Ministry of JUSTICE

Peterborough Social Impact Bond: an independent assessment

Development of the PSM methodology

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Summary

QinetiQ and the University of Leicester were selected by the Ministry of Justice (MoJ) as the Independent Assessor of the reconviction impact of the HMP Peterborough Social Impact Bond (SIB).

The aim of the Peterborough SIB is to reduce the reconviction rates of short-sentence male prisoners leaving HMP Peterborough. A SIB is a unique approach to improving social outcomes within the community by incentivising non-government investors to fund support programmes. In this instance Social Finance (SF) has raised the required social investment. Social investors will then be paid based on the observed improvement of reconviction events of the released prisoners. If there is a sufficiently large observed improvement, these payments will be made by the Ministry of Justice and the Big Lottery Fund and will cover both repayment of capital and a return.

The Peterborough SIB was launched in September 2010 and provides interventions for adult males (aged 18 or over) receiving custodial sentences of less than 12 months ('short-sentence prisoners') and discharged from HMP Peterborough. Interventions are flexible to meet the needs of the offender group. The current intervention model is based on pre- and post-release mentoring and connecting prisoners to services in order to help them break the cycle of reoffending.

The financial model described above relies on statistical measurement techniques as the basis of the payment mechanism. The payment mechanism is designed to ensure that MoJ pays investors when an observable change in reconvictions has occurred. MoJ and Social Finance determined that using a matched control group was the best approach to removing the influence of external events on reconviction levels (such as changes in sentencing policy, economic environment, etc.). Consequently, the approach proposed in the HMP Peterborough SIB contract is to develop a Comparison Group of prisoners discharged from other prisons during the same time period as the Peterborough cohort. This Comparison Group will be developed using propensity score matching (PSM).

The objective of the Comparison Group is to provide a measure of the reconviction levels of the Peterborough cohort without SIB intervention. The actual measure under comparison is the 'frequency of reconviction events', which is defined as the number of times an offender is

reconvicted in the 12 months following release from prison.[1] It counts the number of times an offender is reconvicted at court, regardless of the number of reoffences committed. This measure is being used because the number of court appearances is more closely linked to costs to the criminal justice system than the number of offences committed. Once a valid Comparison Group[2] has been defined, any improvement in the reconviction proxy of the Peterborough cohort will then be attributed to SIB intervention.

Measurement of the SIB in HMP Peterborough

The Peterborough SIB will be measured using three cohorts of approximately 1,000 people (described as Cohorts 1, 2 and 3). The length of time to form each cohort will be determined by the time required for 1,000 unique short-sentence prisoners to be released from HMP Peterborough, but will not be longer than 24 months per cohort. Thus, the cohort may be less than 1,000 if the number of prisoners released from HMP Peterborough over the 24-month period is less than this amount. The whole population of around 3,000 people may be measured in aggregate at the end of the intervention period (described as Cohort 4) if a 10% reduction in reconviction events has not been found for any of the three cohorts separately. If Cohort 4 achieves a 7.5% reduction in the frequency of reconviction events compared to its Comparison Group, outcome payments will be made.

The Independent Assessor is required to perform an independent evaluation of the outcomes of the HMP Peterborough SIB in order to calculate the payment (if any) due to Social Finance. This independent assessment of the SIB is being carried out in three phases:

1. Development of measurement approach:
    a. Development of the PSM methodology;
    b. Assessment of the validity of the PSM methodology for the contractual purpose outlined above. The Independent Assessor will carry out the calculation required to make the assessment by carrying out a sample reconviction study on a sample of data supplied by MoJ. The Independent Assessor will ensure that the PSM methodology is robust and MoJ and Social Finance will determine if the method is consistent with the intentions of the contract;
2. Cohort 1 PSM analysis; and
3. Cohort 1 outcome analysis.

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[1] The 'frequency of reconviction events' measure counts the number of times an offender is reconvicted in the first 12 months following release from prison. This measure is determined 18 months after release from prison to take into account the court processing time.

[2] A valid Comparison Group is one which has no statistically significant differences in the means of the matching covariates compared to the treated group.

This report presents the outcome of Phases 1a and 1b – the development of the PSM methodology and an assessment of the validity of the methodology against the aims of the SIB contract. The purpose of these phases was to develop the PSM analytical framework that would be used to generate a Comparison Group based on the attributes of the individuals in the three cohorts. This report defines the PSM analytical method and includes a sample analysis using data from a cohort of individuals released from HMP Peterborough, and other similar prisons, in 2008. The analysis includes a sample reconviction analysis comparing the individuals released from HMP Peterborough with the Comparison Group.

The sample analysis shows that the PSM was successful at balancing those released from HMP Peterborough to those released from other prisons on the demographic and criminal history background characteristics. Furthermore, the reconviction analysis showed that, after matching, these groups were similar on the number of reconviction events during a one-year follow-up. MoJ and Social Finance are content that the PSM methodology is consistent with the aims of the SIB contract.

1. Introduction

QinetiQ and the University of Leicester working together are the Independent Assessor of the reconviction impact of the HMP Peterborough Social Impact Bond (SIB). This document describes the methodology that has been developed by the Independent Assessor to identify the Comparison Group that will be used when the outcome payment for the Peterborough SIB is calculated.

1.1 Background

The Ministry of Justice (MoJ), utilising a concept developed by Social Finance (SF), have initiated a prototype project, a Social Impact Bond (SIB), to reduce the reconviction rates of short-sentence male prisoners leaving HMP Peterborough.

The SIB approach seeks to improve social outcomes within the community by incentivising non-government investors to fund support programmes. These investors are then paid if there is a sufficiently large observed social improvement.

The Peterborough SIB was launched in September 2010 and provides interventions for adult males (aged 18 or over) receiving custodial sentences of less than 12 months ('short-sentence prisoners') and discharged from HMP Peterborough. Interventions are flexible based around pre- and post-release mentoring and connection to services to help prison leavers break the reoffending cycle.

The Peterborough SIB will consist of three cohorts each consisting of approximately 1,000 people. The length of time to form each cohort will be determined by the time required for 1,000 unique short-sentence prisoners to be released from HMP Peterborough, but will not be longer than 24 months per cohort. Therefore, the cohort may be less than 1,000 should not enough prisoners be released from HMP Peterborough over the 24-month period.

Social Finance (SF) is the financial intermediary that has raised capital for the interventions. Investors will receive the outcome payment. MoJ will pay the investment vehicle a fixed unit payment for each reduced conviction event in a SIB cohort less than a matched baseline cohort, providing the reduction in conviction events in the SIB cohort is at least 10%. If a 10% reduction is not achieved for any of the three cohorts, payment will be made if a 7.5% reduction is achieved at the end of the pilot across all cohorts together.

A key component of the SIB is the payment by outcome mechanism. This is required to ensure that MoJ only pays where there has been a proven result and investors are confident they will receive payments for outcomes they have delivered. The following mechanism has been agreed between MoJ and Social Finance:

- The total number of reconviction events for the cohort of around 1,000 unique short-term male prisoners released from HMP Peterborough over the 12 months following release will be calculated using data held on the Police National Computer (PNC). This is termed the reconviction frequency;
- This will be compared to the number of reconviction events for a 'Comparison Group' drawn from individuals released from other similar prisons who have similar characteristics to the Peterborough prisoners;
- Payment will only be made if the fall in the frequency of reconviction events is 10% or greater than any change in that for the Comparison Group.

If a 10% reduction is not achieved for any of the three cohorts, payment will be made if a 7.5% reduction is achieved at the end of the pilot across all cohorts together (Cohort 4). Otherwise no payment will be made.

The SIB outcome payments will be independently calculated by an Independent Assessor. The Independent Assessor will develop the propensity score matching (PSM) methodology which will be used to create the Comparison Group and, in turn, calculate the baseline reconviction events against which the three cohorts will be compared. The difference in reconviction events will be used by the Independent Assessor to calculate the total level of payment according to a formula agreed by MoJ and Social Finance.

QinetiQ and the University of Leicester were appointed as Independent Assessor to assess the reconviction impact and calculate payment levels in relation to the HMP Peterborough SIB in February 2011. The Independent Assessor was contracted to MoJ through a competitive tendering exercise. The appointment was made with the approval of Social Finance.

1.2 Role of the Independent Assessor

The Independent Assessor is currently contracted to MoJ to:

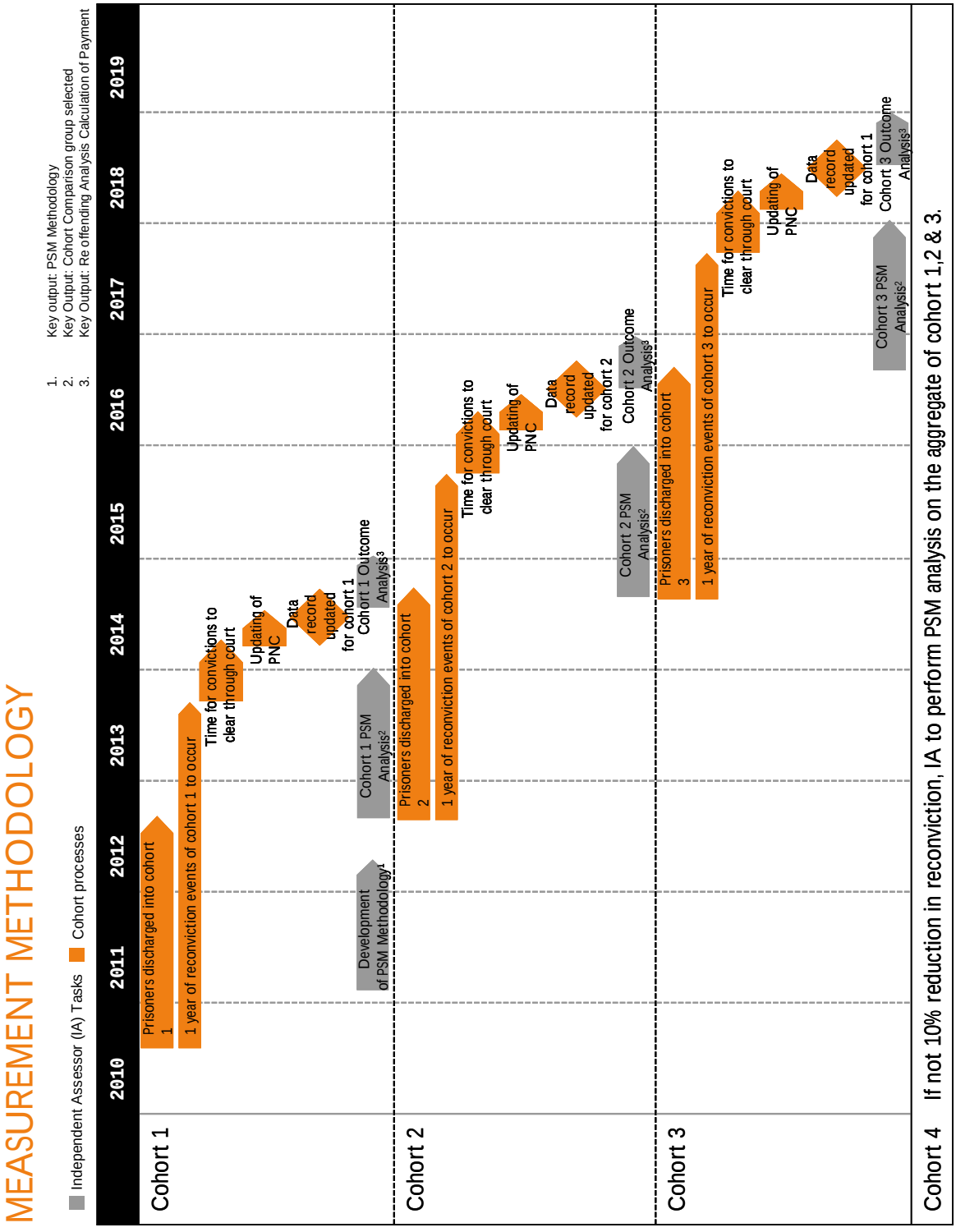
1. Develop the PSM methodology that will be used to define a Comparison Group to reduce pre-existing differences on measured variables between those released from HMP Peterborough and those released from 'other prisons';

2. Use the PSM methodology to create the Comparison Group for Cohort 1; and
3. Calculate any payment due to Social Finance based on the difference in reconviction events between Cohort 1 and the Comparison Group.

The PSM methodology was developed by the Independent Assessor between February 2011 and October 2011 using a sample of data from 2008. Cohort 1 began in September 2010 and is expected to be complete in late summer 2012.

Figure 1.1 provides the timeline for the activities of the Independent Assessor compared with the timeline of Cohort 1 of the HMP Peterborough SIB.

Figure 1.1: Phases of the independent assessment of the Peterborough SIB



Each of the three tasks is described below.

Development of PSM methodology

The Independent Assessor was required to develop the PSM analytical framework that will be used to generate a Comparison Group based on the attributes of the individuals in the

three cohorts. The output of this stage – the current document – was required to define the PSM analytical method that is consistent with the context of the SIB contract. The Independent Assessor was required to make changes in the light of comments received from MoJ and SF provided these did not introduce bias. This report has also been revised in the light of comments received from four independent peer reviewers. The final methodology has been approved by both MoJ and SF.

Cohort 1 PSM analysis

Once the Cohort 1 period is complete[3] the PSM analysis will be carried out in order to define the Comparison Group. This analysis will be based on the agreed PSM methodology. The analysis will result in each member of Cohort 1 being matched with up to ten controls; the Comparison Group will be the aggregate of all controls.

Cohort 2 outcome analysis

The difference in reconviction events between Cohort 1 and the Comparison Group derived using the PSM method will be calculated. The outcome payment will be calculated in accordance with the outcome payment formulae agreed between MoJ and SF.

1.3 Purpose of this document

The purpose of this document is to describe the methodology that has been developed by the Independent Assessor to identify the Comparison Group for use in the reconviction analysis of the payment calculation.

1.4 Report structure

This document is composed of the following sections:

- Section 2 describes the PSM methodology;
- Section 3 provides sample analysis on a cohort of prisoners released from HMP Peterborough in 2008;
- Section 4 presents the conclusions;
- Section 5 defines all abbreviations used in the report;
- Section 6 lists the references;
- Appendix 1 gives the fields made available for the sample analysis on 2008 data.

[3] Currently estimated to be August 2012.

2. Methodology

This section describes the PSM methodology that has been developed by the Independent Assessor to identify the Comparison Group that will be used when the outcome payment for Cohort 1 of the Peterborough SIB is calculated.

Propensity score matching (PSM) is the statistical technique that has been selected by MoJ and SF as the method of controlling for the observable differences between the three cohorts and their Comparison Groups. The creation of the PSM model will involve the development of a process for restricting the data to ensure that only appropriate individuals from both the Intervention and Comparison Groups are included (i.e., those aged 18 or over sentenced to a short term of imprisonment of less than 12 months), and the identification of relevant variables to be tested for inclusion in the statistical model.

This overall process (data restriction and model creation) will need to be repeated for each cohort and potentially the aggregate group of the three cohorts if a 10% reduction in reconviction frequency is not observed in any of the cohorts. The reconviction frequency is defined as the number of times an offender is reconvicted in the 12 months following release from prison.[4] The development of a PSM model is based on the individuals who comprise a given cohort (and the data available about these individuals), and each cohort is expected to contain different individuals. This means that a separate PSM model will need to be created for each cohort.

It should be noted that, unlike random control allocation, PSM cannot take account of unmeasured differences which may account for variation in reconviction aside from 'treatment received'. However, PSM is widely regarded as one of the best ways of matching quasi-experimentally (Rosenbaum, 2002), and it has been increasingly used in a criminological context (e.g. Wermink et al., 2010). The PSM method involves using logistic regression to model group membership using the available data. Specifically, in regard to the PSM model to be used for the SIB evaluation, the response variable is a binary indicator of whether a prisoner was discharged from HMP Peterborough. The explanatory variables cover basic demographic data as well as detailed historic offence, conviction, sentence and disposal information.

[4] The 'frequency of reconviction events' measure counts the number of times an offender is reconvicted in the first 12 months following release from prison. This measure is determined 18 months after release from prison to take into account the court processing time.

The PSM method of matching is useful because it can be used with relative ease to account for (measurable) pre-existing differences between groups. However, it rests on the assumption that, if observable differences in characteristics between the Treatment Group (Peterborough) and the Comparison Group are controlled, the outcomes of these groups would be the same (e.g. Bryson et al., 2002). In order to fully meet the requirements of this assumption (referred to as the conditional independence assumption or CIA), a rich dataset is required so that the evaluator is confident that all variables affecting both selection (i.e., being released from HMP Peterborough and being released from another prison) and outcome (i.e., reconviction events) can be included.

It is debatable whether the use of PSM in the current context violates the CIA assumption. This is because the PNC data is not very useful in controlling for selection of being released from HMP Peterborough. It is likely that individuals were released from Peterborough because they committed their offences in the local area. However, we could not include geographic variables from the Police National Computer (PNC) or the Local Inmate Database System (LIDS) in the PSM model, as these would have overwhelmed the model. (See discussion about inclusion of geographic variables in Section 2.8 below.) In addition, the PNC is potentially rich in information to control for future reconviction, but we are unaware of studies that have attempted to predict the number of reconviction events. However, confidence in the method (for the purposes of this evaluation) was increased by the results of the matching (Section 3.7), which suggested that two groups were similar on pre-existing differences (those from HMP Peterborough and those from other prisons). Furthermore, these groups were found to be similar on the number of reconviction events.[5]

The PSM methodology described in this document was developed by the Independent Assessor based on statistical best practice, the limitations defined in Section 2.1 and the data that was made available for the assessment. Sample data from 2008 was provided in order to enable an assessment to be made of the data that will be available for carrying out the analysis and also to enable a sample analysis to be carried out using the defined methodology.

The following section defines the analytical boundaries of the method, an overview of the method and a detailed description of each stage of the process.

[5] The possibility that this is a chance finding cannot be ruled out.

2.1 Boundaries to the development of the independent assessment PSM methodology

The HMP Peterborough SIB contract was signed between MoJ and Social Impact Partnership LP (SIP LP) in March 2010. The contract defines the eligibility criteria for prisoners to enter the cohort, the method by which the outcome of the SIB will be assessed, and the framework for how the assessment methodology will be implemented.

The methodology developed by the Independent Assessor conforms to the provisions of the contract resulting in some constraints. The constraints that had a material impact are summarised below:

- A cohort will be composed of prisoners released from HMP Peterborough over a 24-month period (or until 1,000 offenders have entered the cohort);
- The prisoners will be male, 18 or over at the time of sentence and released from custody following a sentence of less than 12 months;
- A propensity score matching (PSM) method will be used to identify the Comparison Group;
- Selected data from the Police National Computer (PNC) and the prisons database (LIDS) will be made available to the Independent Assessor in order to develop and perform the PSM methodology; and
- Each released prisoner in the cohort will be matched to up to ten prisoners from a Comparison Group.[6]

In view of this, a pragmatic approach was necessary to ensure the PSM methodology was both statistically valid and useable on a live cohort to generate the outcome payments. The three main boundaries were:

- **Variables included in the analysis**: The Independent Assessor was limited to the variables recorded on the PNC and LIDS. However, this list was reduced in size due to data integrity issues for some of the variables.
- **Data integrity for the cohort**: The outcome payment methodology specified in the contract should be based on all individuals in the treatment group to ensure perverse incentives are not introduced. However, it is likely some of the individuals will have key pieces of data missing from the PNC and LIDS that are required by the PSM methodology and could therefore be excluded. Social Finance and HMP

[6] The original contracted measure was to match each released prisoner to exactly ten other prisoners. Subsequently, MoJ and SF agreed to change this to up to ten prisoners to ensure a balance between the number of matches for each person released from Peterborough and the closeness of the match between the person from Peterborough and the individuals to whom they are matched.

Peterborough will be inputting data for Cohort 1 with the aim of minimising the impact of missing data for the cohort.

- **Matching criteria**: By undertaking 'power calculations' on past data, MoJ and SF agreed that a 10% reduction in the frequency of reconviction events would be sufficient under PSM, given a treatment group (i.e., Peterborough cohort size) of 1,000 and a Comparison Group of over 9,000. This requirement, summarised as 10:1 matching, was stated in the contract between MoJ and SF. This has since been relaxed to up to 10:1 matching, within a stated calliper to be defined by the Independent Assessor to prioritise closeness of match over a strict threshold for the number of matches. However, the objective remains to maximise the number of matches where suitable to increase the diversity of individuals in the Comparison Group.

The PSM methodology developed by the Independent Assessor has been developed based on the understanding that these constraints cannot be altered.

2.2 Overview of the method for identifying the Comparison Group

Figure 2.1 provides a high-level view of the PSM methodology to be used in creating the Comparison Group.

Figure 2.1: PSM methodology

Data will be extracted from the PNC and prisons database. These data will cover all releases from prison over the same analysis period as the cohort. An initial assessment will then be made as to whether the extracted data is fit for carrying out the PSM analysis. Once the dataset is deemed fit for purpose, the data will be restricted to include only those released prisoners who fit the criteria for inclusion in the analysis. The 'relevant' dataset will then be cleaned prior to developing the PSM model on the validated data. The PSM model will then be used as the basis for matching the prisoners in the cohort to 'similar' prisoners in order to identify the Comparison Group.

Each of the stages in the process is described in detail below.

2.3 Source databases

The source data to be used in the analysis is contained in two MoJ data stores, the Police National Computer (PNC) and the Prisons Data Store.

Summaries of these data stores are given below.

PNC data

The PNC holds details of people, vehicles, crimes and property that can be electronically accessed by the police and other criminal justice agencies. It is a national information system maintained and delivered by the National Policing Improvement Agency. The PNC is a relational database used to store extracts from the live, operational system of the same name. Data feeds are received on a monthly basis. These feeds do not reflect wholesale changes to the source data; only certain tables and columns are exported from the live system and input in the PNC. The live data is imported 'as is' and data cleaning or validation is done prior to importing. The database is built on the MS SQL Server. It is managed by the Data Improvement, Analysis and Linking (DIAL) team within MoJ Justice Statistics Analytical Services (JSAS).

Prisons data

The Prisons Data Store is a flat data file, populated by extracts from the Inmate Information System (IIS), which itself is fed by two operational systems used by prisons. These are the Local Inmate Database System (LIDS) and the National Offender Management Information System (NOMIS). The IIS records a large number of fields covering personal, offence and sentence details and disciplinary adjudications. Data feeds are received on a monthly basis. These feeds do not reflect wholesale changes to the source data; only certain tables and columns are exported from the live system and input in the prisons PNC. The live data are validated and cleaned prior to importing, with on-going data cleaning being performed as analysis work reveals anomalies. The data are stored as SAS files (SAS is an analytics software product). The data store is managed by Prison, Probation and Reoffending Statistics (PPRS) within Justice Statistics Analytical Services (JSAS).

2.4 Data extraction process

A data extract will be created for the purpose of creating the Comparison Group. The data extraction will be carried out by MoJ staff and validated by the Independent Assessor. The

data to be extracted will be defined by the Independent Assessor and will cover all prisoners released from custody following a sentence of less than 12 months over the same time period as the cohort. Appendix 1 lists the data made available to carry out the data review and PSM methodology.

Initial validation of the data extract comprises:

1. A review of the SQL code used by MoJ staff to create the data extract;
2. A review of the received data to ensure that it is useable and free of obvious and significant errors. This will include confirmation that the number of released prisoners is correct and that the matching of prisoners is correct; and
3. Automated validation of each data item using predefined validation rules (e.g. expected maximum and minimum values) to flag anomalous data.

Following these three stages the data is accepted for subsequent analysis and the data quality assessment can then be undertaken.

2.5 Data quality assessment

The purpose of the data quality assessment is to establish the quality and composition of the extracted data and to make an assessment of its use for developing the PSM model.
The data quality assessment includes:

- Nature of cases – Assessment of the composition of the extracted sample;
- Data completeness – Assessment of the completeness of the extracted data; and
- Overall data quality – High-level decision on whether the data is fit for purpose.

2.6 Data restriction

The purpose of the data restriction stage is to ensure that only those released from HMP Peterborough who meet the eligibility criteria are included in the sample and that those in the Comparison Groups are as closely matched to them as possible.

The basis of this restriction is that decisions that influenced the selection of HMP Peterborough as the site of intervention, and the focus on the release of a particular subset of prisoners from HMP Peterborough, should be reflected in the Comparison Group.

The data restriction rules were developed based on the data provided in the 2008 sample extract. This extract contained all male prisoners released from custody following a sentence of less than 12 months. The 2008 data extract contained details of 50,510 individuals

released from prisons other than HMP Peterborough, and this included a number of individuals who would not be comparable to those released from Peterborough. For example, the data included those released from young offenders institutions.

The following five variables[7] (described in more detail below) will be used to restrict the population used for creating the Comparison Group:

1. Age
2. Released on date of sentence
3. Time in custody
4. Prison type
5. Data availability.

The agreed restriction rules will be applied sequentially in the order specified above. Where an individual restriction rule results in more than ten people being excluded from the cohort, this will be communicated to MoJ and SF to determine whether the data loss is due to coding errors that can be rectified.

The restriction rules will be reassessed prior to carrying out the analysis on Cohorts 1 to 3. This is to take into account potential changes in policy or legislation. All changes to the restriction rules will be subject to the agreement of the Independent Assessor to ensure that such changes do not introduce bias.

Restriction based on age

Only those aged 18 or over at the point of sentence will be included in the model.

[7] The Independent Assessor also sought to restrict the sample further in two ways. First we wished to use additional variables (type of sentencing court and discharge codes) to exclude cases where valid variable categories indicated cases fell outside the target group of adult offenders on short prison sentences who had spent all of their time since sentence in prison. For example, some of the cases retained appeared to be sentenced at the Youth Court so they would not have been old enough to serve an adult sentence; and some of the discharge codes used suggested they were sentences serving longer than 12 months (e.g. conditional release, extended sentence under CJA 2003). Second, we also sought to use 200 rather than 365 days to limit 'time served' on the grounds that anyone sentenced to less than a year (364 days) would serve a maximum of 182 days, plus a margin for 'additional days' imposed for disciplinary offences. However, MoJ and SF were of the view that these were data coding errors. In MoJ's view the sentence type variable, on which the sample was selected, was the least likely to be coded incorrectly because it determined release date (and legal action could follow a failure to release on that date). The Independent Assessor accepted this outcome.

Restriction to exclude those released on date of sentence

MoJ specified that those individuals in the dataset who have identical sentence/conviction and release dates should not be included. This is to exclude offenders who serve their whole sentence on remand.

Restriction on time served

Anyone who is recorded as serving one year or over (365 days or over) will be excluded. This constitutes approximately 0.7% of the 2008 sample data.

Restriction by release from male local prison

Since HMP Peterborough is a male local prison, only those released from the other 36 male local prisons (Table 2.1, provided by MoJ) will be included. All 36 male local prisons were included in the analysis because, regardless of their size or where they are located, they will release a pool of potentially similar prisoners from which a control group for Peterborough releases can be selected using PSM.

Consideration was given to restricting prisons further, based on their similarity to HMP Peterborough in terms of their location and size. However, it was decided not to restrict prisons any further than to male local prisons for a number of reasons. Firstly, the vast majority of prisons do not observe statistically significantly different reoffending than predicted based on the individual characteristics of the offenders discharged from them. Results published in April 2012 (MoJ, 2012) show that, for short-sentenced prisoners, no prisons have statistically significantly different reoffending rates to those predicted. Secondly, other unpublished research supports the fact that prisoner-level characteristics are better predictors of reoffending than establishment-level or area-level variables. Therefore, it was decided not to restrict the prisons any further than ‘male local prisons’. It may become necessary to exclude individual prisons from the Comparison Group if they become the sites of new Payment by Results (PbR) pilots.

Table 2.1: Male local prisons

ID	Prison
1	Altcourse
2	Bedford
3	Belmarsh
4	Birmingham
5	Blakenhurst
6	Bristol
7	Brixton
8	Bullingdon
9	Cardiff
10	Chelmsford
11	Doncaster[8]
12	Dorchester
13	Durham
14	Exeter
15	Forest Bank
16	Gloucester
17	High Down[9]
18	Holme House
19	Hull
20	Leeds[10]
21	Leicester
22	Lewes
23	Lincoln
24	Liverpool
25	Manchester
26	Norwich
27	Nottingham
28	Parc
29	Pentonville
30	Preston
31	Shrewsbury
32	Swansea
33	Wandsworth
34	Winchester
35	Woodhill
36	Wormwood Scrubs

Source: MoJ

[8] Doncaster has a Payment by Results pilot operating (as of October 2011) so will not be included in the analysis for Cohorts 1 to 3.

[9] High Down may have a pilot operating in 2012 and so may not be included in the analysis for Cohorts 1 to 3.

[10] Leeds is scheduled to become a Payment by Results prison and so may not be included in the analysis for Cohorts 1 to 3.

Restriction based on data availability

Only those individuals who have valid (i.e., non-missing) values for any of the variables that are included in the final model can have a propensity score calculated, and thus only these people can be included in the analysis.

In a preliminary analysis (after applying the full set of proposed restriction criteria) using a typical set of variables that might be included in a PSM model, the number of individuals released from HMP Peterborough in 2008 was reduced from 761 to 694.

2.7 Data cleaning

The aim for Cohort 1 is to have no missing data on HMP Peterborough cases because data quality is being checked by Social Finance as people are released.

Should any data required for the PSM analysis be missing, these will be removed from both the groups used to create the cohort and the Comparison Group. For the purposes of the current analysis, in order to try to reduce the number of HMP Peterborough individuals lost because of missing data, some data was imputed (see 'Recode missing ethnicity' and 'Recode incorrect age at first offence' sections below).

Data cleaning will be carried out to minimise the number of the cohort who are removed through missing data items and also to recode the breach code. The following data cleaning activities will be carried out:

1. Recode breach (as index offence)[11]
2. Recode missing ethnicity
3. Recode incorrect age at first offence
4. Recode nationality.

Each of the individual data cleaning rules is defined below.

Recode and restrict breach (as index offence)

MoJ has stated that breaches of court orders are to be treated as equivalent to index offences in the development of the PSM model and we have been provided with the details about the types of breaches to facilitate this. Of the 13 types of breaches in the 2008 data extract, only those with a Breach of Suspended Sentence Order or a Breach of Community Order were consistent with a prisoner fitting within the target group (i.e., those serving less

[11] An index offence is the offence that the offender committed that led to his current term in prison.

than 12 months) as they will be in prison as a result of re-sentencing. However, a number of the other breach codes will be recoded as advised by MoJ to reflect current terminology and to ensure there are at least five cases in each category. The recoding of the breach codes is given in Table 2.2.

Breach codes referring to those being released from a longer sentence (i.e., Breach of Licence Conditions) and those under the age of 18 (Breach of Detention and Training Order) will be excluded.

Table 2.2: Type of breach code

ID	Breach	Cleaning rule
1	Breach of License Conditions	Exclude
2	Breach of Suspended Sentence	Recode to 'Breach of Suspended Sentence Supervision Order'
3	Breach of Detention and Training Order	Exclude (may fall out because age restriction is imposed first)
4	Breach of Combination Order	Recode to 'Breach of Community Order'
5	Breach of Community Punishment Order	Recode to 'Breach of Community Order'
6	Breach of Community Order	Retain original code
7	Breach of Curfew Order	Recode to 'Breach of Community Order'
8	Breach of Attendance Centre Order	Recode to 'Breach of Community Order' (some may fall out because of age restriction)
9	Breach of Drug Treatment and Testing Order	Recode to 'Breach of Community Order'
10	Breach of Supervision Order	Recode to 'Breach of Suspended Sentence Supervision Order'
11	Breach of Community Rehabilitation Order	Recode to 'Breach of Community Order'
12	Breach of Conditional Discharge	Exclude
13	Breach of Suspended Sentence Supervision Order	Retain original code

Recode missing ethnicity

Missing values from 'PNC_ethnic' (the variable representing ethnicity according to police records) will be filled in with 'Input_ethnic' (another ethnicity variable defined in the prisons data) where available. It was possible to impute ten ethnicities for those prisoners released from HMP Peterborough in the 2008 sample data.

Prisoners released from other prisons with these data values missing will be removed from the population information used to create the Comparison Group.

Social Finance and HMP Peterborough will be inputting data for Cohort 1 with the aim of minimising the impact of missing data for the cohort.

Recode incorrect age at first offence

If a prisoner's age at first offence is recorded as being less than 10 years (the minimum age of criminal responsibility), this will be changed to age 10. This rule resulted in a change for one individual from age 8 to age 10 for those prisoners released from HMP Peterborough in the 2008 sample data.

Prisoners released from other prisons with these data values missing will be removed from the population used to create the Comparison Group.

Social Finance and HMP Peterborough will be inputting data for Cohort 1 with the aim of minimising the impact of missing data for the cohort.

Recode nationality

Nationality is given in the dataset by country and will be recoded according to the overarching categories presented in Table 6.12 of the *Offender Management Caseload Statistics* (MoJ, 2010). The categories are Africa, Europe, Asia, Central and South America, Middle East, North America, Oceania, West Indies, United Kingdom and Missing.

The seven nationalities not covered by the classification of Table 6.12, and observed in the 2008 Peterborough cohort, will be coded as given in Table 2.3.

Table 2.3: Proposed classification of countries not in *Offender Management Caseload Statistics*

Nationality	Category
Philippines	Oceania
Brunei	Middle Eastern
Cayman Islands	UK
French Southern	European
Lesotho	African
Mayotte	European
Pacific Islands	Oceania

2.8 PSM model

Logistic regression will be used to create the PSM model with the dataset created following the restriction processes described in Section 2.6. A series of variables will be tested for inclusion in the model (see 'Variables for testing for model inclusion' below) and actual inclusion will be based on an 'enter' procedure[12] (e.g. Apel and Sweeten, 2010; Hahs-Vaughn and Onwuegbuzie, 2006; Rosenbaum, 2002).

Variables that are statistically significant at the p<.20 level between the Peterborough group and the other prisons will be included in the model. This level of significance was selected based on support from the academic literature (e.g. Apel and Sweeten, 2010; Hahs-Vaughn and Onwuegbuzie, 2006; Rosenbaum, 2002). For continuous variables (e.g. age at first offence, number of previous convictions) squared versions will be included to account for non-linear effects (e.g. Wermink et al., 2010). It is important to consider the impact of the potentially small number of individuals available for some variables on the model. For example, if only one individual from HMP Peterborough had an index offence of child sexual offences, including this person could result in a high standard error. Therefore, dichotomous variables (e.g. index offence of child sexual offences, yes/no) that have five observations will be included and variables that have less than five observations will not be included. Those with between five and nine observations may be excluded from the model as these could result in high standard errors that reduce the stability of the model.[13]

Variables for testing for model inclusion

The variables that will be considered for inclusion in the PSM model are listed in Table 2.4. These make up a standard list of variables that are commonly used in criminal justice system research, and therefore have not been combined to form fewer variables (Howard et al., 2009; MoJ, 2011a).

[12] Generally a forward entry stepwise procedure is preferred for PSM. This is because PSM is typically a method of modelling selection for an intervention, but in the current evaluation PSM is being used to attempt to create two groups equivalent on all measurable background characteristics.

[13] Variables that have less than five observations will not be included, but those with five to nine observations might be included in the model depending on the statistical significance. In cases where a variable has five to nine observations and is statistically and significantly different between Peterborough and other prisons, the variable will be entered into the model and the model will be examined. If the standard error is low (e.g. one or less), then the variable will be retained. This approach was adopted to balance accuracy with the loss of individuals from Peterborough. This should be less of an issue with the live cohort in which Peterborough will have 1,000 (as opposed to 694) individuals.

Table 2.4: Variables for testing for inclusion in the PSM model

ID	Variable for inclusion
1	Age at release
2	Age at release squared[14]
3	Nationality/Ethnicity
4	Age at first offence
5	Age at first offence squared
6	Number of previous offences
7	Number of previous offences squared
8	Number of previous convictions
9	Number of previous convictions squared
10	Number of previous incarcerations
11	Number of previous incarcerations squared
12	Copas score[15]
13	Average number of previous severe convictions (T1 or T2)
14	Average number of previous severe convictions (T1 or T2) squared
15	Length of sentence
16	Length of sentence squared
17	Time served
18	Time served squared
19	Percent with T1 or T2 serious offence
20	Persistent/prolific offender flag
21	Percent chronic offender[16]
22	Index offence: Absconding bail offences[17] (MoJ, 2011a)
23	Index offence: Criminal malicious damage
24	Index offence: Domestic burglary
25	Index offence: Other burglary
26	Index offence: Drink driving
27	Index offence: Import/export/production
28	Index offence: Possession/small-scale supply
29	Index offence: Fraud/forgery
30	Index offence: Handling
31	Index offence: Other
32	Index offence: Other motoring offences
33	Index offence: Public order
34	Index offence: Robbery
35	Index offence: Sexual
36	Index offence: Sexual (child)
37	Index offence: Soliciting/prostitution
39	Index offence: Taking and driving away
40	Index offence: Theft
41	Index offence: Theft from a vehicle
42	Index offence: Violence
43	Index offence: Serious violence
44	Index offence: Breach of Suspended Supervision Order
45	Index offence: Breach of Community Order
46	Index offence: Breach of Conditional Discharge

[14] As mentioned, squared terms of the significant continuous variables will be included to account for non-linear effects.

[15] The Copas score is a measure of the speed of convictions across an individual's criminal career (in a logarithmic scale).

[16] Chronics refer to those individuals who account for half of the total number of previous offences. In the 2008 cohort this was those individuals who had committed more than 74 previous offences.

[17] This breakdown of index offence types is standard for MoJ research.

It should be noted that information about drug testing is available in the dataset (DIP flag), but there is evidence that this testing is not equally consistent across all areas (MoJ, 2011b). For this reason, it is not possible to determine if differences in positive results to drug tests between HMP Peterborough and other prisons reflect actual differences in the use of drugs or differences in testing procedures. Therefore this variable will not be considered for inclusion in the model.

Inclusion of nationality/ethnicity variable

Nationality (from prisons data) records a prisoner's self-report of their nationality. Social Finance and MoJ noted that there was an unusually high proportion of non-UK nationals in the HMP Peterborough sample, and suggested that nationality should be considered for inclusion in the analysis. As such the inclusion of a nationality-based variable will be tested for inclusion in the model. This variable will be a combined nationality/ethnicity variable. Ethnicity was separated into those classified as 'White' (N=634 in Peterborough), those classified as 'Black' (N=57 in Peterborough) and those classified as 'Other' (N=38 in Peterborough, comprising 28 South Asians, 7 Chinese/Japanese, and 3 coded as Middle Eastern). This separation was devised to cope with small numbers rather than being theory driven.

There are two reasons why nationality and ethnicity cannot be included in the PSM model as separate variables:

1. There is likely to be a link between these two variables. For example, someone from the UK is more likely to be White and someone from Africa is more likely to be of Black ethnicity. This means that either nationality or ethnicity might end up being included in the model, but as a proxy for the other variable.
2. Secondly, it is necessary to consider nationality and ethnicity together because of the matching that will be carried out later in the analysis. If only nationality ended up in the model the matching may result in one person in the UK (who happens to be of Black ethnicity) matched to ten people who are also from the UK (but who happen to be of White ethnicity).

As such the PSM model will potentially include a nationality/ethnicity variable. The main consideration in combining nationality and ethnicity will be to ensure that the categories are sufficiently large so that they can potentially be included in the PSM model. As a general rule we will not include a category that contains fewer than six people. In practice the minimum number was 16 (see Table 3.5) and greater numbers will be expected in Cohort 1. Also, the categorisation needs to be justifiable. For example, foreign nationals may be 'different' in

important ways from UK nationals (e.g. increased likelihood of returning to foreign country after release and therefore less likely to have a proven reoffence in the UK). However, we have not been able to identify a legitimate basis to distinguish between different foreign nationals.

Inclusion of geographic variables

A number of variables are available in the PNC and prisons datasets that provide geographical information. These include the prosecuting police area code, the prisoner's home Local Authority Area (LAA) code and the region. Although these might be considered important in the development of the PSM model, analysis of the 2008 sample data suggests that these variables do not possess the overlap between the intervention and Comparison Group required for inclusion. That is, the variables do too good a job at differentiating between those released from HMP Peterborough and those released from other prisons. If they were to be included they could overwhelm the model and result in the exclusion of, arguably, more important variables such as the number of previous offences or age at first offence. While we could restrict the comparison data based on these geographical regions we will not do so. This is because the only basis by which this restriction could be undertaken would be using information held about individuals within these areas, for example by selecting comparison areas that contained individuals who were most similar in their number of previous offences to those individuals in HMP Peterborough. Given that the goal will be to match individuals on these factors anyway (as part of the PSM model) this has the risk of reducing the number of individuals available in the Comparison Group with whom to match those in HMP Peterborough while not (with the information available) increasing their similarity.

In addition, consideration was given to including the proximity of the released offenders to their home address. However, the data held within the PNC would not support this analysis.

2.9 Data matching

The matching process will be carried out to match members of the cohort to those released from other prisons to create the Comparison Group. Matching will be carried out as follows:

- The Independent Assessor will match each member of the Peterborough group with up to ten individuals from the Comparison Group, but these individuals must be within a standard level of closeness (or calliper) of the intervention case. For the sample analysis the calliper was set to 0.05. This was an attempt to balance the closeness of

match between those from HMP Peterborough to those from comparison prisons while also trying to increase the probability of being able to obtain ten matches.

- The matching will be done without replacement to ensure that the Comparison Group is large enough to detect a statistically significant finding. This was required in the sample analysis to ensure that there were sufficient numbers in the Comparison Group so that statistically significant differences could be found (see Section 2.1, Boundaries to the development of the independent assessment PSM methodology).
- The quality of the matching will be tested by comparing the balance of the covariates using the standard level of statistical significance ($p<.05$) and the standardised mean difference (d) between those in HMP Peterborough with those in the Comparison Group on the background and criminal history variables after matching. If there are few significant differences the matching will be viewed as successful. Even in a random controlled trial, 1 out of every 20 comparisons would be expected to be significant at the $p<.05$ level.
- An assessment as to whether this approach introduces bias will also be done in the next phase of analysis to ensure that the Comparison Group is representative of the population leaving HMP Peterborough.

It should be noted that the matching method was previously agreed by SF and MoJ as being exactly ten individuals from the Comparison Group matched to one individual in the Intervention Group. This was based on a power analysis which was conducted by MoJ to ensure that a 10% difference between the Comparison Group and the Intervention Group would reach statistical significance. The method of matching was not specified as 'with replacement' (i.e., where a member of the Comparison Group could act as a comparison for more than one member of the Intervention Group) or 'without replacement'. However, the power analysis conducted by MoJ was based on a 'without replacement' assumption (i.e., where a member of the Comparison Group is included only once). Also, this 10:1 matching method does not take into consideration the closeness of the match (i.e., how close the individual in the Intervention Group is on the propensity score to the ten individuals in the Comparison Group).[18] Therefore, using up to 10:1 matching within a set calliper, and doing so without replacement, was seen as the best way to proceed with the data matching.

[18] Other methods of 10:1 matching (e.g. Kernal/Mahalanobis distance) which involved weighting could introduce complications with respect to counting the outcome (number of reconviction events).

2.10 Degrees of flexibility in the PSM methodology

The PSM methodology has been developed based on academic best practice and has also been informed by the analysis of 2008 sample data. It may be found when carrying out the process on Cohorts 1 to 3 that certain aspects of the methodology do not result in satisfactory results. Should this be the case then the methodology will be refined as described in Table 2.5.

Table 2.5: Defined degrees of method flexibility

ID	Situation	PSM methodology refinement
1	Excessive loss of members of the cohort through restrictions/missing data	• MoJ/SF to locate missing data where possible (index offence) • Relax criteria for statistical significance of finding
2	Excessive loss of members of Comparison Group through restrictions/missing data (implication for matching)	• Relax criteria for statistical significance
3	New PbR pilots commence	• Exclude from Comparison Group on advice of MoJ/SF
4	Distribution of 'Peterborough' and 'other' on propensity score does not overlap sufficiently	• Restrictions will increase overlap • Consider alternative matching strategy (e.g. stratification)

3. Results of a sample PSM methodology

The methodology described in Section 2 was developed based on the constraints detailed in Section 2.1, academic best practice and a sample analysis carried out on data received from MoJ on male prisoners released from custody in 2008 following a sentence of less than 12 months.

The methodology described in Section 2 was applied to the 2008 data. This section reports the results of the data analysis processes, that is, the data quality assessment, data restriction, data cleaning, PSM model development and data matching stages. A sample reconviction analysis was also carried out on HMP Peterborough and the Comparison Group. It should be noted that this analysis, repeated on Cohorts 1 to 3, may yield different results and conclusions.

3.1 Data quality assessment of the 2008 sample data

The 2008 data extract contained 51,271 cases (761 HMP Peterborough and 50,510 other prisons). MoJ confirmed that the sample contained only unique individuals. Although there are data points that are missing and others that are wrong (e.g. implausible dates of birth) it was concluded that this data would be sufficient to develop the PSM model.

Data completeness of the 2008 sample data

Table 3.1 lists the data quality issues that have arisen over the course of the data quality assessment.

Table 3.1: 2008 Cohort analysis: Data completeness

Variable name	Issue	Resolution
pnc_ethnic	1.3% missing in Peterborough sample	The variable *input_ethnic* was used to supplement the missing values
Nationality	1.1% missing in Peterborough sample. A propensity score cannot be calculated for these individuals if ethnicity/nationality is entered into the model	Exclude these cases. The alternative is to exclude nationality from PSM matching criteria
Convdate index_date	convdate = date of offence, and index_date = the date of release from prison 29 individuals in the HMP Peterborough population were released on the same day that the offence was committed	Restrict analysis to date of release from HMP Peterborough Ensure that all calculated variables (e.g. career length for Copas score) reflect this We will not be able to include the time imprisoned (index_date – convdate) but might be able to use length of sentence as a proxy
first_offence_age	One individual in the Peterborough population was below age 10	Scaled up to age 10
severe_T1_index severe_T2_index	Missing on 3.9% and small number of cases	Combine into one variable. Test importance for PSM of combined variable (severe_T1_index, severe_T2_index). If it improves model fit include variable and exclude missing

Overall data quality of the 2008 sample data

Despite the issues identified above, the extracted data provided was deemed fit for developing the PSM model.

3.2 Data restriction applied to the 2008 sample data

Table 3.2 shows the data loss for the 2008 sample.

Table 3.2: 2008 Cohort analysis: Data restriction

Restriction	Other prisons	Peterborough
Total at commencement	505,10	761
Age (less than 18 at sentence)	404	0
Sentence length (0 days or more than or equal to 365 days)	2,537	32
Not male local prisons	15,611	0
Total available for model development[19]	**32,681**	**729**

[19] 723 individuals from other prisons were missing on more than one of the restriction criteria so the impact of adding each additional restriction is not purely additive.

3.3 Data cleaning the 2008 sample data

In order to minimise data loss to the Peterborough cohort, data retention rules were applied to two variables.

Ethnicity

Missing values from PNC_ethnic (variable representing ethnicity) were filled in with Input_ethnic (another ethnicity variable defined in the prisons data) for 10 prisoners with missing PNC_ethnic released from HMP Peterborough in the 2008 sample data. This was an attempt to reduce the number of individuals from Peterborough lost because of missing data. For Cohort 1 SF/Peterborough will be inputting data so the aim will be to have no missing data. Those from 'Other prisons' were missing on ethnicity in 307 cases. These cases were excluded from the potential matching pool.

Age

One individual released from HMP Peterborough had his age at first offence increased from age 8 to age 10 in the 2008 sample data.

One hundred individuals from 'Other prisons' had a missing age at first offence or had an age of first offence below 10. These observations were coded as missing and the individuals were excluded from the potential matching pool.

This approach for minimising data loss for the Peterborough cohort (imputing missing values) was considered acceptable because of the small number of observations (10 ethnicity and 1 age).

3.4 Nationality/Ethnicity categories for the 2008 sample data

An assessment was made of the appropriate Nationality/Ethnicity categories for the model based on the minimum population condition.

Table 3.3 details the population numbers by category according to the nationality and ethnicity.

Table 3.3: 2008 Cohort analysis: Classification of nationality by ethnicity

	Ethnicity		
Nationality	**White**	**Black**	**Other**
African	3	16	0
European	117	3	2
Asian	1	0	12
Central, South American	0	0	0
Middle Eastern	0	0	2
North American	1	0	0
Oceania	0	0	0
West Indies	0	3	0
UK	535	33	22
Unknown	6	3	2
Total	**663**	**58**	**40**

If we were to categorise by nationality for UK, Europe and Other, the numbers in each category would be as shown in Table 3.4.

Table 3.4: 2008 Cohort analysis: Classification of nationality by ethnicity[20]

	Ethnicity		
Nationality	**White**	**Black**	**Other**
UK	535	33	22
European	117	3	2
Other	5	19	14
Total	**657**	**55**	**38**

If we were to categorise by nationality for UK and Foreign, the numbers in each category would be as shown in Table 3.5.

Table 3.5: 2008 Cohort analysis: Classification of nationality by ethnicity

	Ethnicity		
Nationality	**White**	**Black**	**Other**
UK	535	33	22
Foreign	122	22	16
Total	**657**	**55**	**38**

Given the numbers and lack of clarity surrounding the relevant difference between European nationality and Other nationality, the selected breakdown is UK nationals/Foreign nationals. This categorisation provides categories that are not too small to be in the model and also fits with how nationality is reported in custody figures.

[20] The Unknown nationality category is not included in Table 3.4 or Table 3.5 as these individuals could not be classified into the subcategories. In addition these individuals would not be included in the model.

3.5 PSM model for the 2008 sample data

It should be noted that traditional methods of evaluating the model fit of logistic regressions are less relevant when developing propensity scores (Apel and Sweeten, 2010). The ideal model would be a null model where the reconviction events of the Treatment and Comparison Groups could be directly compared because those from HMP Peterborough and 'Other prisons' were already similar on all background and offending characteristics. The worst model would be a model with a perfect fit (i.e., a model that perfectly predicts the difference between those from HMP Peterborough and those from 'Other prisons'). For example, including Police Force Area would make the model close to a perfect fit because almost all of the offending of those in Peterborough was in two police force areas and almost none of the offending of individuals from 'Other prisons' was committed in these police force areas.

The only criteria that will be used to evaluate the fit of the model will be the balance between those from HMP Peterborough and those from other prisons on the available data post-matching.

3.6 Data matching the 2008 sample data

The matching will be evaluated by examining the different balance of the covariates before and after the matching has been completed. A table showing the relevant demographic and criminal background characteristics after the data has been restricted (but before matching) will provide the baseline. After the up to 10:1 matching has been completed the same table will be produced with the matched sample only. The matching will be considered successful if there are few[21] statistically significant differences between the group released from HMP Peterborough and the group released from other prisons. A table which shows the matching frequency (i.e., the number of individuals in Peterborough with 10 matches, 9 matches, etc.) was also produced (see Table 3.10).

Preliminary investigation

A preliminary investigation of the data and process of creating the PSM model was undertaken. This included restricting the data, examining the pre-existing differences between those in HMP Peterborough and those in other prisons, developing the propensity score model and some preliminary matching.

[21] At the p<.05 level 1 out of every 20 statistical tests would be expected to be significant by chance.

Table 3.6 shows the demographic features of the two samples before matching (but after data restrictions had been imposed). For example, the average age at release for the 32,681 from 'Other prisons' was 32.1 (sd=9.4) compared to 33.0 (sd=9.6) for the 729 individuals from HMP Peterborough. This difference was significantly different (t=2.65, p<.008) with a standardised mean effect size difference of d= .10.[22] Also, those released from Peterborough were significantly more likely to be White-Other Foreign and significantly less likely to be White-British or Black-British.

Table 3.6: 2008 Cohort analysis: Demographic features of the sample (pre-matching)

Demographic features		**Other prisons**		**Peterborough**			
	N	**M (sd)**	**N**	**M (sd)**	**t**	**p**	**d**
Av. age at release	32,681	32.1 (9.4)	729	33.0 (9.6)	2.65	.008	.10
Ethnicity & Nationality	**N**		**N**		**chi squared**		
	32,083	%	720	%			
White – British		78.6 (25,125)		71.5 (515)	20.8	.0001	-.20
White – Other Foreign		5.9 (1,888		16.0 (115)	125.0	.0001	.61
Black - British		6.8 (2,188		4.4 (32)	6.3	.01	-.25
Black – Other Foreign		2.1 (685		3.1 (22)	2.9	.22	.22
Asian, Chinese, Japanese, Middle Eastern – British		4.1 (1,312		2.8 (20)	3.1	.19	.22
Asian, Chinese, Japanese, Middle Eastern – Other Foreign		2.5 (795		2.2 (16)	.191	.67	-.06

N = Numbers of observations, M = Mean, sd = standard deviation, t = results of t-test, chi squared = results of chi squared test, p = level of statistical significance, d = standardised mean effect size

Table 3.7 shows the criminal history and index offence variables for both samples before matching (but after data restriction). Overall, the results suggested that those released from HMP Peterborough were of lower risk of reoffending than those released from other prisons. This was based on the fact that those in other prisons had a significantly earlier age at first offence, significantly more previous offences, convictions and incarcerations, as well as a greater Copas score, and these factors have been associated with proven reoffending (Howard et al., 2009). This was also reflected in the fact that those from other prisons were significantly more likely to be chronic offenders. Examining the bottom section of Table 3.7 shows that those from HMP Peterborough were significantly less likely to have an index

[22] The standardised mean difference (d) is an effect size measure that can be used to provide an additional evaluation of the magnitude of the difference between the samples. Effect sizes of >.20 are considered an important difference (Hahs-Vaughn and Onwuegbuzie, 2006).

offence for Criminal damage, 'Other' offences and Theft offences, but were significantly more likely to have index offences for Drink driving, Child sexual offences, Breach of Suspended Sentence Order and Breach of Community Order.

Table 3.7: 2008 Cohort analysis: Criminal history of the sample (pre-matching)

Individual factors	N	Other prison	N	Peterborough	t	p	d
		M (sd)	729	M (sd)			
Age at first offence	32,581	17.8 (7.0)		20.2 (8.7)	8.95	.0001	.34
Number of previous offences	32,681	45.6 (44.7)		35.8 (39.9)	5.82	.0001	-.22
Number of previous conviction occasions	32,681	19.4 (17.8)		15.2 (15.6)	6.82	.0001	-.24
Number of previous custodial sentences	32,681	6.2 (8.0)		4.5 (6.2)	5.63	.0001	-.21
Copas score	32,681	(-.43) (.71)		(-.64) (.76)	7.86	.0001	-.30
Length of sentence	32,681	112.0 (71.2)		108.8 (68.4)	1.2	.225	-.05
Time served	32,681	42.5 (32.5)		43.7 (31.0)	0.94	.346	.03
Number of previous T1 & T2 convictions	32,681	1.80 (2.49)		1.33 (2.13)	5.110	.0001	-.19

		Other prison	N	Peterborough			
	N	% (N)	N	% (N)	chi squared	p	d
Severe current offence	30,480	0.7 (213)	701	0.6 (4)	.163	.68	-.11
% Chronics	32,681	19.5 (6,382)	729	13.6 (99)	16.1	.0001	-.24
PPO Flag	32,681	7.4 (2,431)	729	6.3 (46)	1.323	.250	-.10
Type of Index Offence:	**30,480**	**% (N)**	**701**	**% (N)**			
Absconding or bail offences		3.2 (976)		2.0 (14)	3.24	.072	-.27
Criminal/malicious damage		2.0 (607)		0.9 (6)	4.59	.032	-.47
Domestic burglary		1.2 (372)		0.9 (6)	.760	.383	-.20
Other burglary		3.7 (1,121)		2.9 (20)	1.32	.250	-.15
Drink driving offences		2.8 (852)		6.7 (47)	37.4	.0001	.51
Drugs (import/export/prod)		0.3 (96)		0.1 (1)	.656	.418	-.44
Drugs (possession/small-scale supply)		1.7 (505)		1.6 (11)	.032	.857	-.03
Fraud/forgery		2.2 (663)		2.0 (14)	.102	.749	-.04
Handling		1.1 (349)		1.0 (7)	.130	.718	-.07
Other		4.4 (1,348)		2.0 (14)	9.65	.002	-.45
Other motoring offences		7.2 (2,209)		7.6 (53)	.100	.752	.02
Public order		3.4 (1,043)		3.9 (27)	.382	.537	.07
Robbery		0.1 (39)		0 (0)			
Sexual		1.1 (328)		1.1 (8)	0.027	.869	.03
Sexual (child)		0.4 (136)		1.0 (7)	4.580	.032	.45
Soliciting/prostitution		0.1 (23)		0.1 (1)	.402	.526	.35

	Other prison		N	Peterborough			
	N	% (N)	N	% (N)	chi squared	p	d
Taking and driving away		1.6 (493)		2.4 (17)	2.78	.096	.23
Theft		23.0 (7,002)		18.7 (131)	7.131	.008	-.14
Theft from a vehicle		1.7 (522)		1.3 (9)	.75	.386	-.16
Violence		18.4 (5,603)		17.0 (119)	.905	.341	-.05
Serious violence		0.4 (108)		0.3 (2)	.093	.76	-.12
Breach SSO (combined)		12.2 (3,737)		16.3 (114)	10.2	.001	.18
Breach CO (combined)		6.8 (2,060)		10.3 (72)	13.3	.0001	.25
Breach CD (combined)		0.2 (50)		0 (0)			

N = Numbers of observations, M = Mean, sd = standard deviation, t = results of t-test, chi squared = results of chi squared test, p = level of statistical significance, d = standardised mean effect size

Given the criteria for model inclusion already discussed in Section 2.8, (i.e., p<.20 and more than 5 observations), 28 variables were considered for inclusion in the model. These are shown in Table 3.8, and include 6 squared variables (to account for non-linear effects). All squared variables met the inclusion criteria (i.e., were significantly different at the p<.05 level between HMP Peterborough and those from other prisons). Two variables that had less than 10 observations were tested in the model (Index offence of Criminal malicious damage and Index offence of Child sexual offence) and their standard errors were examined. The standard errors for these variables were not too high so they were retained in the model (see Table 3.8).

Table 3.8: 2008 Cohort analysis: Variables for model inclusion

	Variables for model inclusion
1	Av. age at release
2	Av. age at release_squared
3	White British
4	White Other Foreign
5	Black British
6	Black Other Foreign
7	Asian British
8	Age at first offence
9	Age at first offence_squared
10	Number of previous offences
11	Number of previous offences_squared
12	Number of previous convictions
13	Number of previous convictions_squared
14	Number of previous incarcerations
15	Number of previous incarcerations_squared
16	Copas score

	Variables for model inclusion
17	Number of previous T1 & T2 convictions
18	Number of previous T1 & T2 convictions_squared
19	% Chronics
	Index offences
20	Absconding bail offences
21	Drink driving offences
22	Other offences
23	Taking and driving away
24	Theft
25	Breach SSO
26	Breach CO
	Low numbers, but test
27	Criminal malicious damage
28	Sexual (child)

Table 3.9 shows the parameters of the final PSM model. A positive 'B' figure shows that HMP Peterborough was over-represented on a characteristic and a negative 'B' shows this was less commonly a feature of the Peterborough sample. This is most easily interpreted by looking at the Exp (B) which is the standardised B value and equivalent to an odds ratio. Odds ratios are standardised measures of effect centred around 1. As a rule of thumb, an odds ratio of 2.0 (or 0.5) is considered large as it is equivalent to a doubling (or halving) of the risk (e.g. Farrington and Loeber, 1989). Thus, for example, controlling for all other variables in the model, those released from HMP Peterborough were significantly more likely to be White-Other Foreign (Exp (B) = 2.4, p<.0001) and significantly less likely to be Asian-British, Chinese-British, or Japanese-British. The two variables that had small numbers were included in the model (Index offences of Criminal damage and Child sexual offences) because the standard errors were sufficiently low (i.e., less than 1).

Table 3.9: 2008 Cohort analysis: Final PSM model parameters

	B	SE	p	Exp (B)
Age at index offence	.027	.028	.34	1.027
Age at index offence squared	.000	.000	.63	1.000
White, British	-.228	.101	.58	.98
White, Other Foreign	.876	.130	.00	2.402
Black, British	-.307	.194	.11	.73
Black, Other Foreign	.258	.233	.26	1.294
Asian, Chinese, British	-.500	.250	.04	.60
Age at first offence	.038	.027	.15	1.039
Age at first offence squared	-.001	.000	.16	.99
Number of previous offences	.000	.005	.96	1.000

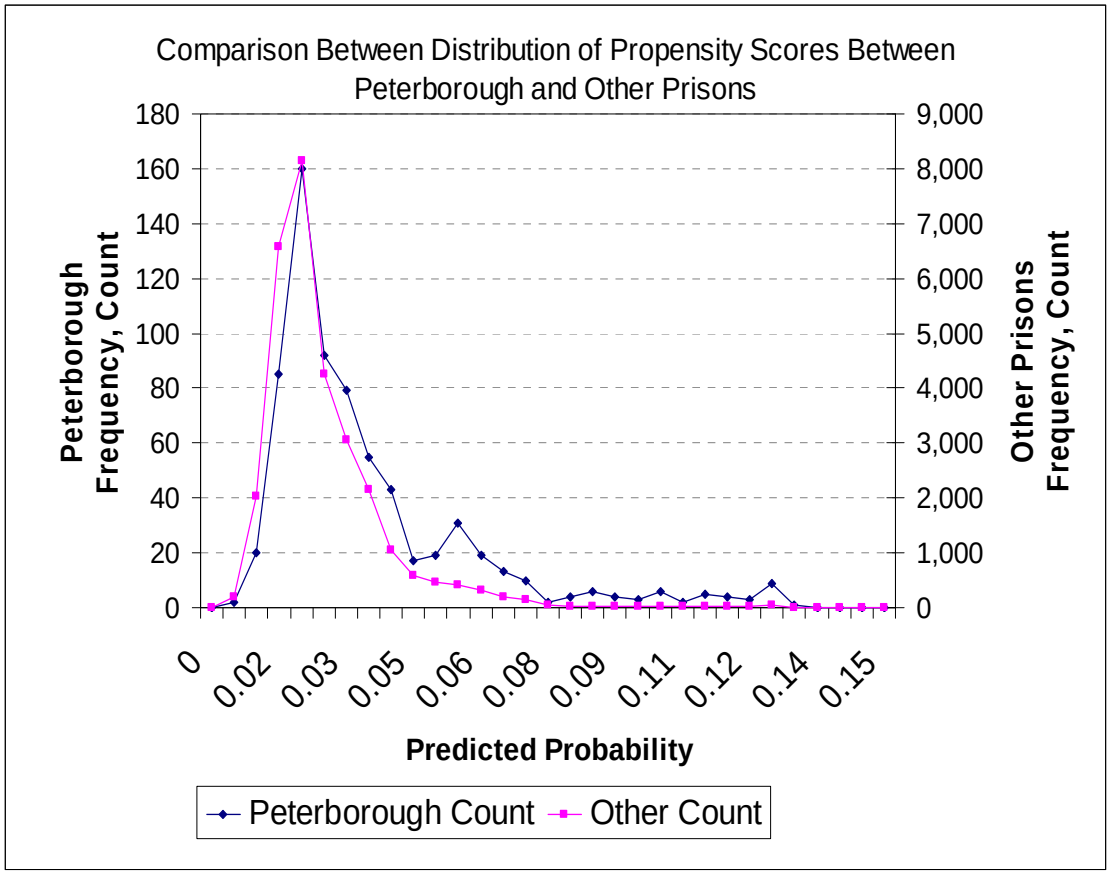
	B	SE	p	Exp (B)
Number of previous offences squared	.000	.000	.59	1.000
Previous total convictions	-.019	.011	.08	.98
Previous total convictions squared	.000	.000	.19	1.000
Number of previous imprisonments	.009	.022	.68	1.009
Number of previous imprisonments squared	-.001	.001	.22	.99
Copas score	.020	.115	.86	1.020
Number of previous serious (T1 & T2) convictions	-.041	.045	.36	.96
Number of previous serious (T1 & T2) convictions squared	.001	.004	.76	1.001
% Chronics	.106	.199	.59	1.112
Absconding/bail offences	-.456	.287	.11	.63
Drink driving offences	.623	.168	.00	1.864
Other offences	-.646	.282	.02	.52
Taking and driving away	.680	.258	.00	1.974
Theft	-.099	.115	.38	.90
Breach of Suspended Sentence Order	.453	.117	.00	1.572
Breach of Community Order	.596	.138	.00	1.815
Criminal damage	-.664	.416	.11	.51
Child sexual offences	.613	.415	.14	1.845
Constant	-4.774	.462	.00	.00

B = coefficient, SE = standard error, p = level of statistical significance, Exp (B) = standardised B value

It was only possible to calculate a propensity score for 694 of those released from HMP Peterborough. The most common reason for being unable to do this was a missing index offence.

The distribution of the PSM score for individuals from HMP Peterborough and other prisons can be seen in Figure 3.1. The y-axis shows the number of individuals with a given propensity score (left-hand side Peterborough, right-hand side Other prisons) and the actual propensity score is along the x-axis. Figure 3.1 also shows that most individuals have a relatively low probability of being released from Peterborough (towards the left of Figure 3.1), but that some individuals have a somewhat higher probability (towards the right of Figure 3.1). The overall similar appearance of the distributions suggested that matching on propensity scores would be possible and that there is common support for the use of PSM.

Figure 3.1: 2008 Cohort analysis: Comparison between distribution of propensity scores



3.7 Matching the 2008 sample data

Up to 10:1 matching was undertaken for the entire sample of 694 released from HMP Peterborough for whom it was possible to calculate a propensity score. It was possible to obtain at least two matches for each of the 694 released from Peterborough. Table 3.10 shows the results. An additional analysis (not shown) was undertaken to explore the characteristics of those from Peterborough by the number of matches (e.g. matched to 10 people from other prisons or matched with two people from other prisons). The results suggested that most individuals released from HMP Peterborough had 10 matches and that those with fewer matches generally had higher propensity scores. This was because these individuals had characteristics which were less commonly found in the comparison prisons, such as being of White Other Foreign ethnicity and nationality and having drink driving as an index offence.

Table 3.10: 2008 Cohort analysis: Number of matches

Matches	Number of individuals from other prisons
1	694
2	694
3	685
4	678
5	669
6	661
7	648
8	630
9	619
10	613
Total	**6,591**

Table 3.11 shows the demographic characteristics of the 694 released from HMP Peterborough with the 6,591 released from other prisons matched on the propensity score. The results suggest that matching those from Peterborough to those from other prisons on demographic features was successful, as there were no statistically significant differences between the two groups.

Table 3.11: 2008 Cohort analysis: Matching quality

Demographic features		**Other prisons**		**Peterborough**			
	N	**M (sd)**	**N**	**M (sd)**	**t**	**p**	**d**
Av. age at release	6,591	32.5 (9.3)	694	32.9 (9.5)	.979	.33	.04
Nationality & ethnicity	**N**		**N**		**chi squared**	**P**	
	6,591	% (N)	694	% (N)			d
White British		72.4 (4,769)		71.9 (499)	.065	.80	-.01
White Other Foreign		14.6 (960)		16.1 (112)	1.2	.27	.05
Black British		4.8 (317)		4.2 (29)	.55	.46	-.08
Black Other Foreign		2.9 (189)		3.2 (22)	.20	.65	.05
Asian, Chinese, Japanese, Middle Eastern British		2.6 (170)		2.4 (17)	.04	.84	-.03
Asian, Chinese, Japanese, Middle Eastern Other Foreign		2.8 (186)		2.2 (15)	1.0	.31	-.15

N = Numbers of observations, M = Mean, sd = standard deviation, t = results of t-test, chi squared = results of chi squared test, p = level of statistical significance, d = standardised mean effect size

Table 3.12 shows the criminal history variables of the two groups when matched on the propensity score. The results suggest that the two groups are no longer significantly different on any of the measured variables.

Table 3.12: 2008 Cohort analysis: Criminal history variables

Individual factors	N	Other prison	N	Peterborough	T	p	d
	6,591	M (sd)	694	M (sd)			
Age at first offence		19.5 (8.1)		19.9 (8.5)	1.2	.22	.05
Number of previous offences		37.9 (41.6)		36.8 (40.5)	.64	.52	-.03
Number of previous conviction occasions		16.1 (16.4)		15.5 (15.8)	.80	.42	-.04
Number of previous custodial sentences		4.9 (6.7)		4.6 (6.3)	.92	.35	-.04
Copas score		-.58 (.74)		-.61 (.74)	1.1	.27	-.01
Length of sentence		112.7 (70.7)		109.2 (68.6)	1.1	.28	-.05
Time served		41.8 (33.3)		43.8 (31.2)	1.5	.13	.06
Number of previous T1 & T2 convictions		1.4 (2.2)		1.4 (2.2)	.64	.52	0

		Other prison		Peterborough			
	N	% (N)	N	% (N)	chi squared	p	d
Severe current offence		0.6 (40)		0.6 (4)	.01	.92	-.03
% Chronics		14.7 (968)		14.3 (99)	.09	.77	-.02
PPO flag		5.6 (367)		6.6 (46)	1.3	.25	.10
Type of index offence	**N**	**% (N)**	**N**	**% (N)**	**chi squared**	**p**	**d**
Absconding or bail offences		1.8 (119)		1.9 (13)	.02	.90	0
Criminal/malicious damage		1.1 (70)		0.9 (6)	.24	.63	-.11
Domestic burglary		0.7 (47)		0.9 (6)	.20	.67	.10
Other burglary		3.4 (223)		2.9 (20)	.49	.48	-.09
Drink driving offences		5.7 (376)		6.8 (47)	1.3	.25	.10
Drugs (import/export/ prod)		0.5 (30)		0.1 (1)	1.4	.23	-.66
Drugs (possession/ small-scale supply)		1.6 (106)		1.6 (11)	.002	.96	0
Fraud/forgery		2.5 (166)		2.0 (14)	.66	.42	-.12
Handling		1.0 (64)		1.0 (7)	.01	.92	0
Other		2.2 (142)		2.0 (14)	.06	.81	-.03
Other motoring offences		7.2 (472)		7.6 (53)	.21	.64	.05
Public order		2.8 (182)		3.9 (27)	2.9	.09	.19
Robbery		0.1 (4)		0.0	.42	.52	
Sexual		1.0 65)		1.2 (8)	.18	.68	.10
Sexual (child)		0.8 (55)		1.0 (7)	.22	.64	.10
Soliciting/prostitution		0.1 (7)		0.0 (0)	.74	.39	
Taking and Driving Away		2.4 (158)		2.4 (17)	0.0	.93	0
Theft		20 (1,317)		18.7 (130)	.62	.43	-.05
Theft from a vehicle		1.5 (96)		1.3 (9)	.11	.74	-.06

	Other prison	Peterborough			
Violence	17.9 (1,177)	16.7 (116)	.56	.45	0
Serious violence	0.3 (19)	0.3 (2)	0.0	1.0	0
Breach SSO (combined)	15.4 (1,017)	16.3 (113)	.35	.56	.05
Breach CO (combined)	9.3 (614)	10.4 (72)	.83	.36	.05
Breach CD (combined)	0.2 (15)	0.0 (0)	1.5	.21	

N = Numbers of observations, M = Mean, sd = standard deviation, t = results of t-test, chi squared = results of chi squared test, p = level of statistical significance, d = standardised mean effect size

Table 3:13 shows which prisons the 6,591 individuals (matched with those 694 released from HMP Peterborough) were released from. It might be expected that the prisoners would be uniformly distributed between the prisons. However, it is interesting to note that of the 36 prisons, 4 produced matches with more than 300 prisoners (Altcourse, Birmingham, Forest Bank and Liverpool).

Table 3.13: 2008 Cohort analysis: Which prisons the matches come from

ID	Prison	Number matched
1	Altcourse	386
2	Bedford	160
3	Belmarsh	103
4	Birmingham	322
5	Blakenhurst	111
6	Bristol	139
7	Brixton	141
8	Bullingdon	199
9	Cardiff	107
10	Chelmsford	205
11	Doncaster	290
12	Dorchester	48
13	Durham	205
14	Exeter	221
15	Forest Bank	314
16	Gloucester	62
17	High Down	205
18	Holme House	138
19	Hull	142
20	Leeds	161
21	Leicester	87
22	Lewes	152
23	Lincoln	229
24	Liverpool	490
25	Manchester	267
26	Norwich	107
27	Nottingham	119
28	Parc	185

ID	Prison	Number matched
29	Pentonville	200
30	Preston	136
31	Shrewsbury	80
32	Swansea	81
33	Wandsworth	220
34	Winchester	114
35	Woodhill	166
36	Wormwood Scrubs	299
Total		**6,591**

3.8 Reconviction analysis

This section reports the results of the reconviction analysis on the 2008 sample data. The reconviction measure has been defined as the number of times an offender is reconvicted in the 12 months following release from prison.[23]

It should be noted that the count of reconviction events in the 2008 sample data that was provided by MoJ has not been validated. The data will be validated for the reconviction analysis of Cohort 1.

Table 3.14 shows the results of the reconviction analysis for the 694 individuals from HMP Peterborough compared to the 6,591 with whom it was possible to match from 'Other prisons'. The 694 individuals at Peterborough accrued 1,140 court convictions (average of 1.64 per person) compared to 11,303 for the 6,591 individuals from other prisons (average of 1.71 per person).

Table 3.14: 2008 Cohort analysis: Reconviction analysis for the 694 individuals from Peterborough compared to the 6,591 from 'Other prisons'

	N individuals	N court conviction (freq_conv_court)	Mean	SD
Peterborough	694	1,140	1.64	2.562
Other prisons	6,591	11,303	1.71	2.484

The reconviction analysis shows that, after matching, the two groups were similar on the number of reconviction events during a one-year follow-up.

[23] The 'frequency of reconviction events' measure counts the number of times an offender is reconvicted in the first 12 months following release from prison. This measure is determined 18 months after release from prison to take into account the court processing time.

4. Conclusions

A methodology has been developed by the Independent Assessor to identify a Comparison Group that will be used when the outcome payment for the Peterborough SIB is calculated. The methodology was developed based on 2008 sample data from the PNC and Prisons Database.

The example analysis on the 2008 sample data suggests that the propensity score matching approach can eliminate the pre-existing differences between those released from HMP Peterborough and those released from other prisons, on measurable variables. Furthermore, the reconviction analysis based on the same 2008 sample showed that these groups were found to be similar on the number of reconviction events.

5. Abbreviations

Table 5.1 provides a definition for each of the abbreviations and variables in this report.

Table 5.1: Abbreviations

Abbreviation	Definition
B	The coefficient for the variable
CIA	Conditional Independence Assumption
CJA 2003	Criminal Justice Act 2003
d	Standardised mean difference
df	Degrees of freedom
DIAL	Data Improvement, Analysis and Linking
DIP	Drug testing carried out in some police areas
Exp (B)	Standardised B value
HMP	Her Majesty's Prison
IIS	Inmate Information System
JSAS	Justice Statistics Analytical Services
LAA	Local Area Authority
LIDS	Local Inmate Database System
LRCS	Likelihood Ratio Chi Square
M	Mean
MoJ	Ministry of Justice
N	Number of observations
NOMIS	National Offender Management Information System
NOMS	National Offender Management Service
p	Probability of statistical significance
PbR	Payment by Results
PNC	Police National Computer
PPRS	Prison, Probation and Reoffending Statistics
PSM	Propensity Score Matching
QQ	QinetiQ
ROC	Receiver Operator Characteristic
sd	Standard deviation
se	Standard error
SF	Social Finance
SIB	Social Impact Bond
SIP LP	Social Impact Limited Partnership
SQL	Structured Query Language
t	Results of t-test
UOL	University of Leicester

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Appendix 1
Data extract specification

Table A1 provides a list of the data made available to the Independent Assessor for the purposes of developing the methodology.

Table A1: Data made available to the Independent Assessor

Variable name	Variable definition
Tempid	Temporary id
Gender	Gender from Person.Sex
pnc_ethnic	From Person.EthnicityCode
input_ethnic	Ethnicity from prison/probation datasets. Any values without labels check with prison team
index_disposal	Disposal of index offence - CODE
index_disposal_desc	Disposal of index offence - DESCRIPTION
date_of_birth	From Person.DateOfBirth
Convdate	Sentence date
index_date	Index date - date discharged from prison or sentence date for non-custodial disposals
career_length	Length of criminal career (in days)
first_offence_age	Age at first offence
age_index	Age at index date
process_station_code_index	Index offence station code
process_force_code_index	Index offence police force code
HOCode_index	Index offence Home Office offence code
OGRS_index	Index offence OGRS category
severe_index	Is index offence severe
severe_T1_index	Is index offence a tier 1 offence
severe_T2_index	Is index offence a tier 2 offence
severe_T3_index	Is index offence a tier 3 offence
court_conviction_index	Did the index offence get a court conviction
court_caution_index	Did the index offence get a caution
OGRS_index_desc	Index offence OGRS description
offence_date_1st_re_convict	Information about the 1st reconviction in one year
age_1st_re_convict	Information about the 1st reconviction in one year
HOCode_1st_re_convict	Information about the 1st reconviction in one year

Variable name	Variable definition
OGRS_1st_re_convict	Information about the 1st reconviction in one year
severe_1st_re_convict	Information about the 1st reconviction in one year
severe_T1_1st_re_convict	Information about the 1st reconviction in one year
severe_T2_1st_re_convict	Information about the 1st reconviction in one year
severe_T3_1st_re_convict	Information about the 1st reconviction in one year
conviction_date_1st_re_convict	Information about the 1st reconviction in one year
first_disposal_1st_re_convict	Information about the 1st reconviction in one year
first_disposal_duration_1st_re_convict	Information about the 1st reconviction in one year
first_disposal_amount_1st_re_convict	Information about the 1st reconviction in one year
daystoreoffence_1st_re_convict	Information about the 1st reconviction in one year
timetoconviction_1st_re_convict	Information about the 1st reconviction in one year
process_force_1st_re_convict	Information about the 1st reconviction in one year
indicator_1y_re_conv_final	Indicates if reconvicted or not
freq_reoff_ocd	Frequency of out of court disposal reoffences
freq_reoff_court	Frequency of court convicted reoffences
freq_reoff_total	Frequency of total reoffences
severe_reoff_ocd	Frequency of severe out of court disposal reoffences
severe_reoff_court	Frequency of severe court convicted reoffences
severe_reoff_total	Frequency of severe total reoffences
severe_T1_reoff_ocd	Frequency of severe Tier 1 out of court disposal reoffences
severe_T1_reoff_court	Frequency of severe Tier 1 court convicted reoffences
severe_T1_reoff_total	Frequency of severe Tier 1 total reoffences
severe_T2_reoff_ocd	Frequency of severe Tier 2 out of court disposal reoffences
severe_T2_reoff_court	Frequency of severe Tier 2 court convicted reoffences
severe_T2_reoff_total	Frequency of severe Tier 2 total reoffences
severe_T3_reoff_ocd	Frequency of severe Tier 3 out of court disposal reoffences
severe_T3_reoff_court	Frequency of severe Tier 3 court convicted reoffences
severe_T3_reoff_total	Frequency of severe Tier 3 total reoffences
freq_conv_ocd	Frequency of caution events
freq_conv_court	Frequency of reconviction events

Variable name	Variable definition
freq_conv_total	Frequency of reoffending events
severe_conv_ocd	
severe_conv_court	
severe_conv_total	
severe_T1_conv_ocd	
severe_T1_conv_court	
severe_T1_conv_total	
severe_T2_conv_ocd	
severe_T2_conv_court	
severe_T2_conv_total	
severe_T3_conv_ocd	
severe_T3_conv_court	
severe_T3_conv_total	
prev_offences	Number of previous offences
prev_off_violence	Number of previous offences in each category of offence
prev_off_violenceserious	Number of previous offences in each category of offence
prev_off_violencenonserious	Number of previous offences in each category of offence
prev_off_robbery	Number of previous offences in each category of offence
prev_off_publicorder	Number of previous offences in each category of offence
prev_off_sexual	Number of previous offences in each category of offence
prev_off_sexualchild	Number of previous offences in each category of offence
prev_off_solicitingprostitution	Number of previous offences in each category of offence
prev_off_domburglary	Number of previous offences in each category of offence
prev_off_otherburglary	Number of previous offences in each category of offence
prev_off_theft	Number of previous offences in each category of offence
prev_off_handling	Number of previous offences in each category of offence

Variable name	Variable definition
prev_off_fraudforgery	Number of previous offences in each category of offence
prev_off_abscondingbailoff	Number of previous offences in each category of offence
prev_off_takingdriveaway	Number of previous offences in each category of offence
prev_off_motoringoff	Number of previous offences in each category of offence
prev_off_drinkdriving	Number of previous offences in each category of offence
prev_off_criminalmaldamage	Number of previous offences in each category of offence
prev_off_drugsimpexpprodsupply	Number of previous offences in each category of offence
prev_off_DrugspossessSupply	Number of previous offences in each category of offence
prev_off_other	Number of previous offences in each category of offence
prev_off_misc	Number of previous offences in each category of offence
prev_off_breach	Number of previous offences in each category of offence
prev_conv_ocd	Number of previous convictions
prev_conv_court	Number of previous convictions
prev_prison	Number of previous custodial sentences
prev_ocd	Number of previous out of court disposals
prev_court_convictions	Number of previous court convictions
prev_total_convictions	Number of previous total convictions
prev_severe_ocd	Number of previous severe out of court disposals
prev_severe_court_convictions	Number of previous severe court convictions
prev_total_severe_convictions	Number of previous severe total convictions
previousconv_severe_T1_ocd	
previousconv_severe_T1_court	
previousconv_severe_T1_total	
previousconv_severe_T2_ocd	
previousconv_severe_T2_court	
previousconv_severe_T2_total	
previousconv_severe_T3_ocd	

Variable name	Variable definition
previousconv_severe_T3_court	
previousconv_severe_T3_total	
copas_rate	Speed of reoffending Log(Number of court appearances or cautions+1/Length of criminal career in years +10)
dis_prison	Discharging prison
dis_code	Discharge code
PPO_start	If they are on a PPO scheme what was the start date
PPO_end	If they are on a PPO scheme what was the end date
PPO_CDRP	If they are on a PPO scheme what CDRP
PPO_Flag	Is the offender on a PPO scheme
Date_DIP	If they are a drug misusing offender what was the date they were identified
Location_DIP	If they are a drug misusing offender what was the location
Source_DIP	If they are a drug misusing offender what was the source of identification
DIP_Flag	Is the offender a drug misusing offender
Prison sentence length	The length of prison sentence
date_first_offence	Date of first offence
OFFENCEFORCECODE_index	Police force code where index offence took place
OFFENCESTATIONCODE_index	Police station code where index offence took place
OFFENCEPOSTCODE_index	Index offence postcode
OFFENCEPOSTCODEPARTIAL_index	Index offence postcode - partial
COURTCODE_index	Which court passed sentence for index offence
COURTDESCRIPTION_index	Which court passed sentence for index offence - description
courttype_index	Magistrate or crown court
csp	Community Safety Partnership area
csp_code	Code for CSP
laa	Local Authority
laa_number	Local Authority Number
region	Region
Nationality	Nationality

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Report title Peterborough Social Impact Bond: an independent assessment – Development of the PSM methodology

QinetiQ and the University of Leicester are the Independent Assessor of the reconviction impact of the HMP Peterborough Social Impact Bond (SIB). This document describes the methodology that has been developed by the Independent Assessor to identify the Comparison Group that will be used when the outcome payment for the Peterborough SIB is calculated.

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