Peterborough Social Impact Bond:

Final Report on Cohort 1 Analysis

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Summary

This report has two main purposes: firstly to validate the Propensity Score Matching methodology that was tested and agreed in March 2012 (see Cave et al., 2012) for the first cohort of offenders in the Peterborough Social Impact Bond pilot, under which the One Service provided interventions for adult males before and after being discharged from custodial sentences of less than 12 months; and secondly to assess reconviction data to determine whether any payment is due to investors for the first cohort. The payment mechanism is designed to ensure that MoJ pays investors, represented in this case by Social Finance (SF), only when a minimum of 10% reduction in reconvictions per cohort or a 7.5% reduction across all cohorts has occurred.

The Independent Assessors, comprising analysts from QinetiQ and the University of Leicester and University of Greenwich, established and tested a method for comparing offenders released from HMP Peterborough with other comparable offenders released from other prisons in a 'dry run', based on 2008 data taken from the prisoner record system (LIDS) and from criminal records information held on the Police National Computer (PNC) (see Cave et al., 2012). The analyses in this report attempts to replicate the above approach with the first cohort of those who experienced the through-the-gates intervention at HMP Peterborough.

Key findings

The current study has matched 936 offenders released from Peterborough with 9,360 released from other prisons on 36 out of 38 variables. The Independent Assessors have concluded that the model is sufficiently accurate and robust to support a reconviction analysis. The analysis shows that there was a 8.39% reduction in reoffending rates within the Peterborough Cohort 1, which is insufficient totrigger payment for the first cohort.

Other findings

The PSM Model: The 936 men released from HMP Peterborough and 9,360 released from other prisons were successfully matched on the propensity score in terms of demographic and criminal history variables. Two differences in nature of index offence remained. However, it is reasonable to conclude that this may be due to chance as we would expect to find one statistically significant result by chance at the $p<.05$ level for every 20 statistical tests conducted (Cave et al., 2012) and in this case there were 2 in 38.

Constructing the PSM model: Nine Peterborough cases were excluded from the PSM model because the nature of their offence remained uncertain, despite the best efforts of SF and the MoJ. 30 (3.2%) of the 936 were men on whom SF held data but MoJ did not. There is often attrition when comparisons are made using administrative data because of data quality and completeness.

Replicating the method: It was not possible to precisely replicate the approach adopted in the 'dry run' because of data quality issues, including missing data pertaining to the type of offence.

Although Social Finance and the MoJ made efforts to fill these gaps, some cases still had to be excluded because of missing data. There were also changes to the content and format of databases held by the MoJ.

Agreeing cases for inclusion: The MoJ and SF views of who had been, and who should have been, helped in Peterborough differed. This had implications for the number of cases included in the Peterborough sample and constructing the Comparison Group. In the 'dry run' the Independent Assessors confirmed that only those who should be included in the Intervention and Comparison groups were included. For the current exercise the MoJ performed this task, thus the number of cases which were excluded cannot be reported upon, nor can the impact this had on the current sample be compared with that of the 2008 sample.

For the benefit of future analysis of the second cohort of the Peterborough Social Impact Bond and of other projects, it should be noted that it took 11 months to agree the sample and obtain all the data needed to begin analysis.

Comparability of those released from Peterborough and other prisons prior to matching: Following data cleaning, the sample for analysis comprised 945 individuals from Peterborough and 31,207 from other prisons. Comparing these samples prior to matching showed that those released from Peterborough were less likely to reoffend, based on significant differences in important predictors including age, age at first offence, number of previous convictions and number of previous custodial sentences. There were also significant differences in the type of offences for which sentences were being served. As these factors all affect the likelihood of further offending, such differences should be controlled and understood before a comparison between Cohort 1 and the Comparison Group can be drawn. The PSM methodology was chosen to control for these factors.

1 Introduction

QinetiQ and the University of Greenwich and the University of Leicester are the Independent Assessors of the reconviction impact of the HMP Peterborough Social Impact Bond (SIB). The choice of subjects for the intervention at Peterborough, the measure of reconviction to be used, and the standard for judging the intervention a success, were developed before the Independent Assessors were involved. This document describes the approach used by the Independent Assessors to identify the Comparison Group for the outcome payment within these constraints. The approach to constructing a comparison group was developed previously using a cohort of prisoners released two years before the intervention at Peterborough commenced (Cave et al., 2012). As that approach was subject to extensive peer review, it was important to replicate the agreed method as closely as possible.

1.1 Background

Since September 2010, the Peterborough SIB has offered interventions on a voluntary basis to all adult males (aged 18 or over) receiving custodial sentences of less than 12 months ('short-sentence prisoners') and discharged from HMP Peterborough. Interventions are tailored to meet the needs of eligible offenders and involve offering pre- and post-release mentoring and connecting prisoners to services in order to help them break the cycle of reoffending.

A SIB is a unique approach to improving social outcomes by incentivising non-government investors to fund support programmes. The Peterborough SIB is intended to reduce the reconviction rates of short-sentence male prisoners leaving HMP Peterborough. In this instance Social Finance (SF) has raised the required social investment. If there is at least a 10% reduction in reoffending per cohort or a 7.5% reduction across all cohorts, the investors will receive a payment. Assessing this involves measuring the frequency with which those released from Peterborough are reconvicted with that of other comparable prisoners released from other prisons. This report describes using the approach the Independent Assessors devised (see Cave et al., 2012) to ensure that the Comparison Group from other prisons could be most usefully compared with the Intervention Group released from Peterborough.

2 Methodology

This section describes the PSM methodology that was developed by the Independent Assessor to identify the Comparison Group.

Propensity score matching (PSM) is the statistical technique that was selected by the Ministry of Justice (MoJ) and SF as the method of controlling for the observable differences between the cohort and the Comparison Groups. The creation of the PSM model originally involved 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 (see Cave et al., 2012).

This overall process (data restriction and model creation) will need to be repeated for each cohort. The reconviction frequency is defined as the number of times an offender is reconvicted at court in the 12 months following release from prison.[1] 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 will 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), however concerns have been raised about its inappropriate use (Shadish, 2013). 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.

The PSM method of matching was used because it can account for (measurable) pre-existing differences between groups with relative ease. 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; Shadish, 2013). 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

[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.

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 data held on the Police National Computer (PNC) are not very useful in controlling for selection of being released from HMP Peterborough. It is hypothesised that 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 PNC or the Local Inmate Database System (LIDS) in the PSM model, as these would have overwhelmed the model. In addition, the PNC is potentially rich in information to control for future reconviction, but the only study of which we are aware that has examined the frequency of reconvictions at court is the previous version of this report (Cave et al., 2012). In this instance the number of reconviction events of those in Peterborough was similar to those released from other prisons after matching (1.64 Peterborough; 1.71 other prisons).[2]

The following sections define the analytical boundaries of the method, an overview of the method and a detailed description of each stage of the process of creating the cohort of those from other prisons who were matched with those released from HMP Peterborough.

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 defined 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. This resulted in some constraints, including:

- 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 Assessors in order to develop and perform the PSM methodology; and

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

- Each released prisoner in the cohort will be matched to up to ten prisoners from a Comparison Group.

The three main boundaries to this methodology were:

- **Variables included in the analysis**: The Independent Assessors were limited to using 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, some of the individuals had key pieces of data missing from the PNC and LIDS that were required by the PSM methodology and were therefore excluded. Social Finance and HMP Peterborough input additional 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 per cohort would be sufficient under PSM to trigger a payment, 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 was relaxed to up to 10:1 matching, within a stated calliper[3] defined by the Independent Assessors to prioritise closeness of match over a strict threshold for the number of matches. However, the objective remained to maximise the number of matches (where suitable) to increase the diversity of individuals in the Comparison Group. In practice, this constraint was unproblematic as a 10:1 match was achieved. [4]

The PSM methodology developed by the Independent Assessors was 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 view of the PSM method that was agreed to be used to create the comparison group. Each of the stages from data extraction to data matching is described in this section.

[3] The calliper was set at 0.05 as stated in Cave et al. (2012).
[4] The Ministry of Justice and Social Finance agreed that a 7.5% reduction across all cohorts would be sufficient to trigger a payment to investors at the end of the pilot.

Figure 2.1: PSM methodology

Data extraction

Data extraction was conducted by the MoJ. It was agreed that three processes would be undertaken by the Independent Assessors to examine this data extraction. These were:

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

The results of this were:

1. The need for a review of the SQL code was obviated by changes to the MoJ data systems since the original development of the methodology.
2. A process of iterative checking was conducted, with errors identified and corrected, and new datasets produced.
3. All data passed the validation process.

Information about reconviction had originally been included in the 2008 data, but was excluded from the current data. This was to ensure that the Independent Assessors were 'blind' to a person's reconviction status in developing the cohort.

Data quality assessment

An agreed dataset which was of acceptable quality and error-free was made available to the Independent Assessors in February 2014. Data were originally provided in March 2013. However, this dataset differed in a number of important respects from the 2008 sample which had been used to develop the methodology described by Cave et al., (2012). For example, Nationality, which formed a key part of the 2008 model development and was important because many of those released from Peterborough were noted to be of Eastern European Nationality (Cave et al., 2012), was not included.

In summary, the problems were:

- variables which were in the 2008 extract no longer being available;
- changes in the measures provided;

- missing values on some variables for the Peterborough cohort;
- clarification discussions between the MoJ and SF about which offenders should be included in the Peterborough cohort.

The Independent Assessors wish to record these issues in the interests of transparency and to make future analysts aware of the sorts of timescales which were involved in resolving these problems. However, as these issues were resolved before the PSM analysis commenced on the final data set, the details are described in Appendix A.

Data restriction

According to the original report, the purpose of the data restriction stage was to ensure that only those released from HMP Peterborough who met the eligibility criteria were included in the sample and that those in the Comparison Group were as closely matched to them as possible.

The data restriction rules were developed based on the 2008 sample which included all male prisoners released from custody following a sentence of less than 12 months (n=50,510). It was agreed that the data would be restricted by the following five variables, sequentially in this order: age; released on date of sentence; time in custody; prison type; data availability. It was also suggested (pg. 12, Cave et al., 2012) that the restriction rules would be reassessed prior to carrying out the analyses on Cohorts 1 to 3.

The data provided by the MoJ appeared to have all the restriction rules already implemented, meaning that no comparison was possible between the population from which the 2008 sample was drawn and the population of the current data. The MoJ advised the Independent Assessors that the delay which would result from providing a new, unrestricted dataset, or details of the numbers lost due to restriction (see pp. 12-15 of Cave et al., 2012) would outweigh the benefits of doing so.

As a result the data provided contained 32,152 male prisoners (31,207 other prisons, 945 Peterborough), all of whom were aged 18 or above, did not have identical sentence/conviction and release dates, and had served less than 365 days. In addition only male local prisons (Table 2.1) were included. HMP Doncaster was not included because of the Payment by Results pilot operating there.

Table 2.1: Prisons Included in Analysis.

Prison included
Altcourse
Bedford
Belmarsh
Birmingham
Bristol
Brixton
Bullingdon
Cardiff
Chelmsford

Prison included
Dorchester
Durham
Elmley (Sheppey cluster)
Exeter
Forest Bank
Gloucester
High Down
Holme House
Hull
Leeds
Leicester
Lewes
Lincoln
Liverpool
Manchester
Norwich
Nottingham
Parc
Peterborough
Preston
Swansea
Thameside
Wandsworth
Winchester
Woodhill
Wormwood Scrubs

Data cleaning

The aim was to have no missing data on the HMP Peterborough cases. Social Finance provided additional information where data was missing.

Figure 2.2 shows a step by step breakdown of how Cohort 1 of the Peterborough pilot was compiled, and which offenders were included in the data provided by MoJ.

Table 2.2 explains each of the steps in Figure 2.2. The MoJ provided this breakdown and the descriptive account.

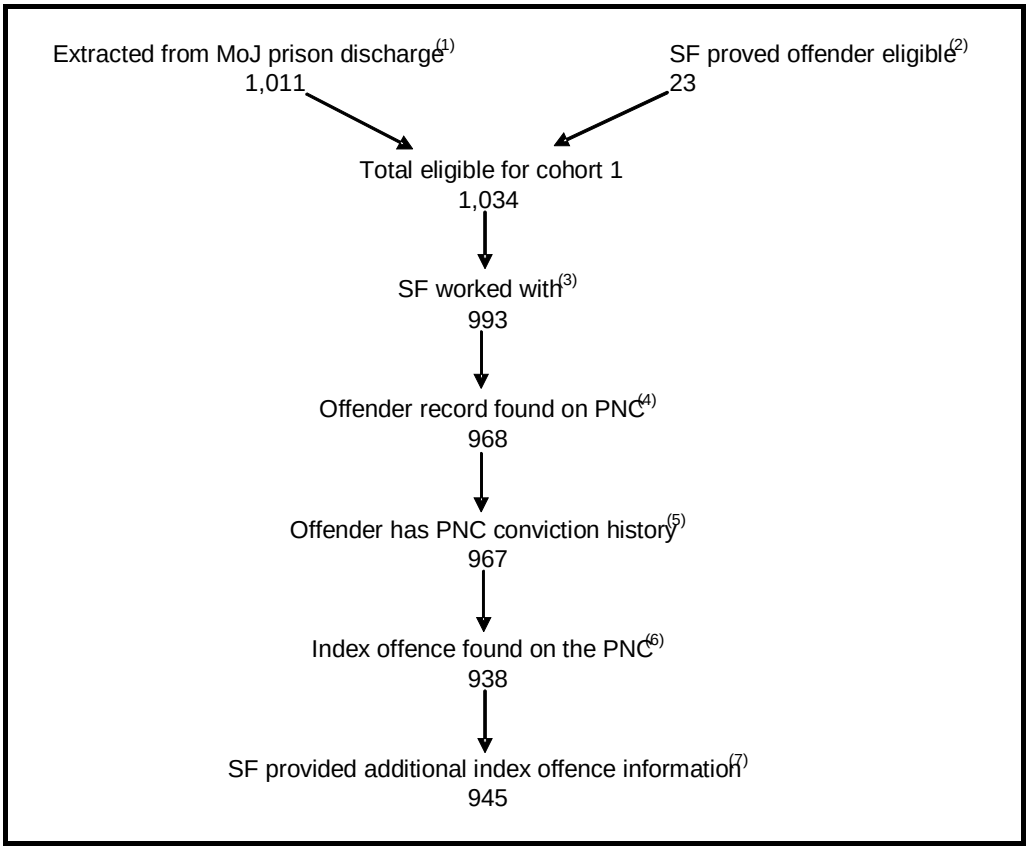

Figure 2.2: Breakdown of offenders included in Peterborough cohort 1

Table 2.2: Step by step explanation of Figure 2.2

Step	Description
1	Prisoners were extracted from MoJ prison discharge dataset with the pilot eligibility criteria applied.
2	SF provided evidence to MoJ to show that these prisoners, not in the original MoJ list produced in step one, met the eligibility criteria. Details of why they did not appear in MoJ's original data extract are provided in Table 2.3.
3	SF and HMP Peterborough provided the evidence to MoJ to show that the HMP Peterborough data on which SF relied to identify eligible offenders did not identify 41 out of 1,034 offenders as eligible. MoJ were content with the evidence and agreed to remove these offenders from the PSM measure.
4	Of the 993 prisoners, MoJ was able to find a PNC record using its standard data matching procedure for 968.

Step	Description
5	1 offender had a PNC record but had no convictions on the database, so this prisoner was excluded.
6	There were 29 prisoners for which an index offence relating to their entry to the cohort could not be identified on the PNC. More details can be found in the *missing index offences* section below.
7	SF provided MoJ with the offence description for those offenders with missing index offences. MoJ checked the PNC to see if it could identify the index offence using the additional information provided by SF, and concluded that 7 offenders could be re-instated. Details of which offences were accepted and why can be found in table 2.4 below.

Offenders not on MoJ discharge data extract

In all of the cases in Table 2.3, SF provided evidence from the NOMIS database to the MoJ that showed these prisoners were eligible for the pilot, and that the details on the prison discharge data extract that had led MoJ to exclude them were therefore incorrect.

Table 2.3: Breakdown of prisoner information provided by Social Finance and reason why they were not in the original MoJ data extract

Reason for not showing on MoJ prison discharge data extract	No.
No sentence length recorded	6
Discharge date – sentence date > sentence length. This condition is applied to exclude offenders where the recorded time served is greater than the recorded sentence length	12
Incorrect discharge date and discharge prison recorded in the prison discharge dataset	1
Offender recorded as having a bailed discharge. This is not counted as a final discharge	1
Discharge not recorded on the prison discharge database	3

Missing index offences

There were 29 prisoners for which the MoJ could identify no index offence on the PNC. That is to say, there was no offence on the PNC where the PNC court caution date (date of court conviction or caution) or subsequent appearance date were within 7 days of the sentence date from the prison

discharge data. Social Finance were prompted to provide additional index offence details for these 29 prisoners to see if this could help the MoJ locate a suitable index offence on the PNC.

SF returned the offence description for 22 offenders for whom an index offence was not found on the PNC. For each of these the MoJ checked to see if the offence description could be matched to a PNC offence of a similar description on the PNC with a matching offence description. If an offence of a similar type was identified on the PNC then the court, caution or subsequent appearance date was examined to see if it was similar to the sentence date, conviction date or the date of release date from prison discharge data. None of the dates of conviction needed to be amended. Details of the index offences the MoJ decided to include are shown in Table 2.4 below:

Table 2.4: Breakdown of index offences accepted by MoJ after receiving additional information from Social Finance

Offence description provided by Social Finance	**Offence description on the PNC**	**Days from court caution or subsequent appearance date on the PNC**
Breach of court order	Breach of community order	Within 14 days of prison data sentence date
Breach of court order	Breach of suspended sentence	Within 31 days of prison data discharge date - 1/2 sentence length
Burglary	Theft Act 1968 Sec.9 Other burglary in a building other than a dwelling.	Same day as prison data conviction date
Drug offence	Possession of class A controlled drug Cocaine	Within 1 day of prison data discharge date - 1/2 sentence length
Drunkenness	Driving or attempting to drive a mechanically propelled vehicle while having a breath, blood or urine alcohol concentration in excess of the prescribed limit.	Within 24 days of prison data sentence date
Fraud	Fraud and Breach of suspended sentence	Within 4 days of prison data discharge date - 1/2 sentence length

Offence description provided by Social Finance	Offence description on the PNC	Days from court caution or subsequent appearance date on the PNC
Offensive weapon in public, common assault and damage to property	Criminal Damage	Within 21 days of prison data sentence date

For the remaining 15 offenders that SF provided index offence descriptions for, the MoJ could not find any offence on the PNC with a court caution or subsequent appearance date within at least a month of any suitable date from the prison data. This was considered too much of a difference to consider any of the offences as plausible index offences.

Other changes

One offender in the Peterborough cohort had a 1st offence age of less than 10 years. This was changed to 10 years of age, in line with the agreed methodology.

One offender in the Peterborough cohort had no recorded date of birth on the PNC. The date of birth was taken from the prison discharge dataset.

Overall, the supplemental information provided by Peterborough Prison and SF resulted in the inclusion of an additional 30 individuals who would have been excluded if only MoJ data had been used. This equates to 3% (30/993) of the offenders which were identified by SF as eligible for the One Service prior to their release and 3.2% (30/936) of those for whom it was possible to develop a propensity score and match to 10 offenders from other prisons (see Section 3.2).

Additional data cleaning

In the original report (pg. 17; Cave et al., 2012) It was agreed that the following data cleaning would be undertaken with those released from Peterborough. These were:

1 Recoding Breach (as an index offence)
2 Recode missing ethnicity
3 Recode age at first offence
4 Recode Nationality

Recode and restrict breach (as index offence)

The treatment of breaches as an index offence and the exclusion of some types of breaches (as these would be indicative of individuals who should not be included) were agreed previously (Table 2, pg. 18; Cave et al., 2012). Table 2.5 shows the breach type, the agreed cleaning rule and the numbers for both Other Prisons and Peterborough.

Table 2.5: Types and Number of Breaches and Previously Established Cleaning Rules

Breach	Cleaning Rule	Other Prisons	Peterborough
Breach of License Conditions	Exclude	40	8
Breach of Suspended Sentence	Recode to 'Breach of Suspended Sentence Supervision Order'	3190	108
Breach of Detention and Training Order	Exclude	28	0
Breach of Combination Order	Recode to 'Breach of Community Order'	0	0
Breach of Community Punishment Order	Recode to 'Breach of Community Order'	7	0
Breach of Community Order	Retain original code	2700	58
Breach of Curfew Order	Recode to 'Breach of Community Order'	34	1
Breach of Attendance Centre Order	Recode to 'Breach of Community Order'	4	0
Breach of Drug Treatment and Testing Order	Recode to 'Breach of Community Order'	0	0
Breach of Supervision Order	Recode to 'Breach of Suspended Sentence Supervision Order'	356	6
Breach of Community Rehabilitation Order	Recode to 'Breach of Community Order'	5	0
Breach of Conditional Discharge	Exclude	25	1
Breach of Suspended Sentence Supervision Order	Retain original code	28	0

It can be seen that 8 individuals released from Peterborough had breach of License Conditions as their index offence and 1 had Breach of Conditional Discharge. These nine individuals were excluded before the propensity score was developed.

Recode missing ethnicity

It was agreed previously that missing values from 'PNC_ethinc' (the variable representing ethnicity according to police records) would be filled in with 'Input_ethnic' (another ethnicity variable defined in the LIDS prisons data) where available.

There were 13 individuals from Peterborough who were missing on 'PNC_ethnic' and these were imputed with information from 'Input_ethnic'. A total of 11 were classified as white, 1 as Black and 1 as Asian.

It is worth noting that an overall comparison of 'PNC_ethnic' and 'Input_ethnic' showed good, but not perfect correspondence. For example, of the 780 individuals classified as white based on 'PNC_ethnic', 756 (97%) were also classified as white based on 'Input_ethnic'.

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

Recode incorrect age at first offence

As previously described in the data cleaning section, one prisoner in the Peterborough cohort had a 1st offence age of less than 10 years which was changed to 10 years of age, and one prisoner in the Peterborough cohort had no recorded date of birth on the PNC. The date of birth was taken from the prison discharge dataset[5].

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

Recode nationality

The 'Nationality' variable provided in the current dataset appeared to be somewhat different from that previously provided to develop the methodology. For example, previously there was only one variable for United Kingdom available, but in the current data England, Wales, Scotland, Northern Ireland and United Kingdom were all available. These five options were all recoded to United Kingdom.

A total of 21 individuals from Peterborough were noted to be missing on Nationality. In order to address this, additional data was requested from the MoJ. Using prison discharge data the Nationality of all 21 missing was imputed (16 from the United Kingdom, 1 from Afghanistan, 1 from Czech Republic, 2 from Romania, 1 from Pakistan).

It was initially agreed to recode Nationality into 10 categories (Africa, Europe, Asia, Central and South America, Middle East, North America, Oceania, West Indies, United Kingdom and Missing). However, subsequent analysis in the Cave et al., 2012 report suggested that nationality and ethnicity would need to be combined because of their potential overlap (pg. 21), and that the classification system that best balanced the variable nationality/ethnicity with having sufficient numbers for analysis was six categories based on ethnicity (UK White, UK Black, UK Other, Foreign White, Foreign Black, Foreign Other). Table 2.6 shows this breakdown for Peterborough.

Table 2.6 Classification of Nationality and Ethnicity in Peterborough

Nationality	**Ethnicity**		
	White	Black	Other
UK	622	58	36
Foreign	198	16	15
Total	**820**	**74**	**51**

[5] This was conducted by the MoJ and reported to the Independent Assessor.

3 PSM Model

As agreed, logistic regression was used to create the PSM model with the data provided following the restriction process. A series of variables were tested for inclusion in the model and an 'enter' procedure was used to create the model (e.g. Apel & Sweeten, 2010).

Variables that were statistically significant at the p<.20 level between Peterborough and the other prisons group were included in the model (Cave et al., 2012).

3.1 Variables for testing for model inclusion

The variables that were considered for inclusion in the PSM model are listed in Table 3.1.

Table 3.1 Variables for potential inclusion

Variables for Potential Inclusion
Av. Age at Release
Av. Age at Release squared[6]
Nationality/Ethnicity
Age at first offence
Age at first offence – squared
Number of previous offences
Number of previous offences squared
Number of previous conviction occasions
Number of previous conviction occasions squared
Number of previous custodial sentences
Number of previous custodial sentences squared
Copas Score[7]
Average number of previous T1 and T2 convictions
Average number of previous T1 and T2 conviction squared
Percent with T1 or T2 serious current offence
Percent of chronic offenders in cohort[8]
Index offence: Absconding bail offences[9]

[6] As before, squared terms of significant continuous variables will be included to account for non-linear effects.
[7] The Copas Score is a measure of the speed of convictions accrued across an individual's criminal career (in a logarithmic scale).
[8] Chronic offenders refer to those individuals who account for half of the total number of previous offences in a cohort. In the current cohort (Peterborough and other prisons combined) those who had greater than 67 offences accounted for half of all of the previous offences.
[9] This breakdown of index offence types is standard for MoJ research.

Variables for Potential Inclusion
Index offence: Criminal malicious damage
Index offence: Domestic burglary
Index offence: Other burglary
Index offence: Drink driving
Index offence: Drug import/export/production
Index offence: Drug possession/ small-scale supply
Index offence: Fraud/forgery
Index offence: Handling
Index offence: Other
Index offence: Other motoring offences
Index offence: Public order
Index offence: Robbery
Index offence: Sexual
Index offence: Sexual (child)
Index offence: Soliciting/prostitution
Index offence: Taking and driving away
Index offence: Theft
Index offence: Theft from a vehicle
Index offence: Violence
Index offence: Serious violence
Index offence: Breach of Suspended Supervision Order
Index offence: Breach of Community Order

3.2 Comparison of Peterborough to other prisons before matching

Table 3.2 shows the demographic features of the two samples before matching, but after the restrictions had been imposed. For example, the average age of release for the 31,207 from 'other prisons' was 32.7 (sd=9.8) compared to 33.5 (sd=9.8) for the 945 individuals from HMP Peterborough. This difference was significant (t= 2.30, p<.02) with a standardised mean effect size difference of d=.08[10]. Those from other prisons were significantly more likely to be White-British and significantly less likely to be White-Foreign.

[10] The standardised mean difference (d) is an effect size measure centred on 0. Therefore, the further this value is from 0, the larger the difference between those from other prisons and those from Peterborough. In general, a mean effect size difference of >.20 is considered significant (Hahs-Vaughn and Onwuegbuzie, 2006).

Table 3.2 Cohort 1 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	31,207	32.7 (9.8)	945	33.5 (9.8)	2.3	0.02	0.08
Ethnicity & Nationality	**N**	**%**	**N**	**%**	**chi squared**	**p**	**d**
White – British	30,531	76.7 (23418)	945	65.8 (622)	60.1	0.0001	-0.30
White - Other Foreign		9.1 (2767)		21 (198)	151.8	0.0001	0.54
Black – British		6.2 (1883)		6.1 (58)	0.001	0.97	0
Black - Other Foreign		1.8 (559)		1.7 (16)	0.1	0.76	0
Asian, Chinese, Japanese, Middle Eastern – British		4.0 (1231)		3.8 (36)	0.11	0.73	-0.03
Asian, Chinese, Japanese, Middle Eastern -Other Foreign		2.2 (673)		1.6 (15)	1.6	0.20	-0.19

N=Number 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 difference.

Table 3.3 shows the criminal history and index offence variables for both samples before matching, but after 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 from other prisons had a significant earlier age at first offence, significantly more previous offences, previous convictions and previous custodial sentences as well as a higher 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 more likely to be chronic offenders.

Table 3.3: Cohort 1 Analysis: Criminal history of the sample (pre-matching)

Individual Factors	N	Other Prisons	N	Peterborough	t	p	d
Age at first offence	31,207	18.5 (7.8)	945	20.4 (8.9)	7.5	0.0001	0.24
Number of previous offences	31,207	37.6 (40.4)	945	32.6 (37.3)	3.7	0.0001	-0.12
Number of previous conviction occasions	31,207	17.4 (16.1)	945	15.0 (15.8)	4.6	0.0001	-0.15
Number of previous custodial sentences	31,207	4.8 (7.0)	945	4.2 (6.7)	2.7	0.006	-0.09
Copas Score	31,207	(-.56(.76))	945	(-.66(.75))	3.6	0.0001	-0.13
Length of Sentence	31,207	125.4 (76.5)	945	125.5 (76.7)	0.028	0.98	0
Time served	31,207	50.9 (32.8)	945	50.4 (32.7)	0.43	0.67	-0.01
Number of previous T1 and T2 convictions	31,207	1.5 (2.4)	945	1.2 (2.1)	4.3	0.0001	-0.12

		Other Prisons		Peterborough			
	N	% (N)	N	% (N)	chi squared	p	d
Severe current offence	31,207	1.1 (347)	945	0.6 (6)	1.9	0.17	-0.31
Chronics	31,207	17.5 (5451)	945	14 (132)	7.8	0.005	-0.15
Type of Index Offence	31,114	**% (N)**	936	**%(N)**			
Absconding or bail offences		1.7 (542)		2.0 (19)	0.44	0.50	0.08
Criminal/malicious damage		1.9 (577)		2.1 (20)	0.4	0.53	0.08
Domestic burglary		2.0 (615)		2.9 (27)	3.8	0.05	0.21
Other Burglary		3.8 (1177)		2.8 (26)	2.5	0.11	0.18
Drink Driving Offences		2.9 (891)		4.1 (38)	4.6	0.03	0.20
Drugs (import/export/prod)		0.8 (241)		0.3 (3)	2.5	0.12	-0.48
Drugs (possession/small-scale supply)		1.8 (560)		2.8 (26)	4.8	0.03	0.25
Fraud/forgery		2.9 (894)		3.2 (30)	0.35	0.55	0.06
Handling		1.4 (427)		1.3 (12)	0.06	0.82	-0.04
Other		3.3 (1032)		2.9 (27)	0.53	0.47	-0.10
Other motoring offences		5.4 (1677)		7.3 (68)	6.2	0.01	0.18
Public order		4.5 (1389)		2.8 (26)	6.1	0.01	-0.27
Robbery		0.2 (71)		0 (0)	2.14	0.143	
Sexual		1.2 (364)		0.5 (5)	3.2	0.07	-0.44
Sexual (child)		0.6 (199)		0.9 (8)	0.66	0.42	0.16
Soliciting/prostitution		0.1 (17)		0 (0)	0.51	0.474	
Taking and driving away		1.4 (433)		2.0 (19)	2.7	0.10	0.21
Theft		18.3 (5705)		18.5 (173)	0.013	0.909	0.0
Theft from a vehicle		1.4 (430)		1.8 (17)	1.2	0.26	0.15
Violence		23.7 (7366)		23.1 (216)	0.18	0.67	0.02
Serious violence		0.6 (183)		0.3 (3)	1.1	0.29	-0.32
Breach SSO		11.5 (3574)		12.2 (114)	0.43	0.51	-0.03
Breach CO		8.8 (2750)		6.3 (59)	7.3	0.007	-0.19

Examining the lower part of Table 3.3 shows that of the 945 released from HMP Peterborough, only 936 had a valid index offence. As previously mentioned (Table 2.5), 9 individuals from Peterborough had to be excluded because they had a breach offence which suggested that they did not fit the agreed criteria.

Those from HMP Peterborough were significantly less likely to have an index offence of drugs (import/export/production), public order, sexual offence, serious violence and breach of a community order. However, those from HMP Peterborough were significantly more likely to have an index offence of domestic burglary, drink driving offences, drugs (possession/small scale supply), and other motoring offences.

The considerable differences in the demographic and criminal history evident between those released from Peterborough and those released from other prisons (Tables 3.2 and 3.3) need to be controlled in order to attribute any differences in later reoffending to the intervention rather than these pre-existing differences.

Given the criteria for model inclusion already discussed (i.e., p<.20 and at least 5 observations), 28 variables were included in the final model. Because no offenders from Peterborough had an index offence of robbery or of soliciting/prostitution, those who had these index offences in other prisons were removed. Table 3.4 shows the variables that were included in the model. These include 6 squared variables (to account for non-linear effects)[11]. Two variables that had 5 or fewer observations were included in the model (Index offence of drug import/export/production, N=3, and sexual, N=5). The standard errors were not too high so they were retained in the model (see Table 3.4).

Table 3.4: Cohort 1 analysis: Final PSM model parameters

	Variable	B	SE	p	Exp (B)
1	Av. Age at Release	0.029	0.024	0.226	1.03
2	Av. Age at Release squared	0	0	0.633	1
3	White, British	-0.041	0.108	0.705	0.96
4	White, Foreign	0.747	0.132	0	2.11
5	Asian, Chinese Foreign	-0.37	0.283	0.191	0.691
6	Number of previous offences	0.012	0.006	0.034	1.012
7	Number of previous offences squared	0	0	0.125	1
8	Number of previous conviction occasions	-0.056	0.012	0	0.946
9	Number of previous conviction occasions squared	0.023	0.015	0.125	1.023
10	Number of previous custodial sentences	0	0	0.002	1
11	Number of previous custodial sentences squared	0	0	0.107	1
12	Age at first offence	0.02	0.022	0.375	1.02
13	Age at first offence - squared	0	0	0.364	1
14	Copas Score	0.326	0.102	0.001	1.386
15	Number of previous T1 and T2 convictions	-0.064	0.039	0.096	0.938
16	Number of previous T1 and T2 conviction squared	0.002	0.003	0.555	1.002
17	Percent with T1 or T2 serious current offence	-0.279	0.425	0.511	0.757
18	Percent of chronic offenders in cohort	-0.05	0.179	0.781	0.951
19	Index offence: Domestic burglary	0.332	0.202	0.101	1.394
20	Index offence: Other burglary	-0.246	0.204	0.23	0.782
21	Index offence: Drink driving	0.044	0.174	0.802	1.045
22	Index offence: Drug import/export/production	-0.817	0.583	0.161	0.442
23	Index offence: Drug possession/ small-scale supply	0.507	0.206	0.014	1.661
24	Index offence: Other motoring offences	0.196	0.133	0.139	1.217

[11] All squared variables met the inclusion criteria of being significantly different at the p<.20 level (all were actually p<.05) between HMP Peterborough and other prisons.

	Variable	B	SE	p	Exp (B)
25	Index offence: Public order	-0.435	0.203	0.032	0.647
26	Index offence: Sexual	-0.847	0.477	0.076	0.429
27	Index offence: Taking and driving away	0.475	0.24	0.048	1.608
28	Index offence: Breach of Community Order	-0.294	0.14	0.035	0.745
	Constant	-3.892	0.398	0	0.02

It was possible to calculate a propensity score for all 936 of those released from HMP Peterborough.

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 shows that most individuals had a low probability of being released from Peterborough (towards the left of the figure), but that some individuals had a somewhat higher probability (the right of the figure). The overall similar appearance of the distributions suggested that matching on propensity scores would be possible and that there was common support for the use of PSM.

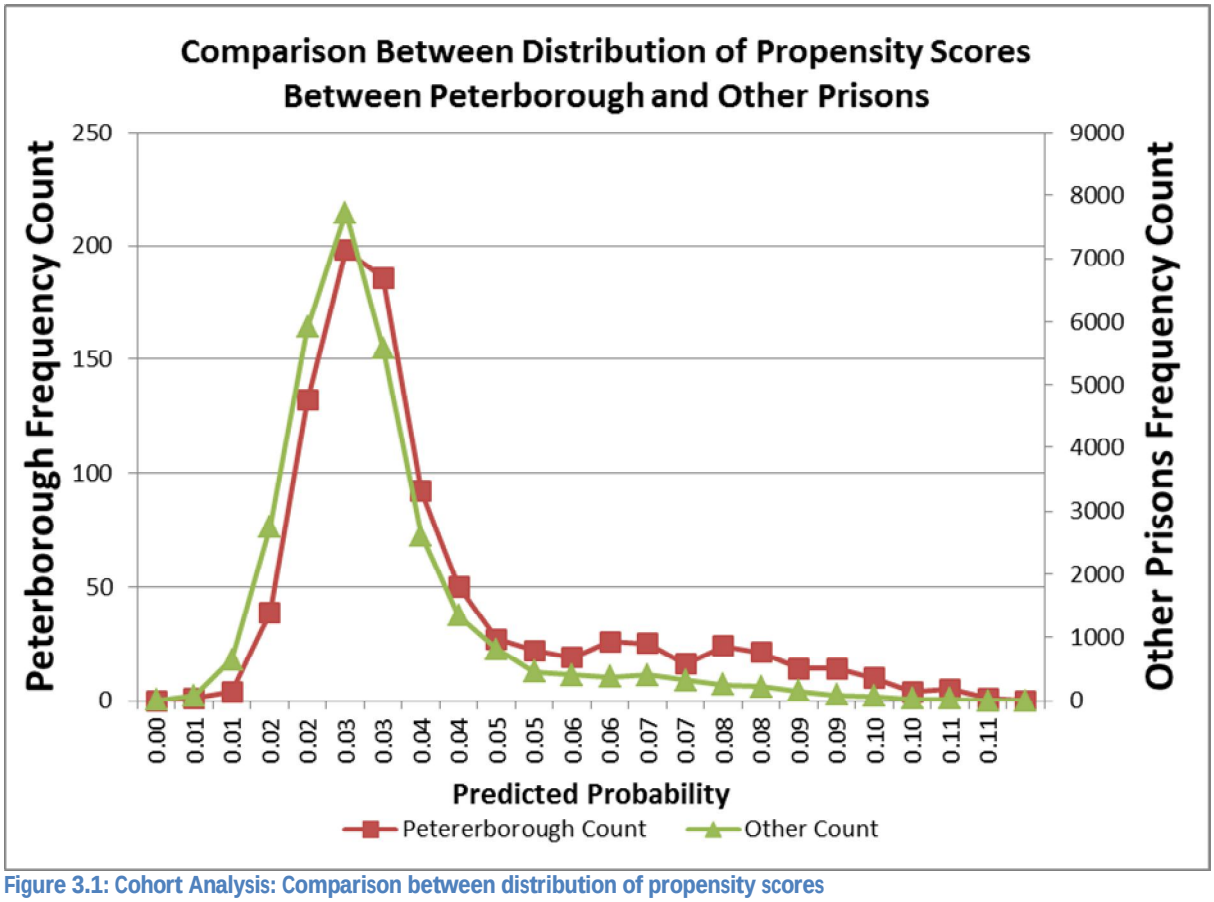

Figure 3.1: Cohort Analysis: Comparison between distribution of propensity scores

4 Matching Cohort 1 Data

Up to 10:1 matching was undertaken for the entire sample of 936 released from Peterborough for whom it was possible to calculate a propensity score. It was possible to identify 10 matches from other prisons for each of the 936 released from HMP Peterborough making a total sample of 10,296 (936 Peterborough, 9,360 other prisons).

Table 4.1 shows the demographic characteristics of the 936 released from HMP Peterborough compared with the 9,360 released from other prisons matched on the propensity score. The results suggested that the matching was successful at reducing the pre-existing differences between those released from HMP Peterborough with those released from other prisons on demographic features as there were no statistically significant differences.

Table 4.1: Cohort 1 analysis: Demographics of the sample (after matching)

Demographic Features		**Other Prisons**		**Peterborough**			
	N	**M (sd)**	**N**	**M (sd)**	**t**	**p**	**d**
Av. Age at Release	9,360	33.3 (9.6)	936	33.4 (9.8)	0.49	0.63	0.01
Ethnicity & Nationality	**N**	**%**	**N**	**%**	**chi squared**	**p**	**d**
	9,360		936				
White British		65.7 (6151)		65.7 (615)	0.00	0.99	0.00
White - Other Foreign		21.2 (1987)		20.9 (196)	0.04	0.84	-0.01
Black – British		5.5 (512)		6.2 (58)	0.86	0.35	0.05
Black - Other Foreign		1.9 (175)		1.7 (16)	0.12	0.73	-0.05
Asian, Chinese, Japanese, Middle Eastern - British		4.0 (374)		3.8 (36)	0.05	0.82	-0.02
Asian, Chinese, Japanese, Middle Eastern -Other Foreign		1.7 (161)		1.6 (15)	0.07	0.79	-0.04

Table 4.2 shows the criminal history variables of the two groups when matched on the propensity score. The results suggested that the matching had been successful in reducing most of the differences between the two groups that had existed prior to matching. However, those from Peterborough were significantly less likely to have committed theft and significantly more likely to have committed theft of a motor vehicle. Given that we would expect to find one statistically significant result by chance at the $p<.05$ level for every 20 statistical tests conducted (Cave et al., 2012), it is not that surprising to find two statistically significant differences after 38 tests were conducted.

Table 4.2: Cohort 1 Analysis: Criminal history variables after matching

Individual Factors	**N**	**Other Prisons**	**N**	**Peterborough**	**t**	**P**	**d**
	9,360	M(sd)	936	M (sd)			
Age at first offence		20.4 (8.8)		20.4 (8.9)	0.24	0.81	0
Number of previous offences		32.1 (35.0)		32.2 (37.0)	0.13	0.90	0
Number of previous conviction occasions		14.8 (13.5)		14.9 (15.8)	0.2	0.84	0
Number of previous custodial sentences		4.1 (5.8)		4.1 (6.6)	0.21	0.83	0
Copas Score		(-.66) (.74)		(-.66) (.74)	0.29	0.77	0
Length of Sentence		122.9 (75.1)		125.9 (76.7)	1.1	0.24	0.04
Time served		49.6 (31.9)		50.5 (32.7)	0.84	0.40	0.02
Number of previous T1 and T2 convictions		1.19 (2.0)		1.19 (2.1)	0.06	0.95	0
	N	**Other % (N)**	**N**	**Peterborough % (N)**	**chi squared**	**P**	**d**
Severe current offence	9,360	0.6 (60)	936	0.6 (6)	0.00	1.00	0
Chronics		13.5 (1268)		13.6 (127)	0.00	1.00	0
Type of Index Offence	9,360	**% (N)**	936	**%(N)**			
Absconding or bail offences		1.9 (177)		2.0 (19)	0.09	0.77	0.04
Criminal/malicious damage		1.8 (164)		2.1 (20)	0.72	0.40	0.11
Domestic burglary		2.8 (261)		2.9 (27)	0.03	0.87	0.02
Other Burglary		2.8 (263)		2.8 (26)	0.00	0.96	0
Drink Driving Offences		4.0 (370)		4.1 (38)	0.03	0.87	0.02
Drugs (import/export/prod)		0.3 (25)		0.3 (3)	0.09	0.77	0
Drugs (possession/small-scale supply)		2.4 (222)		2,8 (26)	0.60	0.44	0.09
Fraud/forgery		3.1 (286)		3.2 (30)	0.06	0.80	0.03
Handling		1.3 (118)		1.3 (12)	0.00	0.96	0
Other		3.1 (288)		2.9 (27)	0.11	0.75	-0.03
Other motoring offences		7.0 (653)		7.3 (68)	0.11	0.74	0.02
Public order		2.7 (250)		2.8 (26)	0.04	0.85	0.02
Robbery							
Sexual		0.5 (48)		0.5 (5)	0.01	0.93	0.02
Sexual (child)		0.6 (55)		0.9 (8)	1.00	0.32	0.21
Soliciting/prostitution							
Taking and driving away		1.7 (158)		2.0 (19)	0.59	0.44	0.1
Theft		21.4 (2001)		18.5 (173)	4.30	0.04	-0.1
Theft from a vehicle		1.2 (108)		1.8 (17)	3.1	0.08	0.25
Violence		24.4 (2282)		23.1 (216)	0.787	0.38	-0.04
Serious violence		0.4 (41)		0.3 (3)	0.276	0.60	-0.17
Breach SSO		11 (1026)		12.2 (114)	1.3	0.26	0.07
Breach CO		6.0 (564)		6.3 (59)	0.12	0.73	0.03

5 Reconviction Analysis

According to Cave et al (2012, p1.), 'MoJ will pay the investment vehicle a fixed unit payment for each reduced conviction event in [the first]SIB cohort less than a matched baseline cohort, providing the reduction in conviction events in [this cohort] is at least 10%'. Table 5.1 shows the results of the reconviction analysis for the 936 individuals from HMP Peterborough compared to the 9,360 with whom it was possible to match from 'Other prisons'. The 936 individuals at Peterborough accrued 1,330 court convictions (average of 1.42 per person) compared to 14,523 for the 9,360 individuals from other prisons (average of 1.55 per person).

Table 5.1: Reconviction Events for Comparison

	N	Number of Reconviction Events	Average Number of Reconviction Events Per Person	Standard Deviation
Peterborough	936	1,330	1.42	2.279
Other prisons	9,360	14,523	1.55	2.339

A 10% reduction in the number of reconviction events received by those from 'Other Prisons' would be 1.55 minus 0.155 (1.55*0.90) or 1.395. Those released from Peterborough had an average of 1.42 reconviction events, suggesting that the 10% threshold was not achieved. Being released from Peterborough was associated with an 8.39% decrease in the number of reconviction events.

Conclusion

The current study has matched 936 of those released from Peterborough with 9,360 released from other prisons on 36 out of 38 variables. While it was not possible to precisely replicate the approach agreed in Cave et al. (2012) because of data quality issues, the Independent Assessors have concluded that the model is sufficiently accurate and robust to support the reconviction analysis.

Furthermore, this analysis has shown that despite a 8.39% reduction in the number of reconvictions in Cohort 1 when compared to the Comparison Group, the reduction was insufficient with regard to the terms set out in the contract between the Ministry of Justice and the Social Impact Bond partnership to be considered an Outcome, thus did not trigger payment.

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Appendix A: Data Quality Assessment

Data were originally provided in March 2013. However, a dataset which was error-free, agreed and ready for analysis was not received until February 2014. It is worth documenting the problems encountered so that future analysts are aware of the potential difficulties they may also encounter as these took nearly a year to resolve. The problems were:

1. **Variables missing**. The following variables, included in the 2008 data extract and needed to fully replicate the model for the Cohort 1 analysis, were missing:
    1. Nationality
    2. Previous Court Convictions
    3. Previous Out of Court Disposals
    4. Previous Serious Court Convictions
    5. Previous Severe Out of Court Disposals
    6. Previous Total Severe Convictions

2. **Variables that had changed format.** Sentence length was originally provided in numerical format (i.e., the actual number of days sentenced) in the 2008 sample, but was provided for the Cohort 1 analysis as a dichotomous variable (b: Less than or equal to 6 months or c: More than 6 months to less than 12 months). The final Cohort 1 analysis did include sentence length in a numerical format.
3. **Variables that because of changes in the way in which data was held or processed, proved too difficult to include.** Data about who was flagged as a Prolific and Priority Offender was not available because of changes in which the data was held. However, it was not included in the 2008 model and the MoJ told us it would be very difficult for them to provide this variable. The final Cohort 1 analysis did not include this variable.
4. **Missing values for the Peterborough cohort**: the MoJ and SF attempted to resolve the missing data points for the Peterborough data. This was provided in February 2014, but had a minor error (column slippage for conviction date).
5. **A difference of opinion about who should be included in the Peterborough Cohort**: During the development of the cohort Peterborough prison provided Social Finance with some incorrect data. Consequently SF invested in 42 individuals who did not qualify for the study, while 41 who did qualify were not supported by SF because they were unaware of them. It was the view of SF that the individuals who were identified by the prison prior to their release onto the Peterborough SIB cohort should be included in the study, and those who were not identified as eligible prior to their release onto the cohort should be excluded. It was the view of the MoJ that this data error should have been dealt with by SF. The Independent Assessors were asked to adjudicate. The Independent Assessors recommended against including the extra 42 individuals with whom SF worked because the Comparison

Group (composed of entirely short-term prisoners, over the age of 18) might not contain appropriate matches. The Independent Assessors declined to adjudicate on whether those with whom SF did not work should be included as this was viewed as a contractual issue rather than a methodological issue. In carrying out the analysis of 2008 data, the Independent Assessors confirmed that only those who should be included in the Intervention and Comparison groups were included. Since the MoJ performed this task for the Cohort 1 analysis, the Independent Assessors cannot report on the number of cases which were excluded nor can they compare the impact this had on the current sample with the impact on the 2008 sample.