



# Potential impact of interventions on the size of the prison population - A Report for the Prison Reform Trust

Savas Hadjipavlou,  
Director, Justice Episteme

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## Summary

The results of this analysis show that reducing re-offending initiatives can help reduce the size of the prison population. However the effects are *limited and take a long time to come through*. Assuming systematic and effectively administered interventions, by 2030, we estimate that the prison population could be ~300 lower for an “Optimistic” scenario and ~600 for a “Heroic” scenario. Such a policy, on its own, will not deliver significant changes to the size of the prison population in the short to medium term (i.e. 3 - 5 years). Nevertheless, it should form part of a broader approach that looks to make more discriminating use of prison. This analysis does not consider the wider economic, social and personal benefits of reduced re-offending.

### 1. Introduction

1. The Prison Reform Trust (PRT) commissioned Justice Episteme to carry out, using simulation techniques, an analysis of the potential impact of rehabilitation interventions on the size of the prison population.
2. This analysis is intended to inform the debate about the extent to which a persistent reduction in the rate of re-offending could make a meaningful contribution to the goal of reducing the size of the prison population.
3. There is already a range of interventions provided within prisons and in the community aimed at helping offenders rehabilitate. These include, for example, interventions to promote behavioural changes (e.g enhanced thinking skills, anger management), tackle the misuse of drugs or alcohol, and treat or support those with mental health problems, as well as education, training and job skills to enable offenders to resettle, gaining employment.

### 2. The Model

4. The approach adopted in simulating criminal justice dynamics is synthetic. What we see in the justice system is the result or confluence of a large number of factors including the size and age make-up of the general population from which offenders are drawn, and the range of criminal justice and other agencies whose work involves tackling crime.
5. The model establishes an in-silico virtual population with gender, age and offending risk profiles imitating the real population. Within this virtual environment, it is possible to identify those who have committed offences (as generated by the algorithms of the simulation) and to track what happens over time. A set of parameter controlled relationships is used to describe the response of the justice system in identifying, detecting, convicting, sentencing and rehabilitating offenders. Among the results of the simulation are estimates of the prison population, the number supervised in the community and many other outcomes reflecting the operation of the criminal justice system.

6. The model necessarily incorporates many simplifications. However, crucially, it incorporates key variables and relationships, ones that capture the essence of the behaviour and dynamics of the various systems involved. This means that it is a powerful tool that can be used to explore and analyse the potential impact of policy or practice reforms.
7. A reference scenario establishes a baseline for comparison of the results to published custodial or other statistics. This provides an “As is” quantitative description of the system, as represented by the model. By choosing alternative values for the variables or relationships the potential impact of changes to policy and practice can be quantitatively estimated. Such changes could, for example, be to sentence lengths or time served in custody. However this study is focussing on how interventions could influence the rate at which offenders re-offend and the impact of that on the size of the prison population. More detail and other examples can be found at [www.justice-episteme.com](http://www.justice-episteme.com)
8. The results presented in this Report are based on the May 2018 version of the simulation engine. This incorporates indictable and summary offences and covers male and female offenders. It is important to note that the scope and accuracy of the simulation engine continue to be developed and tested. The results may be refined as the algorithms are periodically reviewed for improvement.

### 3. Evidence on the effect size of different interventions

9. The most recent publication of re-offending outcomes by the Ministry of Justice<sup>1</sup> relates to April 2016 to June 2016 and states that:

“The overall proven re-offending rate has slightly decreased from the previous quarter (by 0.2 percentage points) and has decreased by around 2 percentage points compared to 2005. Over time, the rate has fluctuated between 29% and 32%”

The re-offending rate is measured as follows:

“An offender enters the cohort if they were released from custody, received a non-custodial conviction at court or received a reprimand or warning in a three month period: April to June 2016. It is important to note that this is not comparable to publications prior to the October 2017 proven re-offending publication, which reported on a 12 month cohort”

10. As these two extracts indicate, it is important to be clear what outcome is being measured, the time at which it is measured, and who is included in the cohort of

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<sup>1</sup> See:

<https://www.gov.uk/government/collections/proven-reoffending-statistics>

offenders being monitored. The precise percentage numbers will differ<sup>2</sup> depending on what criteria are chosen.

11. Even when these are clearly stated, it is hard to discern the scale and importance of changes in the re-offending rate in terms that relate to the general concerns about the impact of imprisonment and the size of the prison population. However, the application of suitable modelling techniques can provide estimates for the short, medium and longer term effects to be expected from reducing re-offending policies and the contribution they would be likely to make to the Government's stated objective to reduce the number of those held in prison.
12. How big an improvement might we expect from treatment and related interventions? A Review by James McGuire<sup>3</sup> reveals that the efficacy of interventions, even under ideal conditions, is comparatively low with effect sizes<sup>4</sup> ranging from near zero, to small (~0.1) or moderate (~0.2). What do these mean in terms of re-offending rates? A positive effect size of 0.1 would equate to approx. a 4% reduction in the cumulative rate of re-conviction. The Review also sets out a range of caveats about the various studies and how reliable the results would be. However, here we take them at face value as typically representative.
13. A further consideration is that the consistent delivery and the fidelity of programmes can easily be compromised by the difficult prison delivery environment. For example, treatment sessions can be curtailed or cancelled owing to a variety of staffing or security related limitations on the routine of the daily regime. Continuity to community based interventions on release also remains problematic, with the ambitions of the Through The Gate reforms<sup>5</sup> still to be achieved.
14. In order to gauge the potential impact of the interventions in this analysis we make some approximations about the improvement that could be achieved, informed by the above discussion<sup>6</sup>. These take the form of three scenarios which are described below.

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<sup>2</sup> The MoJ has changed these from time to time which makes comparing published figures not straightforward

<sup>3</sup> Reducing Personal Violence, Table 15.2, in *The Neurobiological Basis of Violence, Science and Rehabilitation*, OUP, 2009

<sup>4</sup> Briefly, this is the difference in the mean between the treatment group and the control group divided by the standard deviation.

<sup>5</sup> See HM Chief Inspector of Prison reports

<sup>6</sup> A more detailed analysis, for example looking at interventions for different offender groups based on their offences, the availability of interventions, take up and completion rates, and so forth, could in principle be carried out. However the paucity data would mean a wider range of assumptions that would need to be included. A broad analysis of the type carried out here seems a necessary first step, with a more detailed look carried out, if justified.

## 4. Scenarios

15. To be definite, therefore, the analysis in this Report considers three scenarios:

(A). **“As is”**. This is a reference scenario which describes the current state of size and composition of the prison system in terms of age, criminal history and offending risk profile of offenders. The calibration of the various parameters implicitly includes the contribution of the various treatment programmes in place. A separate more detailed study would be needed to attempt to dis-aggregate the effect of these programmes which is not done here. We simply accept the existing treatment programmes - with all the limitations of efficacy and delivery attached to them - make a contribution which is incorporated into base line simulation of both the past and future estimates of the size and composition of the prison population.

(B). **“Optimistic”**. The assumption here is that the organisation and delivery of services in prisons are improved so that a more consistent pattern of interventions is in place, interventions that have been demonstrated to work and are appropriately targeted to the needs of offenders, with the necessary support continuing to be given following release to the community. The effect of these programmes is to reduce the rate of offending by a factor which, in turn, translates to a reduction in the reconviction rate measured at 12 months. Briefly<sup>7</sup>:

Those receiving short term custody <12 months: 2% reduction - equates to a factor of 0.9 the values of the hazard in the "AsIs" scenario  
Those receiving between 12 - 48 months custody: 3% reduction - equates to a factor of 0.85 the values of the hazard in the "AsIs" scenario  
Those receiving sentences of 4 or more years: 4% reduction - equates to a factor of 0.8 the values of the hazard rate in the "AsIs" scenario

(C). **“Heroic”**. The assumptions here are the same as in (B), but the scenario tests the proposition that the priority and effort that are given to reducing re-offending are such that they absolutely maximise the potential of treatment programmes. In such circumstances - and the label “Heroic” betrays our skepticism about the capability of the criminal justice system and partner agencies to achieve this level of collaboration and coordination - the effect of programmes is to reduce the rate of offending by a factor that equates to the change in the cumulative distribution of offenders that are re-convicted after 12 months by the following amounts:

Those receiving short term custody <12 months: 4% reduction - equates to factor of 0.8 the values of the hazard rate in the "AsIs" scenario  
Those receiving between 12 - 48 months custody: 6% reduction - equates to a factor of 0.74 the values of the hazard rate in the "AsIs" scenario

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<sup>7</sup> It is not a straightforward matter to link these two numbers. The relationship between the hazard rate and probability is non-linear and the fact that we are dealing with a distribution of values in the population means that some additional simulations are needed to connect the reduction the hazard rate, used by the simulation model, and the percentage reduction in re-conviction, measured by studies of the effect of treatment

Those receiving sentences of 4 or more years: 8% reduction - equates to a factor of 0.68 the values of the hazard rate in the "AsIs" scenario

16. The simulations carried out for these scenarios had the following parameters:

- The size of the virtual population was set at 400,000. This strikes a practicable balance between computational tractability/speed and “accuracy”.
- When comparing the prison population and the flow of prisoners into custody the change is assumed to have started from January 2019
- Reflecting their different offending characteristics, separate sets of simulations were carried out for male and female offenders.
- The relevant statistics are extracted from a set of 24 runs for each scenario being studied.
- The results cover the size of the prison population and the flow of offenders into custody.

## 5. Results

17. For completeness, more extensive results for the “As is” reference scenario, covering male and female offenders, are given in Annex A. This includes prison, suspended sentences, community sentences and supervision on post-release licence. These results serve to validate the baseline.
18. Figures 1 and 2 compare the male prison population and the flow into custody from 1995 to 2040 for the three scenarios. It is clear that there is (as would be expected, given that interventions reduce some of the risk of re-offending) a consistent downward trend.
19. A summary of the numerical results, Table 1(A), shows more clearly that the impact is slow for both the “Optimistic” and “Heroic” scenarios. It should be noted, however, that these changes are within the 95% confidence interval of the estimates<sup>8</sup> and therefore do not represent a particularity ‘strong’ signal<sup>9</sup>. However, the direction of change and the trend are consistent. We can say, therefore, all other factors remaining fixed, that we should expect a small gradual reduction in the size of the prison population for both the “Optimistic” and “Heroic” scenarios, with a cumulative effect so that by 2030, the “Optimistic” scenario would reduce the number of male prisoners by ~ 300; and the “Heroic” scenario by ~600. The results for the number of male sentenced prisoners coming into prison, summarised in Table 1(B), show a similar pattern.

Table 1

A. Male prison population

Year	“As Is” Average in Calendar Year	“Optimistic” Average in Calendar Year	“Heroic” Average in Calendar Year	Difference “Optimistic”	Difference “Heroic”
2020	84,820	84,820	84,820	<5	<5
2025	82,842	82,701	82,585	141	257
2030	79,963	79,631	79,396	332	567
2035	79,886	79,305	79,166	581	720

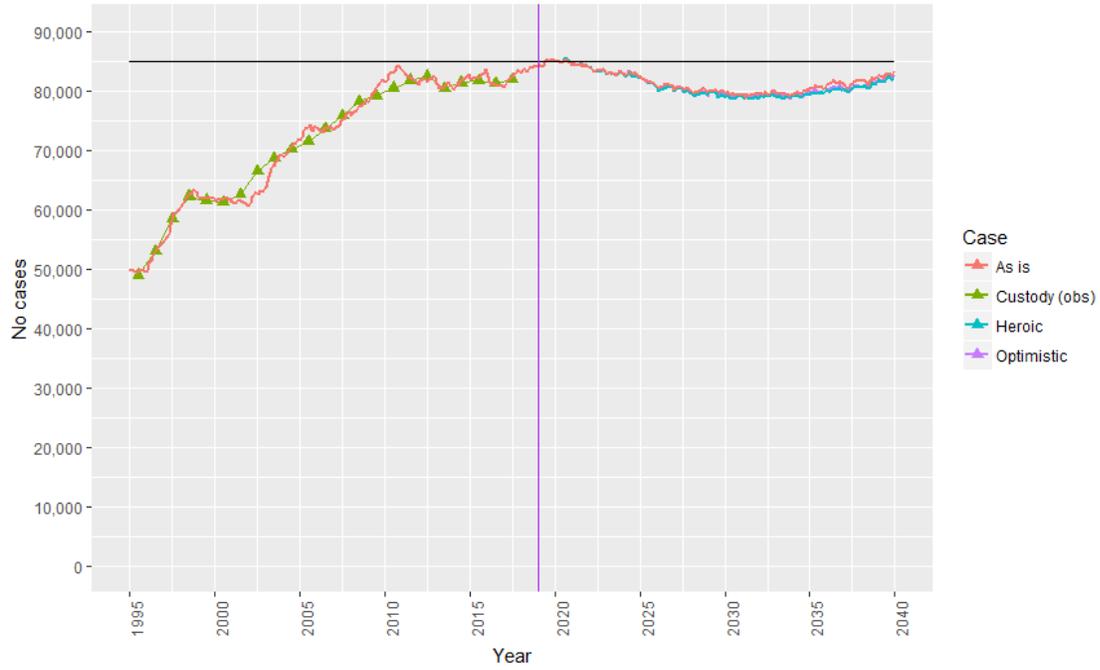
<sup>8</sup> Confidence intervals range across simulation time between ±800 to ±1000

<sup>9</sup> The difference, at each time point, in the average values of each scenario are “occasionally” significant at p=0.1 for the “Optimistic” scenario after 2035, with a more consistent pattern of significance for the “Heroic” scenario after 2030. While statistical significance might be improved somewhat by simulating with a larger virtual population, and more cases for each scenario, the results simply underline the small effect sizes of the treatment interventions.

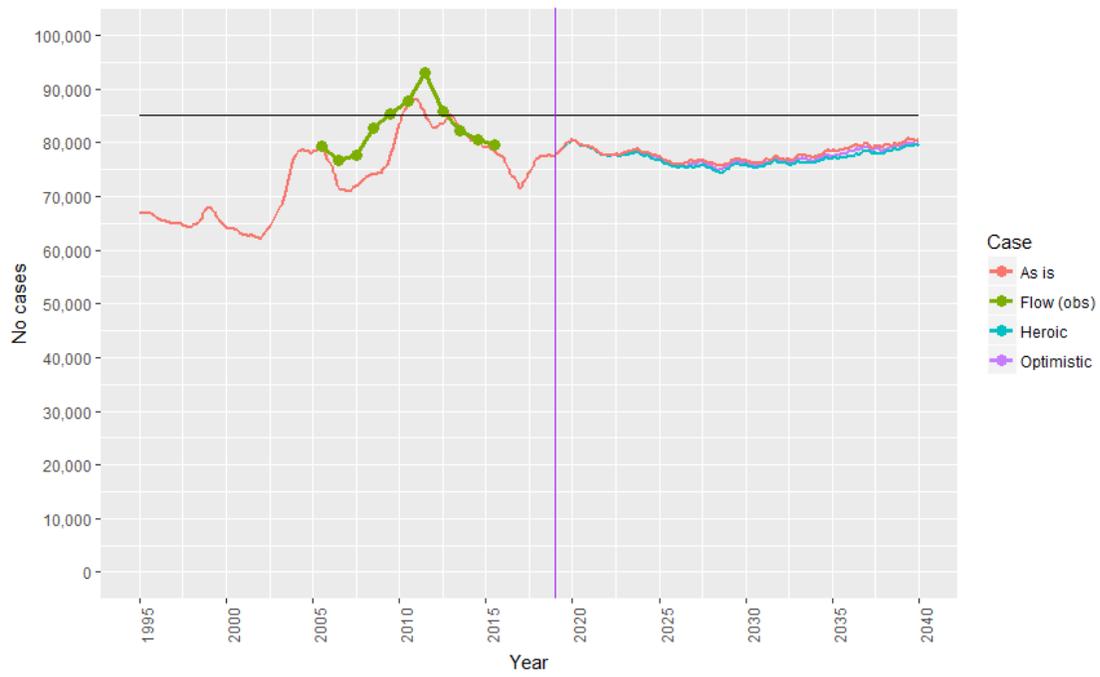
B. Flows into custody

Year	“As Is” Average in Calendar Year	“Optimistic” Average in Calendar Year	“Heroic” Average in Calendar Year	Difference “Optimistic”	Difference “Heroic”
2020	79,365	79,359	79,346	6	13
2025	77,890	77,584	77,183	306	707
2030	76,827	76,393	75,914	434	913
2035	78,172	77,354	76,897	818	1275

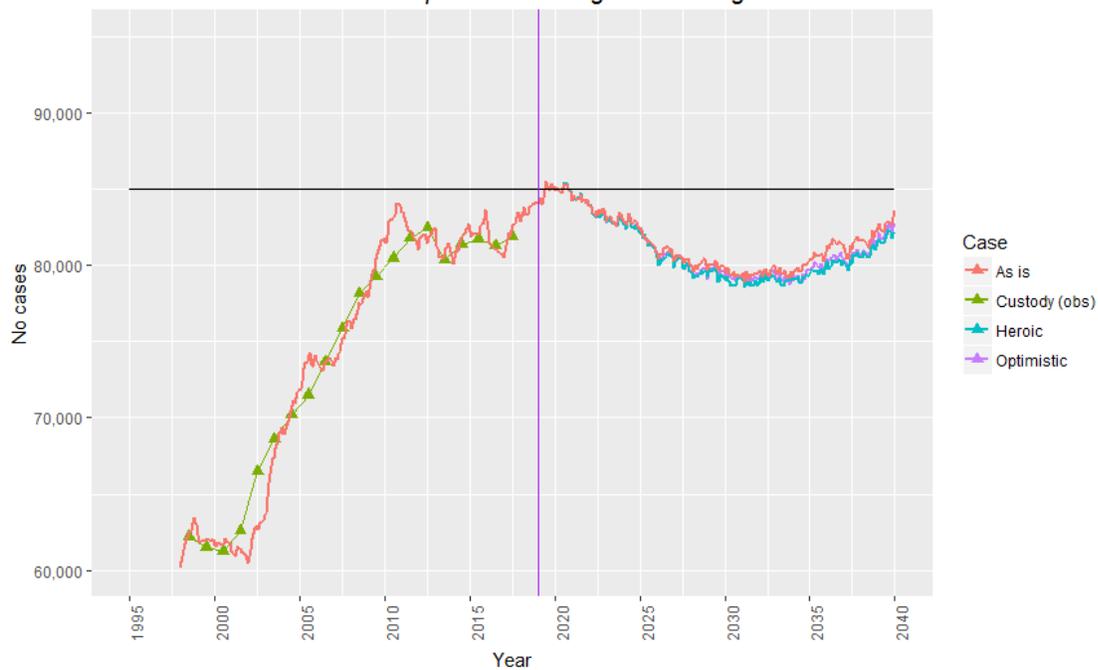
**Figure 1. Male Offenders: Prison population**  
*Estimated impact of reducing re-offending*



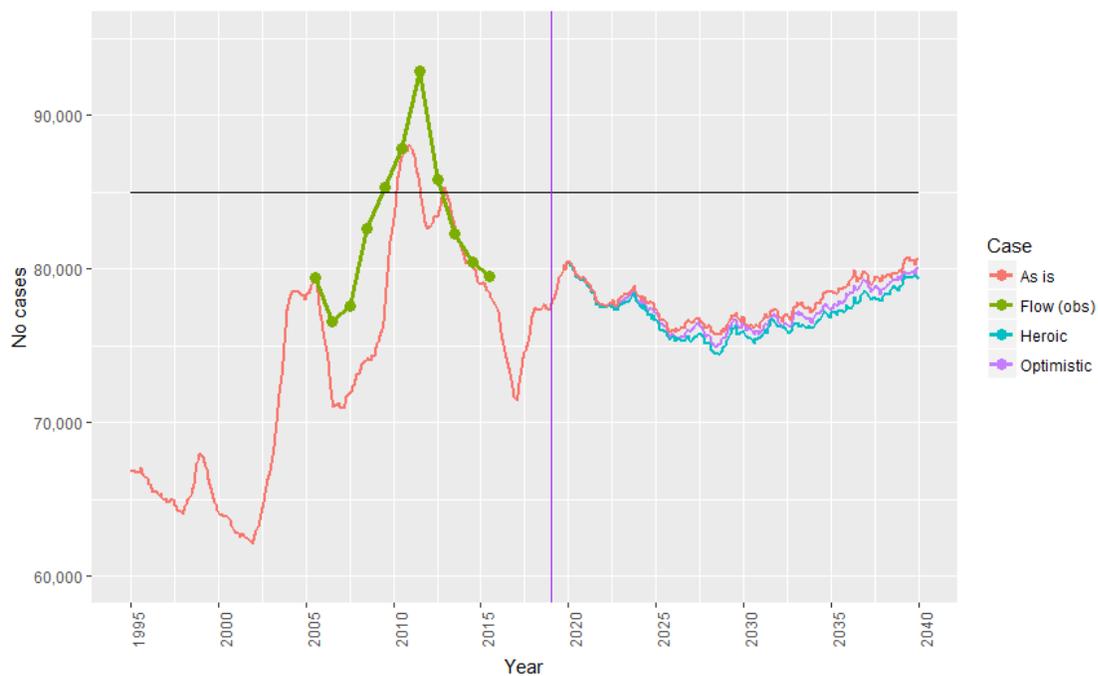
**Figure 2. Male Offenders: Custodial flows**



**Figure 1(bis). Male Offenders: Prison population**  
*Estimated impact of reducing re-offending*



**Figure 2(bis). Male Offenders: Custodial flows**



20. Figures 3 and 4 compare the female prison population and the flow into custody from 1995 to 2040 for the three scenarios. However the differences here are much smaller (given of course the much smaller size of the female prison population) and it is hard to discern any change that could be considered meaningful in a statistical sense<sup>10</sup>. The numerical results, Table 2 (A) & (B), show the differences from the simulated scenarios for the female prison population compared to the “As Is” scenario. For the number coming into custody a reduction of around 120 in the annual rate is projected by 2030, but it should be noted that here too these differences are well within the overlapping 95% confidence intervals of the three scenarios.

Table 2

A. Female prison population

Year	“As Is” Average in Calendar Year	“Optimistic” Average in Calendar Year	“Heroic” Average in Calendar Year	Difference “Optimistic”	Difference “Heroic”
2020	3,857	3,850	3,836	<15	<15
2025	3,655	3,699	3,672	<15	<15
2030	3,510	3,543	3,526	<15	<15
2035	3,621	3,602	3,630	<15	<15

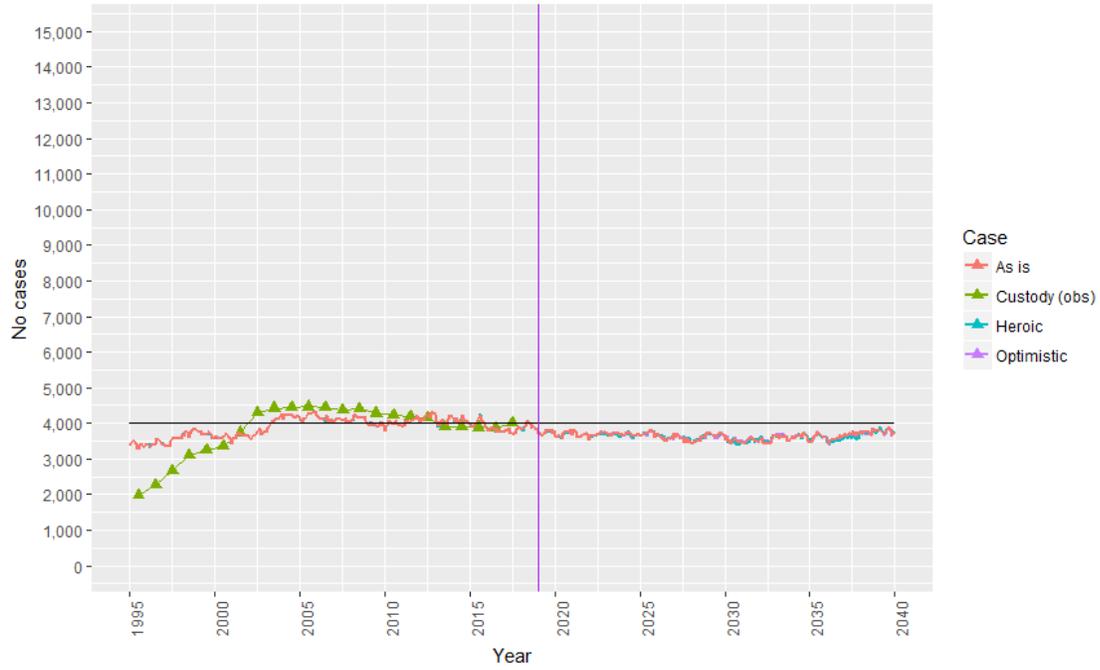
B. Flows into custody

Year	“As Is” Average in Calendar Year	“Optimistic” Average in Calendar Year	“Heroic” Average in Calendar Year	Difference “Optimistic”	Difference “Heroic”
2020	8,975	8,975	8,975	0	0
2025	8,678	8,590	8,534	88	144
2030	8,505	8,378	8,378	126	126
2035	8,420	8,339	8,296	81	124

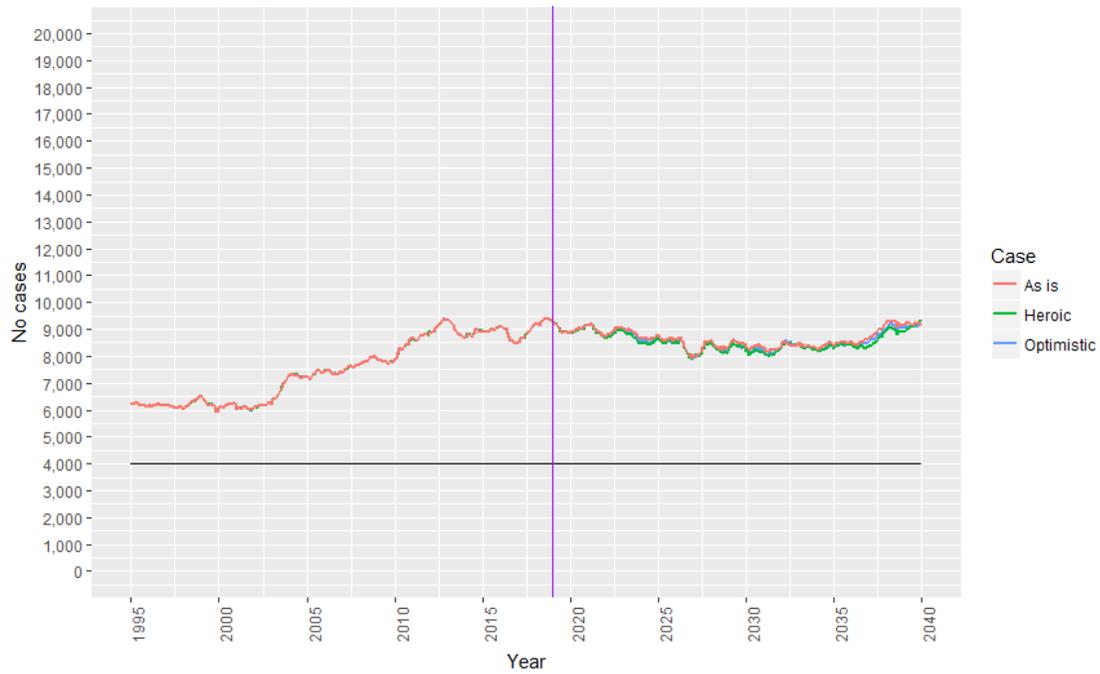
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<sup>10</sup> 95% confidence intervals range across simulation time between ±150 to ±200

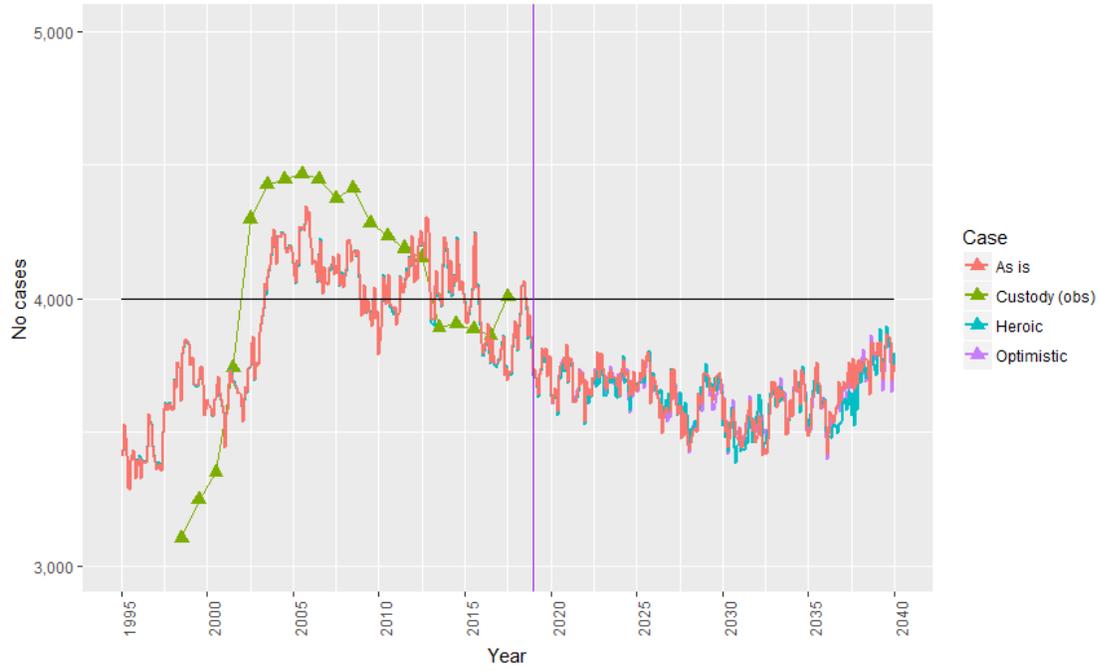
**Figure 3. Female Offenders: Prison population**  
*Estimated impact of reducing re-offending*



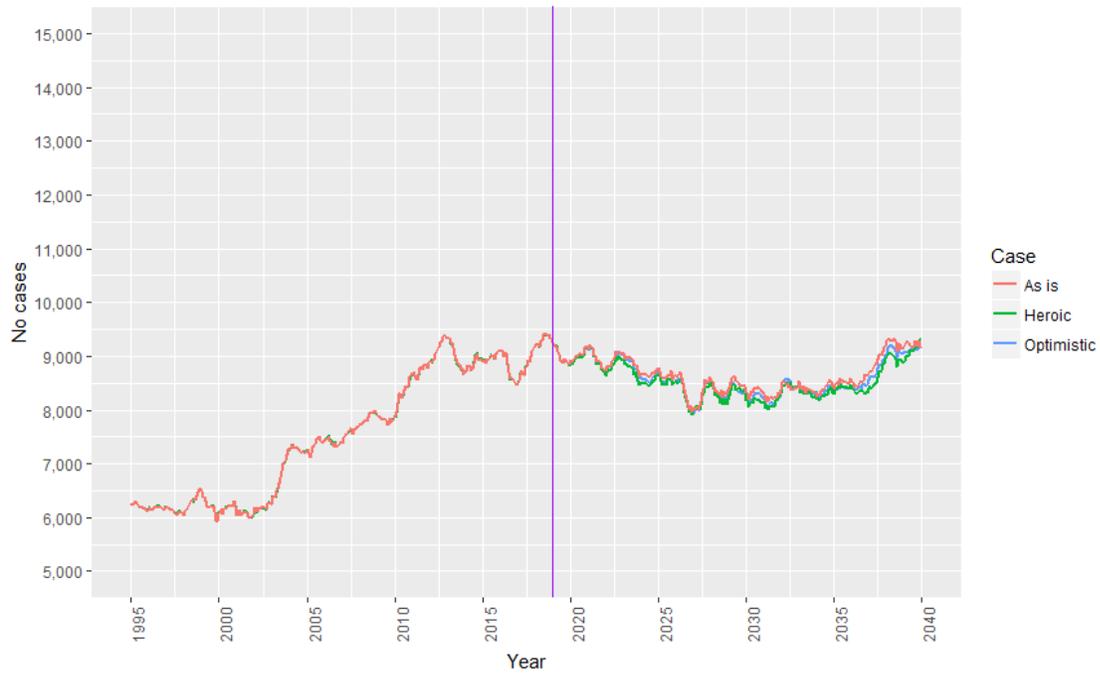
**Figure 4. Female Offenders: Custodial flows**



**Figure 3(bis). Female Offenders: Prison population**  
*Estimated impact of reducing re-offending*



**Figure 4(bis). Female Offenders: Custodial flows**



## 6. Discussion and conclusions

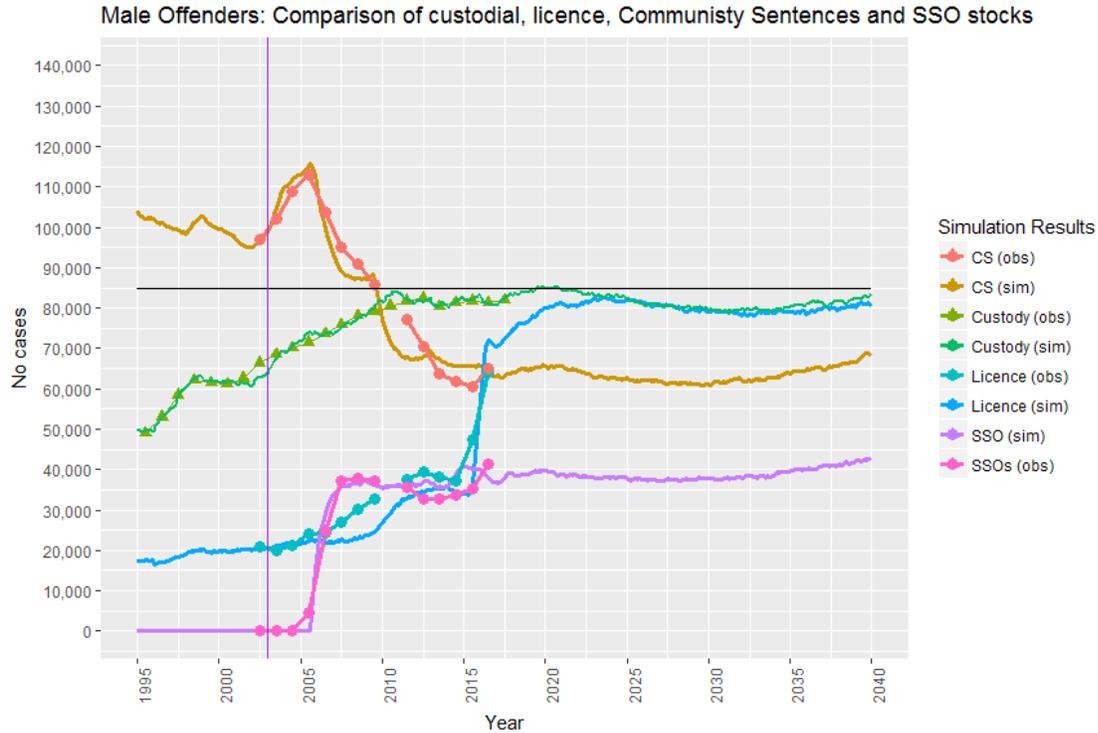
21. The aggregate impact on the prison population of systematic and effectively administered interventions is found by these simulations to be, by 2030, a reduction of ~300 for the “Optimistic” scenario and ~600 for the “Heroic” scenario. The change is gradual. These estimates are consistent with the known limitations of the available interventions.
22. The results can also be interpreted in the context of several other factors that limit the impact of reducing re-offending interventions. The male prison population comprises<sup>11</sup> in large part prisoners serving long sentences. Around 58% of those sentenced are serving 4+ years. So a very large proportion of the prison population is changing slowly or very slowly. In addition remand prisoners form a substantial component of the population. For example in 2017 there were ~10,000 remand prisoners at any one time who would not benefit (there are many practical issues that limit what interventions could be offered to remand prisoners).
23. These results show that reducing re-offending services can help reduce the size of the prison population. *However the effects are limited and take a long time to come through.* Such a policy, on its own, will not deliver significant changes to the size of the prison population in the short to medium term (i.e. 3 - 5 years). Nevertheless, it should form part of a broader approach that looks to make more discriminating use of prison.

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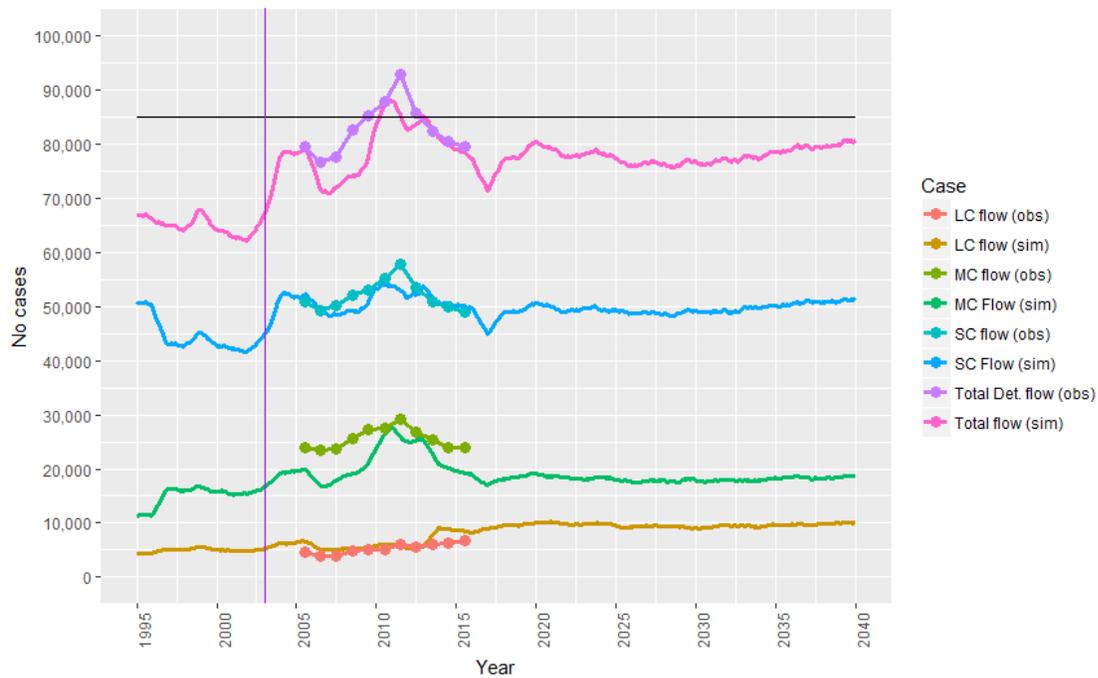
<sup>11</sup> See [http://www.justice-episteme.com/Policy\\_Examples.html](http://www.justice-episteme.com/Policy_Examples.html), Analysis of the determinants of the size and composition of the prison population in England & Wales, Findings, S Hadjipavlou March 2018, Section 5

## Annex A.

### 1. Male Offenders: “As is” reference scenario with prison, suspended sentences (SSO), Community Sentences (CS) and post-release licence case loads



#### Male Offenders: Custodial flows



## 2. Female Offenders: “As is” reference scenario with prison, suspended sentences (SSO), Community Sentences (CS) and post-release licence case loads

