) reaches the national average for the same age and gender profile occurs at least 4½ years after the initial charge (pending cases not guilty) and possibly over five years after (pending cases guilty). The lower bound curve shows that the actual intersection point might occur as early as three years following the

¹⁵ The definition of a sanction here, and in the estimation of hazard rates, includes a conviction, a caution, and a reprimand or warning (for juveniles), which involve proof or acceptance of guilt, but excludes FPNs, which do not.

¹⁶ The list of qualifying offences in the CSA was in turn based on the qualifying offence list in the Criminal Evidence (Amendment) Act (1997). This did not include robbery. However, robbery is an offence which is likely to involve significant levels of violence and attracts a maximum penalty of life imprisonment. Both of these factors (as well as evidence presented by Dubourg *et al.* (2005) on social costs) suggest it is at least as serious as burglary and actual bodily harm, both of which do appear on the 1997 and 2009 lists. Robbery was therefore included in the list of qualifying offences as a likely candidate for inclusion following the Coalition's current review of the DNA retention provisions. This scenario is termed 'CSA+' at various points in this paper.

initial charge. The upper bound and general population curves at the five year point appear close to parallel, suggesting that, in the limit, any convergence might only occur after a significant period of time.

Figure 1 Charge-to-sanction hazard rates and general population sanction risk for 'CSA+' offence list

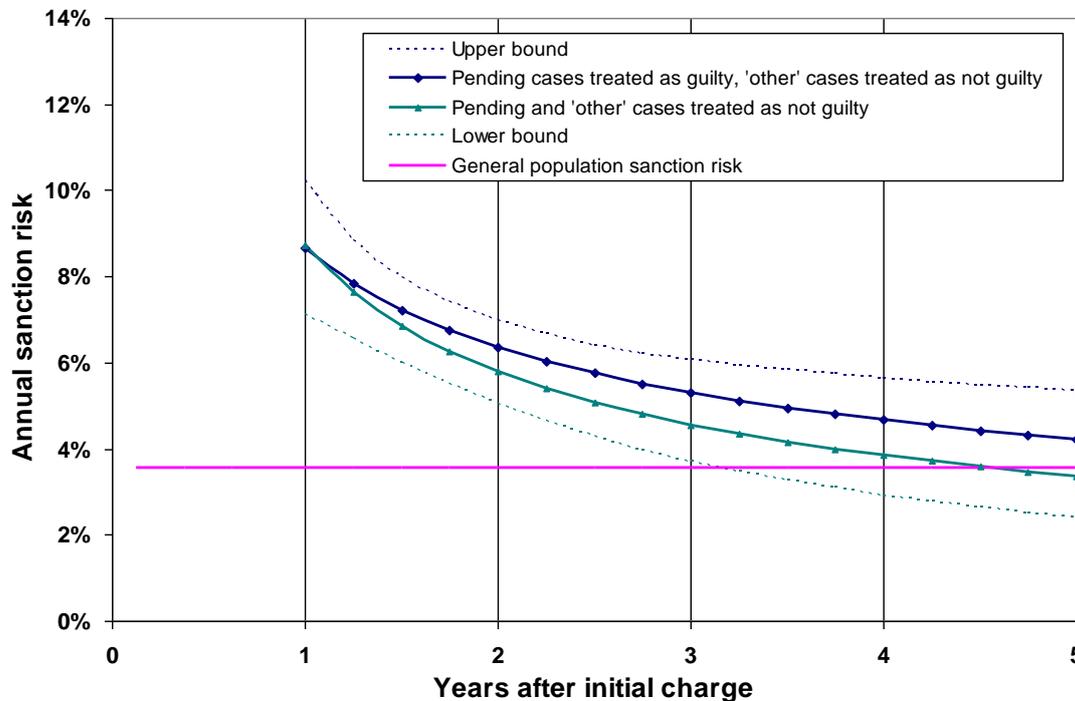
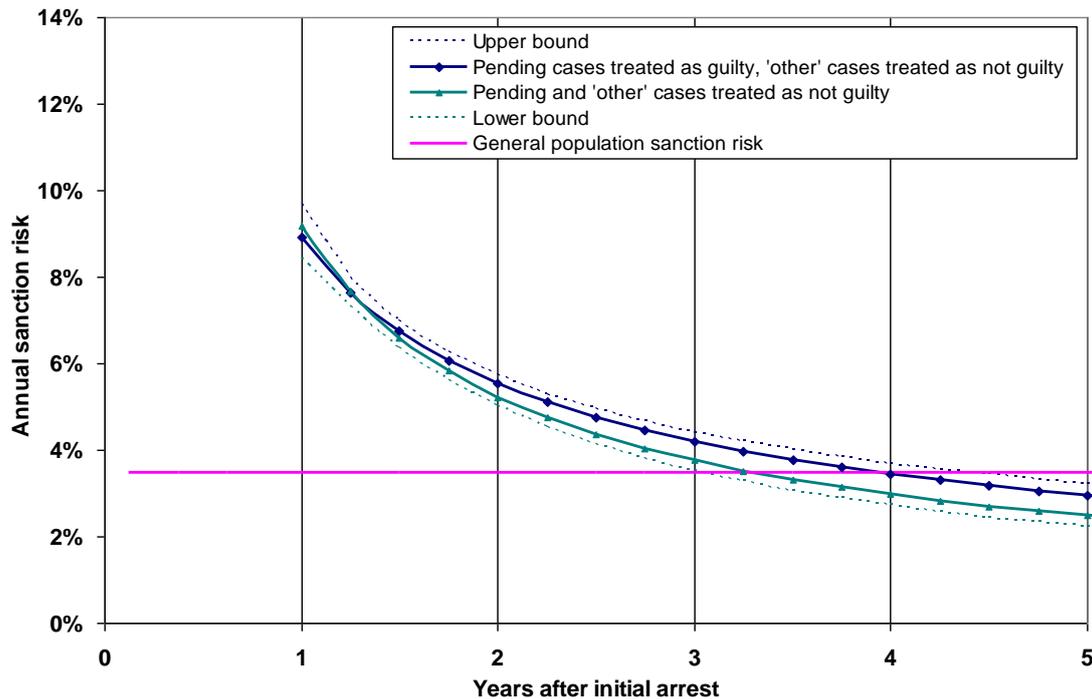


Figure 2 presents similar analysis but for the broader cohort of arrestees which includes those arrested but not charged with an offence. This is the group subject to the DNA retention regime in operation at the time of the S and Marper judgement. The results suggest that the central estimate of the point at which sanction risk for this group reaches the national average occurs between three and four years after the initial arrest. The upper and lower bounds show that the actual intersection point may be as late as $4\frac{3}{4}$ years or as early as three years after the initial arrest. (The narrower confidence interval compared with Figure 1 reflects the larger sample size for the arrest with no further action analysis.) Further, the average risk over the fourth year is not significantly different from the average annual risk in the general population. The earlier intersection periods for the larger 'arrestee' group compared with the 'charge' group suggest that those who are charged but not convicted present an elevated risk of sanction for a longer period than those who are arrested but not charged. This issue is considered further in Table 2 below.

The analysis presented in Figures 1 and 2 compares arrestees' sanction risks against a risk which would be expected in the general population, after adjustment to make the gender and initial age profile of the two groups similar. This means that the risk measure has two important features:

Figure 2 Arrest-to-sanction hazard rates and general population sanction risk for 'CSA+' offence list

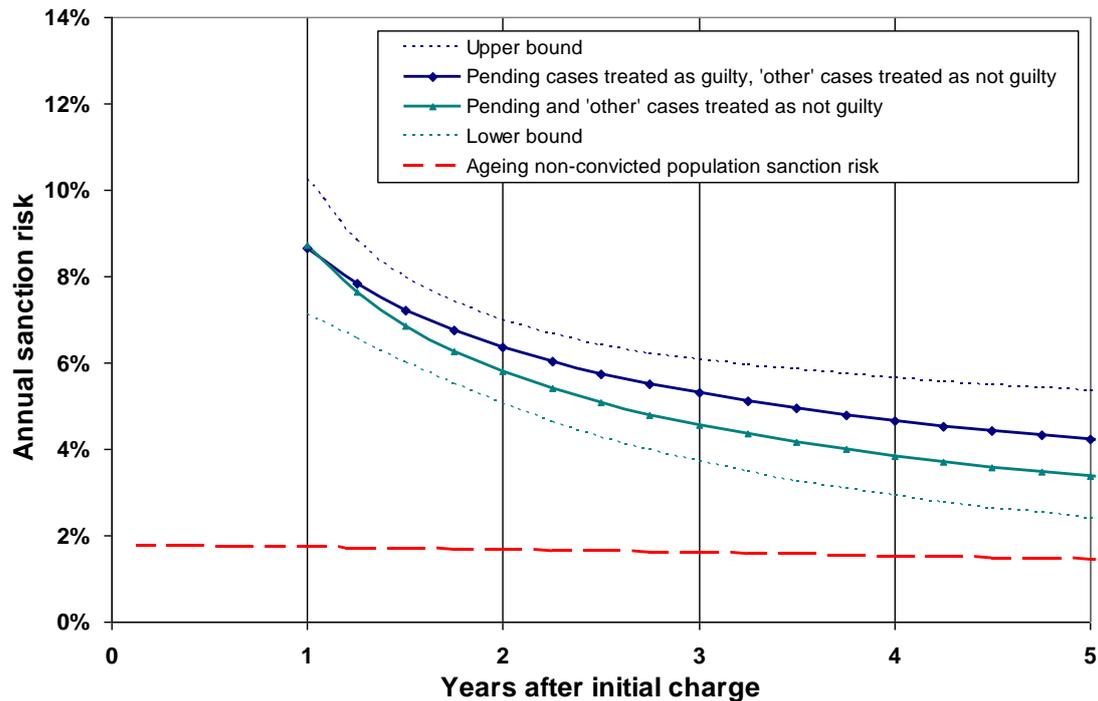


- It is based on a population measure which includes individuals who have been previously sanctioned for an offence. As previously discussed, these individuals are likely to have a higher risk of sanction than individuals who have never been sanctioned previously, meaning that the population average measure will also be higher than for the group limited to individuals with no previous convictions;
- It is constant, and does not reflect the fact that sanction risks change over time. As mentioned above, evidence indicates that risks tend to rise at early ages and reach a peak at around 18, before falling again in later life.

Figure 3 presents the same charge-to-sanction hazard curves as in Figure 1 but with a comparator line which attempts to remove individuals with prior sanctions and to incorporate the effects of ageing. Due to the difficulties in estimating the total number of individuals in the population who have prior sanctions, the comparator line can only be estimated with some uncertainty, and is provided here for illustrative purposes. However, for the purposes of discussion, two remarks can be made about this comparator line:

- The estimated general population risk is lower, at around two per cent per year, compared with almost four per cent per year in Figures 1 and 2, supporting the proposition that individuals with prior sanctions are likely to have a higher risk of future sanction than those without;
- The line slopes very slightly downwards, reflecting the downward effect of ageing on sanction risk. (The effect of ageing on the general population comparator risk estimate can be seen more clearly in Figure 5.)

Figure 3 Charge-to-sanction hazard rate and ageing non-convicted population sanction risk for 'CSA+' offence list



The effect of using this comparator line would be that both measures of risk in the arrestee group, although becoming closer over time to that observed in the comparable general population, would appear to remain significantly higher five years after the initial charge event. It is difficult to forecast the future profile of arrestee sanction risk with confidence. However, the shape of the hazard curves at the five-year point would then suggest that convergence might only occur a long time into the future, and in fact might never happen.¹⁷ This would then imply that the risk of subsequent sanction of the arrestee group would always be higher than that of the comparable general population. There are significant uncertainties in estimating general population conviction risks which exclude individuals with previous convictions, so this example is provided only for illustration. However, it does serve to demonstrate the potential effect of the choice of comparator group on the results and any subsequent inferences that are drawn.

¹⁷ Blumstein and Nakamura (2009) and Kurlycheck *et al* (2006) considered the risk of re-arrest following an initial arrest event, rather than the risk of sanction following charge. Soothill and Francis (2009) considered the risk of court conviction following an initial conviction event. Therefore, none of these studies is directly comparable with the analysis presented here. However, all three studies found that hazard rates converged only after considerable lengths of time. Blumstein and Nakamura (2009) found no convergence after twenty years for some analysis scenarios, although did not report whether the differences at this point were statistically significant. Soothill and Francis (2009) concluded that, 'if persons remain crime-free for a period of, say, ten years after the age of 20 years, then those with an offence record in their youth and/or early adulthood have similar but not quite equal likelihoods of a further conviction compared with the on offending population of their age' (p387).

Figure 4 Arrest-to-sanction hazard rate and ageing non-convicted population sanction risk for 'CSA+' offence list

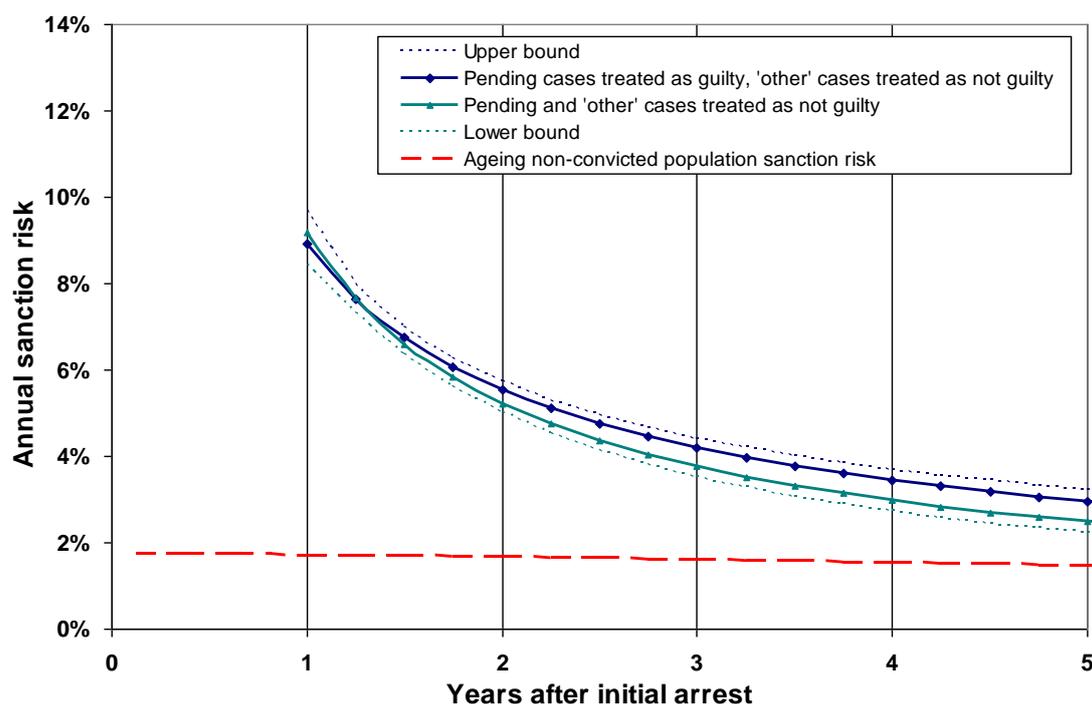


Figure 4 provides the same comparison with the ageing, non-convicted population but for the complete arrestee cohort including those not charged with an offence (Figure 2). The same general results are found, although the 'excess' risk estimated at the five year point are somewhat lower for the general arrestee group than for the charge sub-group.

How does the risk of sanction following arrest and charge with a serious offence compare with the risk of sanction following arrest and charge with a non-serious offence?

There is no single definition of what constitutes a serious offence. Three possible definitions are provided by the following existing legislation:

- The Scottish qualifying list, which focuses on sexual and violent offences, accordingly including common assault (a summary offence) but excluding robbery and burglary (both indictable and punishable with a custodial sentence);¹⁸
- Indictable offences, which are more serious than summary offences and can be tried in a Crown Court, but which also include some less serious offences which are 'triable either way' (e.g. criminal damage);
- The CSA list plus robbery, which can be *broadly* categorised as those more serious offences with one or more (potential) victims.

Table 2 presents sanction risks for the arrestee group and the comparator general population ('baseline' in the table), and the ratio of the two, evaluated

¹⁸ Robbery is excluded apparently despite the evidence which suggests that this offence can involve significant levels of violence, and harm, on average (Dubourg *et al.*, 2005).

at the four-year point following an initial charge with no conviction, and the more general case of arrest with no further action.¹⁹ It does this for the three definitions of serious offences and the implied associated non-serious group.

Table 2 Sanction risks and risk ratios by definition of qualifying offence

Qualifying offence definition	Qualifying offences			Other offences		
	Hazard	Baseline	Ratio	Hazard	Baseline	Ratio
<i>Charged but not convicted</i>						
Scottish list	3.2%	2.6%	1.2	2.8%	2.7%	1.0
CSA list plus robbery	4.3%	3.1%	1.4	2.6%	2.6%	1.0
Indictable offences	3.5%	2.8%	1.2	2.3%	2.5%	0.9
<i>Arrested with no further action</i>						
Scottish list	3.0%	2.7%	1.1	3.4%	3.3%	1.0
CSA list plus robbery	3.5%	3.2%	1.1	3.2%	3.1%	1.0
Indictable offences	3.3%	3.1%	1.1	3.3%	3.2%	1.0

Table 2 shows that the risk ratios at four years are very similar between those arrested for qualifying and non-qualifying offences, and that this similarity is robust to variations in the definition of ‘serious’. The risk ratios at four years for those charged with qualifying and non-qualifying offences are also similar. However, absolute and relative risks of sanction for the charged group do seem to be slightly higher for qualifying offences, particularly for the ‘CSA+’ scenario (ratio of 1.4 for qualifying offences compared with 1.0 for other offences, and absolute risks of 4.3 per cent and 2.6 per cent respectively). Note, however, that these conclusions are not based on a formal statistical analysis of these differences in risk.

How do sanction risks compare following different CJS events?

Table 3 considers the risk of sanction following arrest with no further action; arrest and charge with no guilty verdict; a FPN; and, a proven offence. The risks presented in Table 3 are not calculated on the basis of a restricted set of qualifying offences (which largely explains any difference between risk estimates presented in Figures 1-4). A comparison of adult sanction risks and relative risks at the four-year point suggests no substantial difference between those arrested with no further action and those charged but not found guilty. The baseline risk estimate is slightly higher for the ‘arrest with no further action’ group, possibly reflecting the younger age profile compared with the ‘charged not guilty’ group (average age of 33 in the former case and 35 in the latter). There is less difference in hazard rates at the four-year point, however, resulting in a very slightly higher risk ratio for ‘charged not guilty’, but still not one which suggests the presence of ‘excess’ risk. This suggests that the behaviour of adults following any arrest (i.e. for any offence) with no further

¹⁹ ‘Sanction’ here covers convictions and cautions (and the juvenile equivalents) and excludes FPNs. Estimated sanction risks exclude the impact of ‘clock-resetting’, which would vary depending on the assumed scope of the qualifying list. Baseline risk estimates include the effects of ageing, and is based on a population definition which includes individuals with previous sanctions. The same applies for subsequent comparative results in this section. Comments made above in relation to the choice of comparative general population group therefore apply.

action is very similar to the behaviour of adults who are charged with any offence but not found guilty. However, Figures 1 and 2 and Table 2 suggest this is not the case when the restricted 'CSA+' set of qualifying offences is considered. Insufficient data exist to make any similar assessment for juveniles.

Table3 Sanction risks and risk ratios following different CJS events

Initial outcome	Juveniles			Adults		
	Hazard	Baseline	Ratio	Hazard	Baseline	Ratio
Arrest with no further action	7.4%	5.7%	1.3	2.6%	2.8%	0.9
Charged not guilty	Insufficient Data			2.4%	2.4%	1.0
Fixed Penalty Notice	7.1%	5.7%	1.2	3.6%	3.5%	1.0
Proven offence	9.5%	5.2%	1.8	3.4%	2.7%	1.3

Table 3 provides the same information, for both adults and juveniles, following a proven offence (conviction, caution or equivalent). Risk ratios for juveniles are 1.3 for the 'arrest with no further action' group and 1.8 for the 'proven offence' group. For adults, the ratios are 0.9 and 1.3 respectively, suggesting that relative risks are higher for the proven offence groups compared with those arrested with no further action, although not by a great amount. A comparison with the results for groups given a FPN suggests their relative risks are more similar to those of the arrestee groups than the conviction groups (ratios of 1.2 and 1.0 for juveniles and adults respectively). It should be recalled, however, that these comparisons are not based on formal tests of statistical significance, and do not relate to a restricted list of offences.

How do conviction risks compare following different proven offences?

Table 4 presents sanction risks and risk ratios, measured at the four year point, for adults and juveniles following cautions (or the youth equivalent) and non-custodial convictions for any offence. For both groups, results for first caution and first conviction are similar to each other. The results for a second caution and a first caution-first conviction combination are also similar to each other. For both groups, risks and ratios are higher for second caution, first caution-first conviction and second conviction than they are for a simple first caution or conviction. Risk ratios are highest for the second non-custodial conviction groups.

Table 4 Sanction risks and risk ratios following proven offences

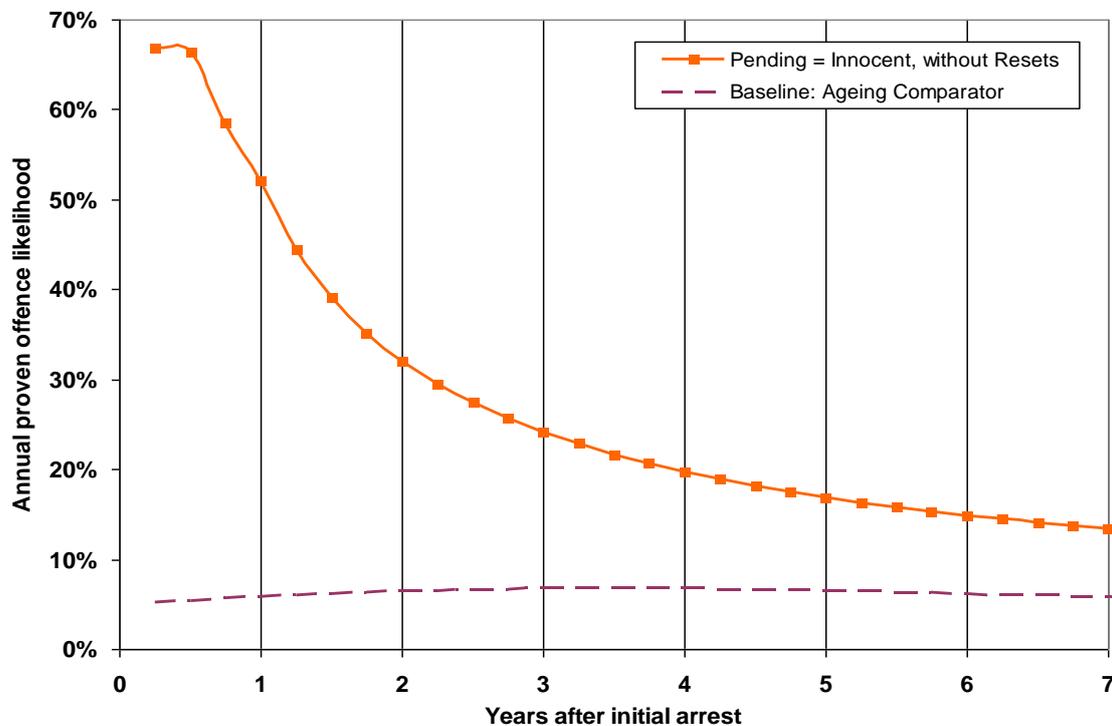
Proven offence groups	Juveniles			Adults		
	Hazard	Baseline	Ratio	Hazard	Baseline	Ratio
First caution (or equivalent)	9.5%	5.2%	1.8	3.6%	2.8%	1.3
First non-custodial (NC) conviction	10.1%	5.9%	1.7	3.2%	2.6%	1.2
Second caution (or equivalent)	15.4%	5.6%	2.8	8.0%	3.8%	2.1
Caution then NC conviction	15.8%	5.9%	2.7	7.8%	3.7%	2.1
Second NC conviction	18.7%	5.9%	3.2	6.0%	2.7%	2.3

Comparing the data in Tables 3 and 4, risks and ratios are higher in all cases following a proven offence (first or second) than they are following an arrest or charge with no conviction. For adults, hazard rates and baseline risks are

under three per cent at the four-year point following arrest or charge, with ratios around 1.0. Hazard rates following a first or second proven offence range from just over three per cent to eight per cent at the same point, with ratios from 1.2 to 2.3.

Further analysis suggests that sanction risks following a second proven offence might not converge with sanction risks observed in the general population, at least over relevant timescales. This is demonstrated in Figure 5 for the case of juveniles, which compares the risk of a second non-custodial conviction following a first non-custodial conviction against an ageing comparator line. Thus it can be seen that, by seven years after the first conviction, there is still a substantive difference in risks between the conviction group and general population group, and the curves appear almost parallel at this point, suggesting no obvious convergence in the 'near' future.

Figure 5 Second-conviction hazard rate and ageing general population conviction risk for juveniles



How do the sanction risks of juveniles and adults compare?

Tables 3 and 4 provide risk estimates and ratios for adults and juveniles separately. It can be seen from these results that, in all cases where estimates could be made, baseline risks and hazard rates at the four-year point following each initial CJS event are substantively higher for juveniles than for adults, as are the corresponding risk ratios. This is in line with a considerable body of academic literature which has found that early contact with the CJS is a strong predictor of more persistent and prolific offending careers (e.g. Farrington, 1992).

Likely effect on these comparisons of excluding convicts

It should be remembered that the preceding comparisons are in most cases made against general population definitions which include individuals with prior convictions. Excluding such individuals is likely to lower the comparator risk in all cases, and could mean that risks do not converge. It would also be expected to increase all of the risk ratios presented in Tables 2-4. It is possible (although by no means guaranteed) that the relativities between these ratios, on which the current comparative analysis has been based, might change, because the age and conviction profiles for different offence types also differ. However, it is not currently possible to estimate conviction risks which exclude the effects of prior convictions, with sufficient confidence or over reasonable timescales, for them to be the general basis for the analysis. Therefore, the current comparisons are likely to be the fairest possible at this point, but their limitations should be recognised.

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