Review of Youth Justice Service Grant Funding Formula

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1 Acknowledgements

In early 2022, the Ministry of Justice requested the YJB lead on a review of the Grant Funding Formula (RGFF) for Youth Justice Services (YJSs). In May 2022, the YJB commissioned a team comprising Economics By Design Ltd (lead contractor), Head and Heart Economics Ltd. and Get The Data Ltd to undertake the review.

The RGFF authors are:

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- Professor Eddie Kane, Get The Data Ltd.

The supporting literature review was undertaken by Professor Eddie Kane, Associate Director of Get the Data Ltd. and Director of the Centre for Health and Justice at the Institute of Mental Health University of Nottingham. Searching was undertaken by Emma Young, Deputy Head of Knowledge Services, and Naomi Thorpe, Senior Information Specialist, from the Library and Knowledge Service at the Institute of Mental Health, University of Nottingham.

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Peer review was provided by Francis Dickinson, Independent Economic Researcher, and former Government Economist.

Final decisions relating to the findings of this RGFF and the implementation transition from current to target funding levels will be referred to the Secretary of State for Justice, advised by the Youth Justice Board.

2 Glossary

CAPRICORN	Collaborative approaches to preventing offending and re-offending in children
FTE	First Time Entrants
IDACI	Income Deprivation Affecting Children Index
LSOA	Lower Super Output Area – a low level geographical area used by ONS for collection / estimation of demographic data.
MoJ	Ministry of Justice
ONS	Office of National Statistics
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
RAWP	Resource Allocation Working Party
REA	Rapid Evidence Assessment
RGFF	Review of the Grant Funding Formula
YJB	Youth Justice Board for England and Wales
YJS	Youth Justices Services
Linear Regression	In statistics, linear regression is a statistical technique for modelling the relationship between a single variable (a dependent variable) and one or more other variables (independent variables). It has been used in the RGFF to identify what factors are likely to explain geographical variation in need for YJSs.
FTE Rate	First Time Entrants Per Population aged 10-17.

3 Key Findings

In early 2022, the Ministry of Justice requested the YJB lead on a review of the Grant Funding Formula (RGFF) for Youth Justice Services (YJSs). The RGFF was undertaken between May and August 2022 and was **evidence based** – the findings are based on a rapid evidence assessment of good practice in designing resource allocation formulas, the factors that drive variation in the need for youth justice service, a critical assessment of relevant and available data sources, and a robust statistical analysis.

Three **key recommendations** have been prepared for consideration by the Secretary of State for Justice, advised by the Youth Justice Board. These are as follows:

1. **A New Formula:** The YJB to set grant funding allocation targets for YJSs in England and Wales using a new formula whereby YJSs target allocations would be determined by an amount per resident child aged 10-17, adjusted up or down based on measures of geographical variation in Child Poverty (Income Deprivation Affecting Children – IDACI), and Housing Overcrowding. Current allocations bear little or no relation to variation in need for YJS. **The new formula would be fairer and more equitable and would target funding to where it is most needed.**

2. **Implementation Transition** The YJB develops an implementation transition policy to smooth the transition from current allocations to target allocations, in recognition that it takes time for local areas to adjust to changes in funding, and that the targets themselves may change as new data becomes available.

3. **New Process**: The YJB commits to updating the YJSs share of the total grants, or even the grant formula itself, when new data become available which could have a significant impact on target allocations. For example, the 2021 Census data should be used to update the YJSs share of total funding once they become available. This would not require the formula itself to be updated.

Other recommendations have been made regarding the potential development of new measures to be used in any future update of the formula.

Exclusions: The new formula is designed to avoid perverse incentives (e.g., YJSs will not lose funding because of increasing diversion activities). The new formula does not incorporate financial performance incentives; these should be addressed separately. Ethnicity is not in of itself a driver of need and is not included in the formula. Initiatives to address over-representation of whatever cause should be addressed separately to this formula.

Benefits: Current allocations are based on historical factors and variations in funding across YJSs bear no relation to measures of variation in funding need. The new YJSs target allocations will be based on good practice in formula design, evidence of what drives variation in need and published data.

4 Executive Summary

4.1 Introduction

This report presents the findings of a Review of the Grant Funding Formula (RGFF) for YJSs. The RGFF was commissioned by Ministry of Justice after they requested the YJB lead on a review of the Grant Funding Formula (RGFF) for Youth Justice Services (YJSs). Decisions relating to the findings from the RGFF, and associated recommendations will be referred to the Secretary of State for Justice, advised by the Youth Justice Board.

4.2 Context

Youth Justice Board has a statutory duty "with the approval of the Secretary of State, to make grants to local authorities and other persons for the purposes of the operation of the youth justice system and the provision of youth justice services". In 2021-22 the total value of the YJ Grant was £79m, increased to £87m in 2022-23.

Current YJSs grant allocations vary geographically for historical reasons which no longer reflect the relative need for funding from the YJB. The YJ Grant funding is on average around one third of the overall funds received by YJSs; other funding comes from statutory partners. However, in any given YJSs the proportion of their total budget which comes from the YJ Grant may be very different.

There is a strong case for setting new "fair share" YJSs target funding allocations based on their relative need for funding. The YJB has developed a set of key principles to guide the RGFF to ensure that the results are evidence based, equitable, transparent, policy aligned and avoid perverse incentives.

4.3 Approach to the Review

The RGFF findings are based on a rapid evidence assessment of good practice in designing resource allocation formulas, the incorporation of these into the YJB key principles and the development of a conceptual framework for the design of the formula.

Evidence from the REA suggests that there is no perfect funding formula design, with formulae only able to offer 'rough justice' (Bevan, 2009). However, the literature does identify the core components of the more effective funding formulae, the advantages and disadvantages of different formulae indicators, and criteria for sourcing data. It also addresses key questions such as the objectives of funding formulae and the trade-offs between simplicity and complexity, and stability and

responsiveness. These have been incorporated in the design principles, and the proposed approach.

Of particular importance is the need to avoid incorporating those factors which can be influenced on the ground by those receiving the funding (perverse incentives). For these reasons the RGFF has focused on factors which impact on the relative scale of service requirements namely: **population size** (resident population of 10-17), unavoidable variation in **need/risk** of children needing the support of YJSs, and unavoidable **unit cost** pressures (e.g., local wage rates, staff travel distances etc.).

The ONS provides published mid-year population estimates and these have been used for the RGFF. It should be noted that the data used for the RGFF do not include the 2021 census results as these are yet to be made available for children aged 10-17.

Incorporating variation in need has been undertaken using evidence of what factors are likely to be important, selecting those where there exist robust published data sources, and then identifying which are significant and their relative impact using statistical techniques. Informed by the literature review, the RGFF has selected linear regression as the preferred statistical technique.

Ideally variations in unit costs would be measured using indices like those used for the local Government Area Cost Adjustments, however, data are not published / available for Wales. For these reasons, an analysis of unwarranted variation in Unit Costs is not included in this RGFF.

Quality assurance was undertaken by the RGFF review team, YJB analysts and an independent reviewer. The quality assurance covered the REA, the conceptual design, data accuracy, analytical accuracy and relevance and credibility of recommendations.

4.4 Identifying Variation in Need

A key task for the RGFF has been the identification, selection, and analysis of drivers of need for YJSs.

Candidate drivers of need for YJSs were determined from a review of Collaborative approaches to preventing offending and re-offending in children (CAPRICORN), 2019[1]. This included a review of the literature curated with expert elicitation, developed by Public Health England in collaboration with partner agencies, academia and the YJB Board.

A search of published data sources was undertaken to establish the best source for each of the candidate measures. Data sources were then reviewed to establish whether they were available for YJSs areas, up to date, likely to be updated, and

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/828228/CAPRICORN_resource.pdf

could not be directly influenced by YJSs (no perverse incentives) and that these were available for both England and Wales.

A final list of drivers, indicators and data sources was identified and included IMD measures for Low Income, High Unemployment, Child Poverty, and Housing Overcrowding, and national statistics on population density. There were additional drivers, indicators and data sources that met the criteria except that they were only available for England. These data were also analysed to assess the impact their inclusion may have had on the recommendations.

Regression analysis is a statistical method used to determine the relationship between changes in one metric (the dependent variable) and changes in a series of other metrics (the independent variables). The measures listed above are all candidate “independent variables”.

The RGFF has also explored options for measures for the dependent variable, namely a measure of need for YJSs. There is no single accepted measure of ‘need’ for YJSs. First Time Entrants (FTE) data is the only consistently recorded measure of the demand for each YJS. (Note: consideration to other metrics is given in Section 7.3). Whilst FTEs should not be used to set target grant allocations, they can be used to identify other factors that drive variation in demand and by how much. This means that YJSs with relatively high levels of need should receive relatively more funding, even though their FTE rate may be relatively low on account of having delivered successful diversion practices.

The regression analysis has shown that across England and Wales YJS, variation in need is explained by variation in **Population Size**, **levels of Child Poverty (IDACI)** and **Housing Overcrowding**. These three factors should be considered in setting grant funding allocation targets.

Extensive sensitivity tests have been undertaken to examine the impact of using different time periods (even as far back as 2011) and using different regression models. The overall conclusions remain the same.

Tests to establish whether the inclusion of data which are only available for England would improve the robustness of the model suggest that **Population Sparsity** might be an important driver. If data were available for England and Wales, this might improve model results.

4.5 New Grant Funding Formula

The aim of the formula is to calculate, for each YJSs, the target share of the overall YJSs Grant.

The starting point is the size of the population aged 10-17. All other things being equal, each YJSs should receive the same amount per child aged 10-17.

However, as the regression analysis shows, some YJSs have higher levels of need than others. Those YJSs with higher relative need should therefore receive a higher amount per child aged 10-17, and those YJSs with a lower relative need should

receive a lower amount per child aged 10-17. The adjustments are referred to as "needs weights".

The needs weights are calculated for each YJS using the regression results:

Needs Weight = 54.6 (*the regression constant*) + 825.9 (*the regression coefficient estimate for the IDACI*) multiplied by the IDACI index for that YJSs + 353.9 (*the regression coefficient estimate for Housing Overcrowding*) multiplied by the Housing Overcrowding index for that YJS.

Needs Weight $_{YJS^i}$ = 54.6 + 825.9 x IDACI $_{YJS^i}$ + 353.9 x Housing Overcrowding $_{YJS^i}$

These needs weights are then used to calculate a needs index which is applied to the relevant YJSs population to calculate a needs weighted population. The needs weighted populations are used to calculate the percentage share of the overall funding which would be allocated to the YJS.

A worked hypothetical example of how the needs index is used to estimate the target share of funding for an example YJS is shown in the table below:

Indicator		Value
Population 10-17	Example YJS	22.90k
IDACI	Example YJS	0.236
Housing Overcrowding	Example YJS	0.075
Needs Weighting	Example YJS	275.95
Total Population 10-17 across all YJS	All YJS	5600.1k
Average Needs Weighting (all YJS)	All YJS	229.09
Needs Index	Example YJS	120.46%
Needs Adjusted Population	Example YJS	27.58k
Target share	Example YJS	0.49%

In this example, the YJS has a population of 22,900 children aged 10-17. However, this YJS has a relatively high level of need. The new formula results in a positive needs adjustment of 120.46% as its needs are 20.46% higher than the average YJS. The needs weighted population is therefore estimated to be 27,580 compared to the unweighted population of 22,900. Based on this higher needs weighted population, its target share of the Grant would be 0.49%. The target share of the Grant for this YJS may be higher or lower than the current grant which, for reasons described earlier, is not based on population size or relative need.

Under the current allocations, which are not based on population size or relative need, the minimum allocation received by a YJS is £6.42 per child 10-17 and the maximum allocation is £49.54 per child 10-17.

The application of the new targets reduces the variation in Grant allocations. The lowest allocation for any YJS would be £7.76 per child 10-17 and the highest £26.83 per child 10-17.

Some YJSs have lower than average need, but because their past funding has been disproportionately low, they are nevertheless assessed as having current allocations that are below their target. They would receive additional funding from the new GFF.

This situation affects 45 YJSs. Some YJSs have higher than average need, but because their past funding has been disproportionately high, their current allocation is nevertheless above their target. They would receive a reduced level of funding from the new GFF. This situation affects 57 YJSs and is discussed further in the main report section 8.5 as part of the implementation transition considerations.

4.6 Benefits of the New Formula

Current allocations bear little or no relation to variation in need for YJS. The consolidation of different funding programs and the historical basis for the original allocations has resulted in funding levels varying significantly and without reference to variations in population size, or drivers of variation in the risk that a child might need the support of the YJS.

An **Equality Impact Assessment** has concluded that adoption of the new formula to set target allocations would have a positive impact on equity improving access to resources for children in general, and black and ethnic minority children.

Given the number of YJSs affected, the scale of the impact for some YJS, and in the absence of a significant, permanent increase in funding, there may be a need for the YJB to smooth the transition from the current allocations to the target allocations. These issues are discussed in section 8.5 of the main report. Ultimately the move from current to target allocations should be informed by an implementation transition policy to be determined by the YJB and which is beyond the scope of this RGFF.

4.7 Study Limitations

As discussed in this executive summary, the RGFF has been undertaken in accordance with the key principles set by the YJB, the evidence from the literature regarding good practice in formula design, evidence of what drives variation in need reliable data sources and robust statistical analysis.

The analysis would benefit if there were a more comprehensive measure of need for / demand for YJSs which included the number of children diverted from the youth justice system. The estimates may be more encompassing, and the results may be improved. Moreover, if there were consistent, comparable data for sparsity (for example, travel time to local shopping area) for England and Wales, this could also improve the analysis.

The Grant Funding Formula would also be improved if it were to incorporate an equivalent of the English Local Authority Area Cost Adjustment for YJSs across England and Wales. This would enable adjustments to reflect wage pressures arising from local labour markets, and additional costs of travelling in areas which cover large geographical areas.

One important consideration going forward is the need to keep the target allocations up to date. This RGFF has been comprehensive and should not need to be repeated. However, as new population, IDACI and Housing Overcrowding data become available, these could be easily plugged into the model to estimate target

allocations. This would mitigate against the risk of the formula becoming quickly outdated. Similarly, an area cost adjustment could be added to the Grant Funding Formula; used to scale the needs weighted population up or down in line with variations in unavoidable differences in costs.

Periodically, it may also be valuable to use this conceptual framework as the basis for refreshing the regression analysis. This would be valuable if there are significant changes such as the availability of new measures of need, and or measures of sparsity across England and Wales.

5 Context

5.1 Introduction

YJSs have a statutory duty to:

- co-ordinate the provision of youth justice services for all those in the local authority area who need them
- carry out such functions assigned in the youth justice plan which has been formulated by the local authority after consultation with relevant bodies.

The purpose of the Grant has been revised through the YJB (Amendment of Functions) Order 2015, article 2c. The monies are now given expressly "to make grants to local authorities and other persons for the purposes of the operation of the youth justice system and the provision of youth justice services" with a view to achieving the following outcomes:

- reduction in youth reoffending
- reduction in the numbers of FTEs
- reduction in the use of youth custody
- effective public protection
- effective safeguarding[2].

In 2021-22 the total size of the YJ Grant was £79m and this increased to £87m in 2022-23.

In 2021, the YJB published its Strategic Plan for 2021-2024[3]. The Plan sets out a vision for a child-first youth justice system. In this vision, all those who work within the system will see the child first, and work to support them to achieve their goals, rather than occupying themselves with what made the child offend in the first place.

In May 2022, the Ministry of Justice (MoJ) announced a significant uplift in funding to Youth Offending Teams in England and Wales taking central government funding to £300m over the next 3 years. £60m of this funding is targeted specifically at early intervention activities[4].

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[2] https://www.gov.uk/government/publications/youth-justice-service-governance-and-leadership/youth-justice-service-governance-and-leadership

[3] YJB (2021) Strategic Plan 2021-2024 - accessed April 2022: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/966200/YJB_Strategic_Plan_2021_-_2024.pdf

[4] https://www.gov.uk/government/news/300-million-to-cut-youth-crime-and-make-streets-safer

5.2 History of Grant Funding Formula

There are two formulae used to distribute funds to the YJSs to enable them to perform their duties:

- **England**. This is based on population size, geographic size of area covered and various measures of deprivation; and
- **Wales.** This is based on population size, caseload, and various measures of deprivation.

The current formulae were introduced in 2005-6. In addition, there were several individual targeted grants which were awarded to some, but not all YJSs. These were ringfenced and separate from the baselined grant. In 2010 ringfencing of separate grants was removed. All grants were consolidated for each individual YJSs into a single 'Core Grant'. No losses were experienced, what YJSs had received before was carried on into the Core Grant allowance. This has remained the case up to today.

YJSs also receive funding from other statutory partners[5]. The YJSs includes staff seconded from or employed by these agencies. To support the YJS, additional partners may also be recruited to provide specific services and support to children. The level of funding contribution from other agencies varies from place to place based on locally defined priorities and targeted initiatives. On average YJ Grant funding contributes around 29% of overall YJS funding[6]. Hence, in any given YJSs the proportion of their total budget which comes from the YJ Grant may be very different.

5.3 Case for Change

Current YJSs grant allocations vary geographically for historical reasons which no longer reflect the relative need for funding from the YJB. Challenges and issues include:

- the evidence underpinning the selection of factors used to drive target allocations
- the frequency of updates to the target allocations (current allocations are based on frozen allocations from 2001 census data and have been fixed since 2011)
- the confounding influence of legacy grants that have been included in final allocations, but which are no longer ring-fenced and are now considered part of the core funding
- the apparent disconnect between the need for funding and the allocation of funding as evidenced from per-capita benchmarks of localities with similar population characteristics.

[5] https://www.gov.uk/government/publications/youth-justice-service-governance-and-leadership/youth-justice-service-governance-and-leadership
[6] https://www.gov.uk/government/statistics/youth-justice-statistics-2020-to-2021

There is, therefore, a strong case for setting new “fair share” YJSs target funding allocations based on their relative need for funding.

5.4 Key Principles

The YJB is keen to ensure that the design and development of any future funding formula is guided by the following **key principles**:

- a model which has a fair and equitable distribution
- supporting of delivery against youth justice outcomes, including FTEs, custody, and reoffending
- the costs and challenges of delivering YJSs in localities
- no perverse incentives
- clear, transparent, and evidenced allocations
- credible, transparent, publicly available data at lower tier local authority level which is open to scrutiny
- the levelling up white paper[7].

5.5 Objectives for the RGFF

The YJB set the following objectives for the RGFF:

- to undertake a rapid evidence assessment of good practice and evidence of what drives variation in relative need for YJSs funding
- to develop a new formula consistent with the YJB key principles
- to document the analysis and findings of the review in a report
- to prepare a funding allocation tool for the YJB to use to set target allocations and compare targets with current allocations.

The analysis and findings of the RGFF are documented in this report and associated appendices.

[7] Department for Levelling Up, Housing and Communities (2022). Levelling Up in the United Kingdom. Levelling Up the United Kingdom - GOV.UK (www.gov.uk).

6 Approach to the Review

6.1 Introduction

The RGFF findings are based on a rapid evidence assessment of good practice in designing resource allocation formulas, and factors that drive variation in the need for youth justice service, a critical assessment of relevant and available data sources, and a robust statistical analysis. The approach taken is described in more detail in the following paragraphs.

6.2 Evidence Review

The RGFF commenced with a Rapid Evidence Assessment (REA) of funding formula methodologies, challenges, and issues. The REA methodology was based on the DFID (2015) Rapid Evidence Assessment Protocol.

Government departments have been using funding formulae to allocate national funds to local agencies since the Report of the Resource Allocation Working Party (RAWP) in 1976. Evidence from the REA suggests that there is no perfect funding formula design, with formulae only able to offer 'rough justice' (Bevan, 2009).

In summary:

- formulas are generally based on a combination of resource allocation drivers based on "need", "risk" and "cost"
- where relevant, formulas based on per-capita allocations with a small number of needs-based variables are considered relatively transparent and easy to explain
- formulas are less robust the smaller the geographical area being funded, and the more extreme the variation in risk factors between these small areas
- consultation with stakeholders can improve transparency and acceptability but it can also lead to providers putting forward their own judgements and wants which may not be well informed
- a simple formula is seen as more democratic and equitable since it is easy for people to understand and for parliamentarians or members of the public to scrutinise. This therefore makes it more difficult for politicians to manipulate.

The literature does identify the core components of the more effective funding formulae, the advantages and disadvantages of different formulae indicators, and criteria for sourcing data. It also addresses key questions such as the objectives of funding formulae and the trade-offs between simplicity and complexity, and stability and responsiveness. These have been incorporated in the design principles, and the proposed approach.

The REA methodology and more detailed findings are presented in Appendix 1.

6.3 Key Principles

The design principles set by the YJB for the RGFF have been mapped against the evidence from the literature and elaborated in Table 1 below:

Table 1: Key Design Principles for the Grant Funding Formula

Key Principles	Description based on review of the evidence
A model which has a fair and equitable distribution.	To support the equalisation of service provision capacity across different YJSs.
Supporting of delivery against youth justice outcomes, including FTEs, custody, and reoffending.	Should not run counter to the Child First policy agenda, diversion schemes, and the goal of reducing FTEs, custody, and reoffending.
The costs and challenges of delivering YJSs in localities.	Should consider not just the risks which increase demands on the youth justice system but also the factors which drive up unavoidable geographical variation in costs.
No perverse incentives.	The formula should not include drivers which can be influenced or manipulated by the YJS.
Clear, transparent, and evidenced allocations.	The formula should be objectively based, relatively simple, and be readily understood by stakeholders and have a strong underlying logic.
Credible, transparent, publicly available data at lower tier local authority level which is open to scrutiny.	The formula should be based on objective, accepted published data sources which can be aggregated for the different YJSs service boundaries.
The levelling up white paper.	Movement from current and target allocations, and the transition policy, should be mindful of any unintended consequences in relation to Government policy objectives for levelling up.

The literature review suggested that the RGFF should also include "**stability**" as a key principle. Good practice suggests that there should not be large and frequent fluctuations in target allocations.

6.4 Formula Design

A conceptual framework for the design and development of a new Grant Funding Formula has been developed. This was based on the findings of the REA and the key principles.

Figure 2 provides an overview of the design of the new formula.

The Figure illustrates the three drivers of variation in funding requirements that should ideally feature in the new formula: population, need/risk, and unit costs.

The Figure shows other drivers of variation in local expenditure which should not be incorporated within a funding formula, namely local performance, local policy, and local practice. The YJB may legitimately want to influence these and even potentially to use financial incentives to reward performance, practice innovation, and/or local policies. However, policies to influence local performance, policy and practice should not be implemented through a resource allocation funding formula:

- These factors fall under the direct influence of local teams and are difficult to incorporate within a funding formula without creating perverse incentives.

- Incorporating these factors into funding formulas would automatically reduce access to resources for those children who are resident in an area considered to be performing poorly. This could further disadvantage children and achieve little in terms of addressing the underlying causes of poor performance.

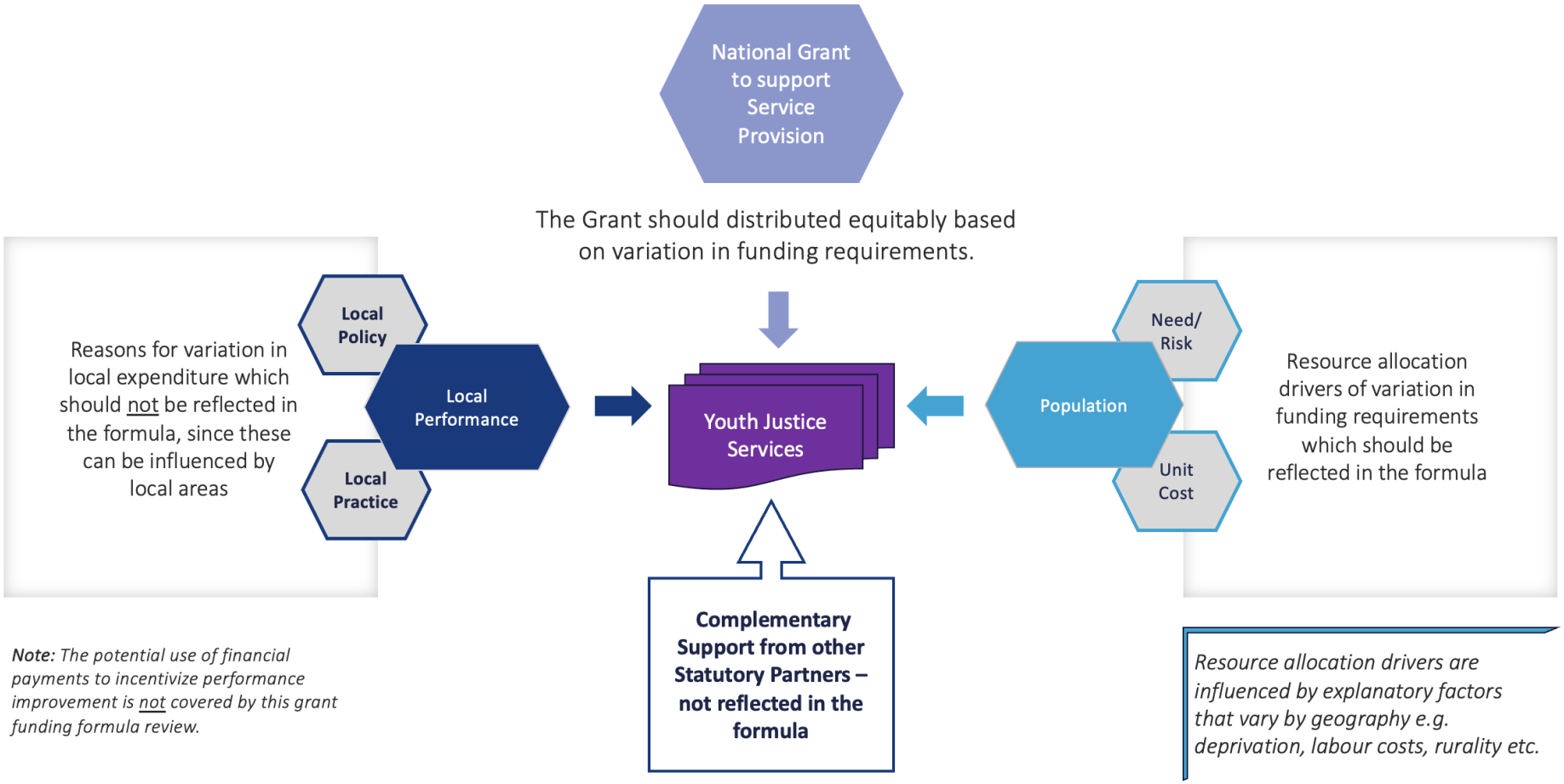
The Figure also shows the important role of statutory partners[8] who contribute by seconding staff or with targeted funding. These statutory partners are:

- the local authority (this should include children's social care and education)
- the police
- the probation service
- health.

Including the funding provided by statutory partners in the formula would potentially create a perverse incentive for these partners to reduce funding levels. Contributions from statutory partners are not included in the RGFF.

[8] https://www.gov.uk/government/publications/youth-justice-service-governance-and-leadership/youth-justice-service-governance-and-leadership

Figure 2: Conceptual Framework for YJSs Grant Funding Formula



6.5 Analytical Approach

Figure 2 illustrates the three drivers of variation in funding requirements that should ideally feature in a new formula: population, need/risk, and unit costs.

Population: The literature suggests that formulas used to allocate funding to support service provision for a given population should, all other things being equal, provide the same amount of funding per head of population, in this case per resident child aged 10-17. The starting point for the RGFF analysis is therefore to use 'ONS mid-year population estimates of the number of children aged 10-17 resident in each YJS, since this is the population covered by the YJSs grant. It should be noted that the 2021 census results have yet to be incorporated into ONS population estimates of the number of children aged 10-17.

Need: Analysis to explain variations in need/risk is best undertaken using evidence of what factors are likely to be important, selecting those where there exist robust published data sources, and then identifying which are significant and their relative impact using statistical techniques. Four types of statistical techniques were considered as part of the RGFF: linear regression, multi-level regression, factor analysis, and principal components analysis. A high-level appraisal of each method was undertaken using three criteria taken from the REA: conceptual clarity, transparency of results and robustness. The appraisal is summarised in Table 3.

Table 3: Selection of Statistical Analysis of Need

	Conceptual Clarity	Transparent Results	Robustness
Linear Regression	xxx	xxx	xx
Multi-level Regression	xx	xx	xxx
Factor Analysis	xx	x	xx
Principal Components Analysis	xx	x	xx

For this RGFF, Linear Regression was selected as the preferred approach as is conceptually clear and therefore easier to explain, and the results are transparent. It is the most referenced in the literature.

The approach taken to identifying and analysing drivers of variation in need is discussed in more detail in Section 6 of this report.

Unit Costs: Ideally variations in unit costs would be measured using indices like those used for the local Government Area Cost Adjustments, however, data are not published / available for Wales. For these reasons, unwarranted variation in Unit Costs is not included in the proposed GFF.

6.6 Quality Assurance

Quality assurance was undertaken from three perspectives:

- Internal review team quality assurance: the RGFF review team comprised experienced economists, statisticians, and researchers with expertise in resource allocation. Each element of the work was prepared by one part of the team and then reviewed by a nominated team member who had not been directly involved.

- Independent peer review: all aspects of the work were submitted for peer review to an independent economist with experience in resource allocation and statistical analysis, and who had no direct involvement in the review.

- Youth Justice Board analyst review: all aspects of the work were submitted for quality review by the YJB analytical team.

The quality assurance covered the REA, the conceptual design, data accuracy, analytical accuracy and relevance and credibility of recommendations.

7 Identifying Variation in Need

7.1 Introduction

A key task for the RGFF has been the identification, selection, and analysis of drivers of need for YJSs. This section of the report provides a detailed description of the candidate drivers, the critical appraisal of data sources, and the statistical analysis undertaken to identify the drivers recommended for inclusion in a new Grant Funding formula.

7.2 Candidate Drivers

Candidate drivers of variation in need/risk of children needing YJSs were determined from a review of Collaborative approaches to preventing offending and re-offending in children (CAPRICORN), 2019[9]. This included a recent review of the literature curated with expert elicitation, developed by Public Health England in collaboration with partner agencies, academia, and the Youth Justice Board.

Table 4 provides a summary of the candidate drivers identified from the review. These have been broadly grouped into four high level categories to reflect the underlying cause or determinant: society; community; relationships; individual.

Some candidate drivers have the potential to be influenced by the YJSs performance. To include these as candidate drivers of variation in need/risk in the new Grant Funding Formula might result in perverse incentives, e.g., relatively poor performance on activities to reduce alcohol or substance abuse amongst children at risk of offending might lead to a relative increase in funding target.

There is evidence of over-representation of black and minority ethnic children in YJSs. However, ethnicity is not in of itself a driver of need and is not included in the formula. Initiatives to address over-representation should be addressed separately to this formula.

9 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/828228/CAPRICORN_resource.pdf

Table 4: Candidate Drivers of Variation in Need for YJS

Potentially independent of YJSs performance			
Society	**Community**	**Relationships**	**Individual**
• Deprivation • High unemployment • Homelessness or poor housing • Difficulty in accessing services • Culture of violence, norms and values which accept, normalise, and glorify violence • Societal discrimination • Opportunities of valued social roles	• Insufficient infrastructure for the satisfaction of needs and interests of young people/ Lack of possibilities for recreation • Sense of belonging and connectedness • Community cohesion • Opportunities for sports and hobbies	• Low income • Family size • Mental illness • Family breakdown • Frequent shared activities with parents	• School readiness • Behavioural and learning difficulty • Alcohol or substance misuse • Perinatal trauma • Genetic or biological • Early malnutrition • Traumatic brain injury • Good communication skills • Healthy social relationships
Potentially influenced by YJSs performance			
Society	**Community**	**Relationships**	**Individual**
	• Unsafe or violent communities	• Abuse • Abuse / neglect • Poor parenting • Household offending • Family violence	• Alcohol or substance misuse

7.3 Critical Appraisal of Data Sources

Each of the risk drivers were initially compared with the data available from the indices of deprivation (2019) published by the Ministry of Housing, Communities and

Local Government[10]. For the risk drivers where data were not available from the indices of deprivation, other data published by central government, local authorities and public bodies were searched via the government's open data portal and through Google searches. The analytical team at the YJB also provided advice on the sources of relevant data.

Data sources were then reviewed against the following criteria:

- Available at Lower Super Output Area (LSOA) – to allow building of future Youth Justice Service areas from the data
- Not theoretically influenced by YJSs – the evidence reviewed found that the needs drivers should not be influenced by the organisation the grant formula is providing resources to
- Highly likely to be updated – this was a subjective assessment based upon the presence of previous updates and how recent the last data were published. Data not published since before 2019 were chosen to ensure data are reasonably up to date (2019 was chosen as that is when the IMD data were last published).

Table 5 below shows the drivers and data sources that met the criteria and were available for both England and Wales

Table 5: Candidate Drivers and Data Sources England and Wales

Driver	Indicator	Source
Low income	Income domain score weighted to LA (UT)	IMD England and Wales Income
High unemployment	Employment domain score weighted to LA (UT)	IMD England and Wales Employment
Low income	IMD income measure relating to children (IDACI)	IMD England and Wales Income
Urbanicity	Population density	National Statistics
Family size	Overcrowding	IMD England and Wales Barriers to Housing and Services[11]

Some data sources are not consistently available across England and Wales. Table 6 below shows the candidate drivers and data sources that met the criteria but were only available for England.

Table 6: Candidate Drivers and Data Sources England only

[10] Note the Ministry of Housing Communities and Local Government who was previously responsible for publishing these data became the Department for Levelling up, Housing and Communities in 2021.
[11] Note that these are defined slightly differently for England and Wales – see section 6.4.

Driver	Description	Source
Low income	Income domain score weighted to LA (UT)	IMD domain scores
High unemployment	Employment domain score weighted to LA (UT)	IMD domain scores
Homelessness or poor housing	Barriers to housing and services domain score weighted to LA (UT)	IMD domain scores
Poor housing	Living environment domain score weighted to LA (UT)	IMD domain scores
Deprivation	Education domain score weighted to LA (UT)	IMD domain scores
Difficulty in accessing services	Average distance to post office (km)	IMD underlying indicators
	Average distance to primary school (km)	IMD underlying indicators
	Average distance to general store / supermarket (km)	IMD underlying indicators
	Average distance to GP surgery (km)	IMD underlying indicators
Family size	Proportion of households classed as overcrowded weighted to LA (UT)	IMD underlying indicators
Homelessness or poor housing	Rate of acceptance for housing assistance weighted to LA (UT)	IMD underlying indicators
	Measure of inability to afford to enter owner-occupation of the private rental market weighted to LA (UT)	IMD underlying indicators
	Proportion of social and private homes that fail to meet the Decent Homes standard weighted to LA	IMD underlying indicators
	Proportion homes without central heating weighted to LA	IMD underlying indicators
School readiness	Proportion of young people not staying on in school or non-advanced education above age 16 weighted to LA	IMD underlying indicators
	Proportion of young people aged under 21 not entering higher education weighted to LA	IMD underlying indicators
Mental illness	Measure of the levels of mental ill health in the local population weighted to LA	IMD underlying indicators
Difficulty in accessing services	Average time in minutes to a town centre walking or by public transport	Journey times to town centre by LSOA 2019
Low income for children's families	IMD income measure related to children	IMD domain scores
Urbanicity	Population density	National Statistics

The planned regression analysis required a dependent variable that measured the need for YJSs in an area. The study team selected the rate of FTEs to the youth justice system (per 100,000 children aged 10-17). Figures for each year 2011 to 2021 were obtained covering both England and Wales.

Of the available data, FTE rate was the best option because:

- It is available for most YJSs
- It is available yearly for the period 2011-2021
- It focuses on child only offending.

There are limitations to the measure, however:

- it does not include young people diverted from the youth justice system ; and
- it is not available for YJSs that had a small number of FTEs (the rate was suppressed for locations with less than 10 FTEs).

The following measures were also considered for the dependent variable, but rejected:

- crime rates by police force – these are not available for specific YJSs and included crimes committed by adults
- number of children known to the YJSs per 100,000 young people – such a measure would include many of the children diverted from the youth justice system, but collecting this data would have meant requesting and validating additional data from all YJSs in England and Wales, and these data are not published
- community sentences per 100,000 young people – this would have the drawback (compared to FTE rates) of being more heavily influenced by system decisions on the desirability of this disposal and on the systems reoffending performance, so potentially biasing results of the regression analysis. It would also relate to fewer cases, which theory indicates is likely to lead to reduced robustness in statistical assessment of relationships with contextual factors.
- number of cautions per 100,000 young people - the same drawbacks apply as per community sentences
- number of convictions per 100,000 young people - the same drawbacks apply as per community sentences
- Hospital admissions for youth assaults – this metric faces several drawbacks. Most importantly, it is focused on only one aspect of outcomes (albeit an important element of such) and it is less general than FTE as a broad-based measure of difficulties among the relevant population. It is also a measure based on victims. It is also somewhat affected by system decisions (not just the availability of A&E, but also the perceived level of medical confidentiality given to victims will affect A&E volumes). This problem is exacerbated by the lack of financial incentives for health staff to provide youth justice data on a robust basis. Such a metric could well also be highly subject to much variability at YJS level on a yearly basis.

The most recent ONS **population estimates** were selected for the population data – mid 2020. This included Population All Ages, Population of Working Age 16-64), Population Dependent Ages (0-15) and Population Youth Justice Qualifying Children (10-17). These are the most recent estimates and are available at LSOA. LSOA data

from England and Wales were weighted and aggregated to local authorities using the method guidance from the Index for Multiple Deprivation Technical Report[12]. Each of the datasets above were mapped to each YJSs based on lookup tables provided by the YJB.

7.4 Regression Analysis

Regression analysis is a statistical method used to determine the relationship between changes in one metric (the dependent variable) and changes in a series of other metrics (the independent variables). The candidate drivers listed above are all candidate “independent variables”.

The RGFF has also explored options for measures for the dependent variable, namely a measure of need for YJSs. There is no single accepted measure of ‘need’ for YJSs.

As discussed above, FTE data is a measure of the demand for YJSs. However, FTE rates per head of resident population aged 10-17 can be influenced by local practice so cannot be used as a direct measure of demand for services.

FTEs can however be used to identify other factors that drive variation in demand and by how much. This is done using regression analysis to isolate the effect of each explanatory factor, and separate them from unrelated variations in local FTE rates for YJSs.

The baseline regression analysis was therefore undertaken using the following variables for each YJS:

- **Dependent Variable**: FTE per head of population aged 10-17 (FTE Rate), Average of 2018 & 2019 (pre COVID-19).

- **Independent Variables**: Listed above in Table 5 above. 2019 data (latest available).

Local authorities with missing data / supressed FTE data were either excluded from the regression analysis or had missing values estimated based on trends from previous years. One local authority (South Tyneside) was identified by a regression diagnostic (Studentied residuals) as a potential outlier; however, since the validity of its IMD IDACI and overcrowding data was confirmed, and since its characteristics (in terms of population demographics) are not unusual for a local authority in England and Wales, its data were retained in the regression.

In Table 5, the definition of Housing Overcrowding is slightly different for England (proportion of households affected) and Wales (proportion of people affected). This made a small difference to the level of the index and an adjustment was made

[12] Available here: English indices of deprivation 2019: technical report - GOV.UK (www.gov.uk) Accessed: 26/07/2022

accordingly. Sensitivity tests demonstrated that the adjustment did not make a material difference to the results.

Linear regression analysis was used for the modelling. Given that all candidate drivers were based on evidence of potential impact, a "step-wise" regression approach was used to identify the model of "best fit". This starts with the inclusion of all variables in the dataset and then reduces the included variables to those that are statistically significant. The statistical parameter used for assessing whether a given variable counts as "statistically significant" as a driver of need is to use a 95% confidence interval, which equates to a 5% significance level. This is in line with standard economics practice[13].

Sensitivity tests were undertaken to explore the impact of using different years, and using different assumed relationships between the variables in the model.

All regression analysis was undertaken in Stata. A full description of the regression analysis and results is provided in Appendix 3.

7.5 Regression Results

The regression analysis has shown that across Youth Justice Services, variation in need **per head of population** is partly explained by variation in **levels of Child Poverty (IDACI)** and **Housing Overcrowding**. A summary of the results of the regression analysis is shown in Table 7 below.

Table 7: Results of Regression Analysis

Independent Variable	Coefficient	Robust Standard Error	t ratio (a value above 1.96 shows statistical significance at 95% confidence levels)
IDACI	825.94	92.04	8.97
Housing Overcrowding	353.86	60.50	5.85
Constant	54.59	14.65	3.73

These results suggest that expected "need per head of population" (proxied as FTE rates) can be predicted for each YJSs based on the following formula:

Expected FTE Rate(Need)$_{YJSs}$ = 54.59 + 353.86 * Housing Overcrowding Index Value$_{YJSs}$ + 825.94 * IDACI Value$_{YJSs}$

[13] https://www.investopedia.com/terms/s/statistical-significance.asp

The R^2 is 0.445 [14]. This is a measure of "goodness of fit", with a perfect fit having an R^2 value of 1.

This implies that variation in FTEs is in part (40%) explained by variation in IDACI and Housing Overcrowding. Some YJSs will have actual FTE Rates which are lower than this model would estimate. Others will be higher. Some of these differences may be due to "missing drivers", namely factors which have not been identified or for which no published data source exists. Some of the variation may be due to variation in practice in relation to diversion policy. The statistical analysis shows that these missing factors are unlikely to impact on the estimated impact of IDACI or Housing Overcrowding.

7.6 Sensitivity Analysis

Extensive sensitivity tests have been undertaken. Overall, these tests have demonstrated that the results presented above are robust.

Six variants of the main model were examined. These are shown in Table 8 together with the adjusted R^2 results. The models with the best fit (highest adjusted R^2) were for 2018-2019, both having R^2 of 0.42. The additive model was selected as it is simpler to explain and more transparent. A full discussion of these models and the size of the coefficients is shown in Appendix 3.

Table 8: Results of Six Variants of the model – adjusted R^2 Model

Time Period (FTE rates)	Additive Model	Multiplicative Model (variables are converted to logged values)
2018 - 2019 average	.438	.439
2020 - 2021 average	.363	.372
2019	.336	.391

All six models identified IDACI and Housing Overcrowding as statistically significant independent variables. Three of the lower performing models (the models for the average of 2020-2021, and the multiplicative model for 2019) also showed population density as a significant driver. Note that the above table uses standard linear regression (and so not applying robust standard error approaches) to facilitate comparison between the variants.

Population matters. The new formula is based on a starting position that, all other things being equal, YJSs should receive a share of funding based on the relative size of the population they serve. The team has also tested whether different results would be seen by either omitting population or treating population size as an independent variable, and assessing how much this explains variation in FTEs. Excluding population altogether results in a very low performing model (only 6% of the variance in FTEs is explained by IDACI and Housing Overcrowding). Including

[14] Adjusted R-squared is not available with the statistical approach involving "Robust Standard Errors

population as an independent variable with FTEs as the dependent variable (instead of using FTE rates) results in a co-efficient close to 1 – implying that this is the equivalent of using the FTE rate as the dependent variable. These results suggest that population is an important determinant of need and supports the per capita approach to the formula development.

The adjustment for different definitions of Housing Overcrowding in England and Wales makes little difference. Assuming the definitions are identical, and not making any corrective adjustment, results in minor changes in the size of the coefficients for IDACI and Housing Overcrowding.

YJSs diversion practices do not materially affect the results: The model was tested using FTE rates for 2011. FTE rates were generally higher across YJSs, and hence estimated coefficients are higher from the regression. However, the predicted variation in expected FTEs which the prototype grant funding model provides is within 5% or so of the estimated target allocations achieved when using the regression results from the 2018-2019 data. This suggests that variation in diversion practice is not linked to IDACI or Housing Overcrowding and that the model is relatively stable over time.

Ignoring the drivers for which data exist only for England makes little difference: A stepwise regression was run using the wider dataset only available for England. All six variants of the model shown in Table 7 were undertaken. The models showed an improvement in “goodness of fit” and, as with the England and Wales model, the model using average FTE rates for 2018-2019 as the dependent variable produced the most robust results. All models showed IDACI and Housing Overcrowding as the main drivers of variation in need. The variables “distance to primary school”, is statistically significant for the preferred model but not others. This shows that if some comparable measures of sparsity were available for both England and Wales their inclusion might improve the robustness of the model. Population density is also significant, though on an inconsistent basis and not for the preferred model.

8 New Grant Funding Formula

8.1 Introduction

The analysis presented in section 5 and 6 has been used to develop a new formula for YJ Grant Funding for YJSs. The components of the formula are described in the following paragraphs together with an equality impact assessment and an overview of the benefits of the new formula.

8.2 Setting Target Allocations

The aim of the formula is to calculate, for each YJS the target share of the overall YJSs Grant. The starting point is the size of the population aged 10-17. All other things being equal, each YJS should receive the same amount per child aged 10-17. Those YJSs with higher relative need should receive a higher amount per child aged 10-17, and those YJSs with a lower relative need should receive a lower amount per child aged 10-17. The adjustments are referred to as “needs weights”.

Target allocations for each Local Authority are calculated as follows:

1. Needs weight$_{LA}$ = 54.59 + 825.94* IDACI$_{LA}$ + 353.86 * Housing Overcrowding$_{LA}$

2. Needs adjusted population$_{LA}$ = population 10-17$_{LA}$ * Needs weight $_{LA}$ /Average Needs Rate (across all LAs)

3. Target Share of Grant$_{LA}$ = needs adjusted population $_{LA}$ / total population (for all LAs)

4. Target Grant$_{LA}$ = Target Share of Grant$_{LA}$ * National Grant

Target Grants are then mapped to the relevant YJSs.

A worked example is shown in Table 9. As can be seen, LA 1 has a positive needs adjustment of 120.46% on account of a relatively high level of need. LA 2 has their share deflated to 77.94% of the average on account of having a relatively low level of need. The needs weighted populations are used to calculate the target percentage share of the overall grant for each LA.

Having mapped the target grants to each YJS it is then possible to combine these with population estimates for each YJSs to calculate the target amount per child aged 10-17. This is shown in Table 10. If each YJSs were to receive the same amount of grant funding per head of population, they would receive approximately £15.54 per child. In this example, LA1 would receive £18.73 per child 10-17,

compared to a current allocation of £26.20 per child 10-17. LA3 would receive £18.90 per child 10-17 compared to a current allocation of £4.80 per child 10-17.

Table 9: Illustrative Calculation of Target Grant using Findings from RGFF (figures are rounded to the nearest 2 decimal places)

Hypothetical Local Authority	Population 10 to 17 (000s)	IDACI	Housing Over-crowding	Needs Weight	Needs Index	Needs Weighted Population (000s)	Target Share	Target Grant £m
LA 1	22.90	0.24	0.08	275.95	120.46%	27.58	0.49%	0.429
LA 2	17.74	0.13	0.06	178.56	77.94%	13.59	0.24%	0.211
LA 3	20.82	0.23	0.10	278.37	121.51%	25.30	0.45%	0.393
All LAs	5600.70			229.09		5600.70	100.00%	87.054

Table 10: Illustrative Calculation of Current & Target Grant Per Child Aged 10-17

Table 11: Distribution of Grant Funding

Hypothetical Youth Justice Service	Population 10 to 17 (000s)	Current Grant £m	Grant Per Child 10-17 Current	Grant Per Child 10-17 Target	Distribution across all YJS	Grant Per Child 10-17 Current	Grant Per Child 10-17 Target
YJS 1	22.90	0.60	26.20	18.73	Minimum	6.42	7.76
YJS 2	17.74	0.37	21.23	12.12	Maximum	49.54	26.83
YJS 3	20.82	0.10	4.80	18.90	1st Quartile	12.02	13.29
All YJSs	5600.70		15.54	15.54	3rd Quartile	22.97	19.00

Table 11 shows the distribution of grant funding across the Youth Justice System. Under the current allocations, the minimum allocation is £6.42 per child 10-17 and the highest is £49.54 per child 10-17. The application of the new targets reduces the variation. The lowest allocation would be £7.76 per child and the highest £26.83 per child.

8.3 Distance from Target – Summary

The current grant allocations do not reflect variations in size of the child population aged 10-17, or variation in underlying need for or risk of need for Youth Justice Services. It is therefore unsurprising that changing to the target allocations will result in a significant redistribution of funds.

A summary analysis of the scale of redistribution and number of YJSs affected is shown in Table 12.

The analysis shows that the overall redistribution would be a net £9.7m, a value of just over 11% of the total grant. If the overall value of the grant were set at the same level as the 2022-23 allocation:

- 75 YJSs would currently be below target. For these YJS, they would each have their funding increased by an average of £129k (25% average gain), with the minimum increase being £0 and the maximum £953k.

- 81 YJSs would currently be above target. For these YJSs, they would each have their funding reduced by around £120k (21% average loss), with the minimum reduction being £3k and the maximum £415k.

Table 13 shows the number of YJSs with relatively high needs (needs weights above 1) and relatively low needs (needs weights below 1) and the number that gain and lose under the new formula.

- 45 YJSs are currently below target (they would gain funding) even though their need is assessed as being below average. Their current funding levels were disproportionately low and did not account for their population size or their actual level of need.

- 57 YJSs are currently above target (they would lose funding) even though their need is assessed as being above average. These YJSs had been relatively generously funded, even more than their population size and relative need would suggest.

Table 12: Summary Analysis of Distance from Target

	YJSs Currently Below Target	YJSs Currently Above Target
Number of YJSs	75	81
Proportion of YJSs	48%	52%
Total value of distance from target (difference between current and target allocation)	£9.697m	-£9.697m
Minimum value of distance from target	£144	-£3k
Maximum value of distance from target	£953k	-£415k
Average distance from target	£129k	-£120k
Number of YJS with current allocations more than 25% from target allocations	27	35

Table 13: Summary Analysis of High and Low Need Gainers and Losers

	Current allocations are below target (gainers)	Current allocations are above target (losers)	Total
Relatively High Need	30	57	87
Relatively Low Need	45	24	69
Total	75	81	156

Given the number of YJSs affected, the scale of the impact for some YJSs, and in the absence of a significant, permanent increase in funding, there may be a need for the YJB to smooth the transition from the current allocations to the target allocations.

Moving all YJSs to new targets at the start of the 2023-24 would provide a swift, one-off adjustment and provide a new baseline for moving forwards.

Arguments in favour of phasing a transition include:

1. Helping YJSs to plan for the changes in consultation with statutory partners who may wish to adjust their funding in the light of the findings from this RGFF.

2. Helping to mitigate any wider economic impact, where YJSs affected are also recognized as priorities for levelling up under other government policy initiatives.
3. Recognition that some of the data used to calculate target grants, when updated, may change the target allocations. New Census data for example may change target allocations for those YJSs whose population estimates are expected to change, potentially reducing distance to target.

Ultimately the move from current to target allocations should be informed by an implementation transition policy to be determined by the YJB and which is beyond the scope of this RGFF.

8.4 Benefits of the New Formula

Current allocations bear little or no relation to variation in need for YJS. The consolidation of different funding programs and the historical basis for the original allocations has resulted in funding levels varying significantly and without reference to variations in population size, or drivers of variation in the risk that a child might need the support of the YJS.

An **Equality Impact Assessment** has been undertaken and is provided in Appendix 4.

In summary, it has concluded that adoption of the new formula to set target allocations would have a positive impact on equity. The populations benefiting from the change include children in general aged 10-17, and black and ethnic minority children.

Statistical analysis shows that in variation population size is a very important driver of need for YJSs (see Appendix 3, Annex 3). The new formula will increase the targeting of limited resources to those areas with the highest number of children aged 10-17, adjusted for additional drivers of variation in need or risk of need for Youth Justice Services.

Government research suggests that in 2019, people from all ethnic minority groups, except the Indian, Chinese, White Irish, and White Other groups, were more likely than White British people to live in the most overall deprived 10% of neighbourhoods in England[15]. The new formula will increase funding allocations for geographies which have higher rates of deprivation as measured by Child Poverty, and Housing Overcrowding. This will improve targeting of resources on ethnic minority populations as illustrated in Figure 14 which shows a positive relationship between target funding per capita and proportion of the population with an ethnic minority background.

Figure 14: Relationship between YJSs Target Grant Allocations Per Capita and Proportion of Population from an Ethnic Minority Background

[15] https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/people-living-in-deprived-neighbourhoods/latest

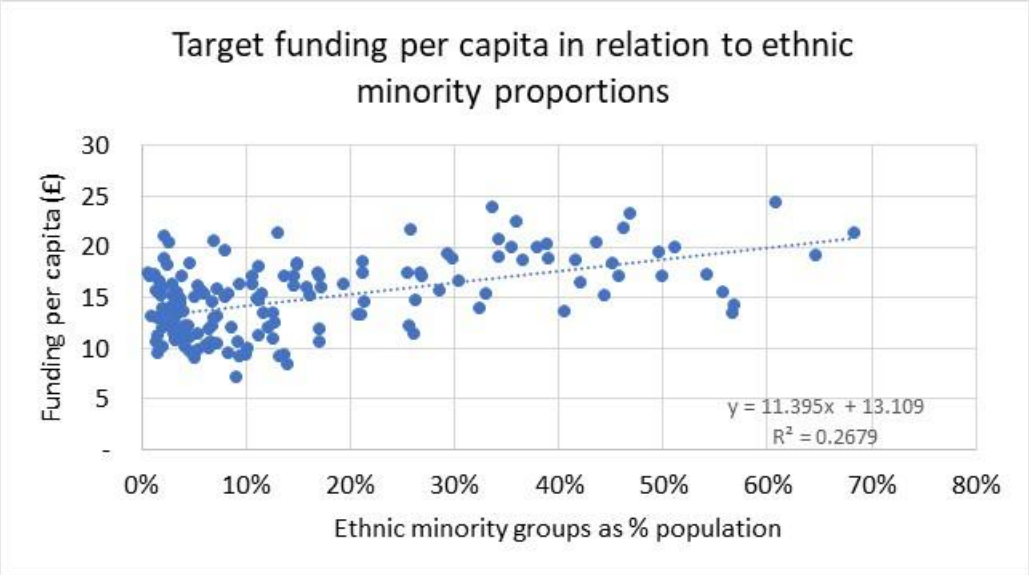


Figure 14 shows an R^2 of 26.70% which, put simply shows that 26.7% of the variation in funding per capita is correlated with ethnic minority populations as a proportion of the total population. A similar comparison with the current grant shows no such relationship; an R^2 of 0.0031; suggesting that under the current formula funding is not going to areas with high ethnic minority populations.

8.5 Implementation Transition Considerations

Given the number of YJSs affected, the scale of the impact for some YJSs, and in the absence of a significant, permanent increase in funding, there may be a need for the YJB to smooth the transition from the current allocations to the target allocations.

Moving all YJSs to new targets at the start of the 2023-24 would provide a swift, one-off adjustment and provide a new baseline for moving forwards.

Arguments in favour of phasing a transition include:

1. Helping YJSs to plan for the changes in consultation with statutory partners who may wish to adjust their funding in the light of the findings from this RGFF.
2. Helping to mitigate any wider economic impact, where YJSs affected are also recognised as priorities for levelling up under other government policy initiatives.
3. Recognition that some of the data used to calculate target grants, when updated, may change the target allocations. New Census data for example may change target allocations for those YJSs whose population estimates are expected to change, potentially reducing distance to target.

Ultimately, the move from current to target allocations should be informed by an implementation transition policy to be determined by the YJB and which is beyond the scope of this RGFF.

9 Recommendations

Key Recommendations from the RGFF are as follows:

1. **A New Formula:** The YJB consider setting grant funding allocation targets for YJSs in England and Wales using a new formula using published data from the ONS. YJSs target allocations would be determined by the overall grant distributed as an amount per resident child aged 10-17, adjusted based on measures of geographical variation in Child Poverty (Income Deprivation Affecting Children – IDACI), and Housing Overcrowding.

   Rationale: Current allocations bear little or no relation to variation in need for YJS. The new formula would be fairer and more equitable and would target funding to where it is most needed.

2. **Implementation Transition**: The YJB consider developing an implementation transition policy to smooth the transition from current allocations to target allocations, in recognition that it takes time for local areas to adjust to changes in funding, and that the targets themselves may change as new data become available.

   Rationale: Given the number of YJSs affected by moving from the current allocations to the new target allocations, the scale of the impact for some YJS, and in the absence of a significant, permanent increase in funding, there may be a need for the YJB to smooth the transition from the current allocations to the target allocations. The “Implementation Transition” policy may simply be to move all YJSs to target allocations from 2023 onwards. Alternatively, the YJB may decide to phase the transition and potentially provide interim protection for those YJSs that are areas of relatively high need but are nonetheless facing reductions in their share of the grant.

3. **New Process**: The YJB consider developing a policy for updates of the formula. YJSs target allocations could be updated in line with updated mid-year population estimates, IDACI and Housing Overcrowding metrics from ONS. There could also be a periodic review of the formula itself as new evidence, new measures and data sources become available.

   Rationale: These changes which result from applying the new target allocations are, in part, a reflection of the historical nature of the current allocations and that they have not been refreshed for many years.

   It would be relatively simple, to use the latest population, IDACI and Housing Overcrowding data to refresh the grant funding target allocations. These data are relatively stable (the 2021 Census adjustments notwithstanding). If would not require any new analysis.

   This RGFF has also been relatively comprehensive and has developed a robust conceptual framework. The RGFF should not need to be repeated for some

considerable time. However, it should be feasible to periodically refresh the regression analysis if new evidence comes to light. If the new measures included in Recommendation 4 become available (the measure of relative need and an England and Wales measure of relative sparsity), a new regression could result in additional needs drivers being identified for inclusion in the formula. These issues could be considered by a small standing committee on resource allocation which would meet annually to consider whether there is a compelling case for review.

4. **New Measures:** The YJB consider working with partner organisations to develop new measures, or to encourage them to develop new measures, including:

   - a comprehensive measure(s) of the range of YJSs support including diversion, support to FTEs and corrections.

   Rationale: The use of a measure which provided a comprehensive overview of YJSs need could enable a more comprehensive statistical analysis of variation in need and might result in the inclusion of a wider set of needs drivers.

   - comparable measures of variation in **population sparsity** for YJSs across both England and Wales.

   Rationale: The use of a measure of sparsity has been shown to be potentially significant driver of need when included using an English metric for English data. If data were available for both England and Wales, this could be shown to be a significant factor in explaining variation in needs for YJSs and hence included in the formula.

   - an area cost adjustment index relevant to YJSs across both England and Wales.

   Rationale: This RGFF took no account of unavoidable variation in costs of labour, or time spent travelling in areas with large geographies. If the Area Cost Adjustment for English local authorities were available for England and Wales, elements of it would be directly applicable to YJSs and could be incorporated directly into the formula. Such an index could be used to adjust the needs weighted populations to reflect unavoidable differences in unit costs.

10 Appendix 1: Rapid Evidence Assessment

10.1 Summary

A Rapid Evidence Assessment (REA) was undertaken to review funding formulae used to allocate resources for public services. The REA question was: **What are the main features of a successful funding formula?**

Five electronic databases were searched, covering the period 2008-present, building on a literature review for the Independent Commission on Funding and Finance for Wales covering the years 1979 – 2008. Following application of inclusion and exclusion criteria, an initial total of 248 records were reduced to a final set of 40 for full text review which, in turn, reduced the final list for inclusion to 23 (in addition to the original Independent Commission on Funding and Finance for Wales covering the years 1979 – 2008). Much of the literature related to healthcare systems. A full reference list can be found in Annex 3.

The evidence is clear that there is no perfect funding formula design, with formulae only able to offer 'rough justice' (Bevan, 2009). However, the literature does identify the core components of the more effective funding formulae, the advantages and disadvantages of different formulae indicators, and criteria for sourcing data. It also addresses key questions such as the objectives of funding formulae and the trade-offs between simplicity and complexity, and stability and responsiveness.

Keywords: youth justice, youth criminal justice, youth offending/er, funding, funding formula, resource allocation, public sector.

10.2 Background

The debate around funding formulae for the allocation of public services resources became prominent following the Report of the RAWP in 1976, which was commissioned to explore how to secure equal opportunity of access for people at equal risk in the NHS (Bevan, 2009). Since then, various government departments have allocated funding to local bodies and service providers using funding formulae which aim to take account of a population's needs and risks and the costs of service providers. Over the last 45 years, despite formulae becoming more complex, there continue to be problems in attempting to account for needs, risks, and costs.

10.3 Search Strategy

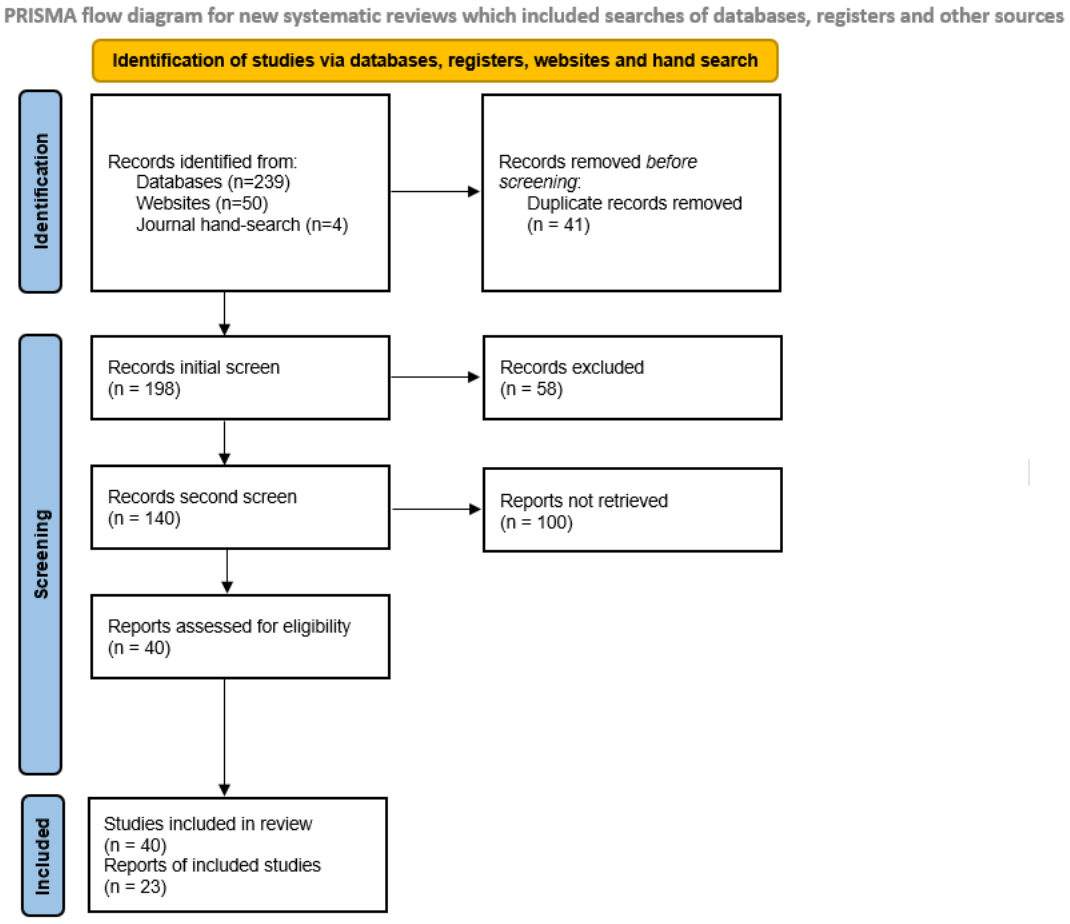
Two REA searches were undertaken using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guide (Page et al, 2021). One focused specifically on youth justice and the other the wider public sector.

The following databases were searched in May 2022: Criminal Justice Abstracts with Full Text, Business Source Corporate Plus (both via EBSCOhost Research Databases), Criminology Collection, CanLit (both via ProQuest), and Social Policy and Practice (via Ovid). It was restricted to papers available in the English language, and published since 2008.

The searches were undertaken by an information specialist using a combination of free text terms (searching the title and abstract) and relevant controlled vocabulary headings customised for each database, as well as advanced search syntax (truncation, Boolean logic AND/OR, and proximity searching) to ensure all relevant studies were identified. The search terms included the following themes, with synonyms to describe each: youth justice and funding formula, and public sector and funding formula. Detailed tables of the scoping searches carried out to determine the final search strategy, and of the final search results are in Annex 1 and 2.

Supplementary website searching was conducted for both searches, and relevant journals were hand searched for youth justice. References were imported into EndNote reference software and duplicates were removed.

Figure A1_1: PRISMA Flow Diagram



10.4 Previous Reviews

A literature review was published in 2008 by economics and policy consultancy LE Wales for the Independent Commission on Funding and Finance for Wales, and reviewed the literature to that date on needs-based formulae. It provides a comprehensive overview of the key issues associated with constructing and using needs-based formulae.

This review seeks to report the key findings of the LE review and bring them up to date by reviewing the literature from 2008 to May 2022.

10.5 Search Results

The literature search identified a significant number of papers on the use of funding formulae in relation to the health systems both in the UK and internationally. Aside from these, there was one relevant article related to UK education funding formulae and one related to devolving the custody budget for England and Wales.

The studies identified for inclusion in the present review are presented alongside the findings from LE Wales (2008) in three main areas:

- objectives and purpose of needs-based formulae
- strengths and weaknesses of needs-based approaches
- issues in the construction and application of needs-based formulae.

10.5.1 Objectives and purpose of needs-based formulae

Hewson et al's (2016) detailed review of both the police and Fire and Rescue Service funding formulae states that a vital component of any formula is a clear statement of its aims, including what services and what priorities the funder believes will be delivered (and how) and what inequalities the formula is trying to correct. Others (Johnston et al, 2022; NAO, 2011) concur that clearly defined, specific, prioritised and time-bound objectives and a rationale of the funding formula are key, and should be decided before any technical aspects of a model are considered.

There is no clear and recent statement of the UK government's objectives for funding allocation, however there are several different ways in which the objectives of distribution mechanisms can be formulated in practice. LE Wales (2008) suggest that the key issue is whether the distribution is aimed at equalisation of service outcomes across regions or at equalisation of regional capacities to provide services. In those countries where the lower tier of government has significant autonomy in the way it chooses to spend, then the objective is more likely to be the equalisation of regional capacities to provide services since, in this case, equalisation of service outcomes is a less realistic goal (LE Wales, 2008).

Achieving equity may not always be consistent with efficiency, particularly when the aim is horizontal equalisation (LE Wales, 2008), or addressing differences in needs. For example, ensuring the same level of services in rural and urban areas is costly,

because rural services often cost more to deliver. Smith (2008) agrees that equity can be pursued up to a point, but that it must be moderated by considerations of cost and efficiency.

10.5.2 Desirable characteristics of needs-based funding formula

LE Wales (2008) sets out some desirable characteristics of needs-based formulae, which are added to by Agyemang (2010) and Asthana (2014). These are set out in Table A1_2 below.

Table A1_2: Desirable Characteristics of a Needs-Based Formula

LE Wales (2008)	Agyemang (2010) citing Levacic and Ross (1999)	Asthana (2014)
• Simple and transparent • Objectively based – not subject to partisan political influence • Stable – does not lead to large and frequent fluctuations in allocations • Based on data from independent and objective sources that cannot be subject to manipulation • Does not provide perverse incentives for service recipients	• Effectiveness – amounts given should reflect resources needed • Efficiency – should be encouraged by the formula • Equity – reflecting cost differentials for service providers • Integrity – based on indicators that cannot be easily manipulated • Administrative costs – easy to calculate and maintain • Accountability and transparency – readily understood by stakeholders to ensure accountability to policy makers	• A strong underlying logic • Supports policy objectives • Technically robust • Resistant to manipulation by providers and budget holders • Transparent and comprehensible

10.6 Strengths and Weaknesses of Needs-based Approaches

LE Wales's review of needs-based formulae (2008) does not consider simple per capita approaches to funding, such as the Barnett Formula. However, elsewhere Smith (2008) notes that per capita formulae can only work when differences in expected service use between areas are not substantial and where the areas only have small differences in socio-economic profile. The requirement for a needs-based element is well documented (McLean et al, 2008; House of Commons Library, 2021).

Needs-based approaches use population criteria adjusted to reflect need and cost factors (Johnston et al, 2022). Their effectiveness depends on how successfully capitation payments are adjusted to account for variations in local population statistics (Smith, 2008) however in terms of health care systems, they are considered a 'valuable policy lever' (Johnston et al, 2022) to promote equity in healthcare outcomes. An overview of the different needs-based approaches discussed in the literature is set out below.

10.7 Regression Approaches

This approach was the one referred to most often in the literature and is the most used approach in the UK (Asthana, 2014). Regression approaches use regression analysis to identify past variations in expenditure and service use (utilisation), using indicators of need for services that are objective and independent of service providers - such as deprivation. Additional factors that reflect regional differences in the unit costs of providing services are also included. (LE Wales, 2008).

The main criticism of regression approaches is that past expenditure or utilisation for example are not always a good proxy for need, particularly where expenditure can be affected by other factors including budget constraints and political factors (LE Wales, 2008; Johnston et al, 2022). Asthana and Gibson (2008) suggest that, in the context of healthcare, deriving needs from past utilisation is 'highly questionable', because it pre-supposes that historical patterns of service uptake by different care groups are either appropriate or can be adjusted to better reflect a population's underlying needs – both of which they consider inadequate. Jones (2017) and NAO (2011) agree that using utilisation as a proxy for need can be problematic because use of service is influenced by issues of access, yet it remains the preferred practical compromise in the absence of less imperfect, comprehensive measures of the need for resources (Jones, 2017).

Other disadvantages of a regression approach are that it is often undertaken at large geographical levels which fails to capture local relationships between dependent variables and needs indicators (Anselmi et al, 2015). In addition, whilst the stability provided by regression approaches is an advantage, it can also mean that formulae are less able to adapt or react to changed circumstances (NAO, 2011; Smith, 2008). For example, analysis of the Older People's Social Care funding formula in the UK (CCN, 2015) found that the formula was not being revised to take account of older

people's current and projected population growth, leading to significant under-funding. Asthana (2014) warns that regression models also often include a reliance on 'data ransacking', where possible datasets are used with little or no consideration of their appropriateness as an indicator. Regression approaches are also seen to have inherent circularity – perpetuating existing patterns of service provision precisely because the allocation of resources, to different types of population, will reflect the use they make of services that are already differentially available (Asthana, 2014, LE Wales, 2008).

Other needs-based approaches discussed in the literature are set out in Table A1_3 below.

Table A1_3: Other Needs-Based Approaches

Multi-level modelling (LE Wales, 2008)	Standard cost approach (LE Wales, 2008)	Regression approaches using outcome measures (LE Wales, 2008)	Bottom-up modelling (LE Wales, 2008
This approach attempts to address some of the problems of using expenditure as the dependent variable by using small-area information to capture some of the local relationships missed by a large-area regressive approach. A disadvantage of this approach is that obtaining data at this level can be costly and time consuming.	Used in Australia, Sweden, and Japan, this sees population measures combined with a standard cost of providing services per capita, derived using judgements about needs indicators and weights. LE Wales (2008) caution that this as a complex and opaque process.	These approaches seek to assess what resources are needed to achieve centrally-set outcome targets, but LE Wales (2008) suggest that being able to agree what these targets might be is unlikely.	Used in the Netherlands, this is an iterative process involving a detailed examination of costs which aims to understand the exogenous factors that explain expenditure variations used for regression approaches. Using an example of domestic care for older people, this would go down to the level of understanding the hours a care provider provides per client and the

	level of qualification of the care worker. Bevan (2009) suggests that this would likely identify costs for what was needed that would well exceed the funding available and would therefore lead to 'rationing' decisions.

10.8 Issues in the Construction of the Formulae

10.8.1 Simplicity and Transparency vs Accuracy

A simple formula is seen as more democratic and equitable since it is easy for people to understand (LE Wales, 2008) and for parliamentarians or members of the public to scrutinise (Smith, 2008; Asthana, 2009). This, therefore, makes it more difficult for politicians to manipulate. Hewson et al (2016) looked at two case studies where spreadsheets of funding formulae were published, and found that 'considerable' work was needed to decipher them, concluding that transparency requires an audience that understands the policy assumptions, data sources, and methodology behind a formula. McLean et al (2008) agree that needs assessments which are too 'fine-grained' can be opaque and obscure the 'procedural fairness' which is essential to legitimacy and sustainability. Furthermore, increasing the complexity of a funding formula makes finding accurate and consistent data more difficult and increases the risk of technical error (Hewson et al, 2016) and chance correlations (Hewson et al, 2009). However, the literature also recognises that a level of complexity is necessary to deliver a more accurate formula which effectively targets need (LE Wales, 2008; Smith, 2008; Agyemang, 2010).

The formulae which are considered most transparent are per capita formulae with a small number of needs-based variables (LE Wales, 2008). This means a weaker link between indicators and expenditure needs because of the aggregate, higher level of the formula, but provides more flexibility in the choice of indicators which makes it easier to ensure good and consistent data can be sourced (LE Wales, 2008).

Consultation with service providers as part of the development of funding formula, including the choice of variables and the weights attached to them, can improve transparency, and help service providers accept the funding outcome (Agyemang, 2010). However, consultation with providers may also lead them to use the language of needs to put forward their own judgements about user demands or 'wants' that may not be that well-informed (Agyemang, 2010).

10.8.2 Finding Good Quality Data

Bevan (2009) states that funding formula require 'sound estimates' of population for which the Census is the only reliable source, however in their analysis of funding for Fire and Rescue Services, Hewson et al (2009) highlight that Census data does not capture people coming in and out of the area daily. This is important to the provision of response services however it is unlikely that this will be a significant factor for YJSs.

LE Wales (2008) sets out some desirable criteria for needs indicators to be added to population data, in addition to Johnson (2022), who looked at health care variables across six countries, and Smith (2008). These are set out below in Table A1_4.

Across all, the importance of data not being collected at local authority or service-provider level – and therefore not open to manipulation – is key, since local reporting creates obvious incentives for local populations to maximise the populations on which their revenues are based (Smith, 2008). For example, Bevan (2009) found that where lists of patients registered with GPs were used in NHS funding formulae this led to 'list inflation'. McLean et al (2008) and the NAO (2011) advocate for the establishment of advisory bodies to oversee choice of indicators and their incorporation into funding formula. Because the use of any statistical data involves a judgement as to what data sources to use and which techniques of analysis to adopt, and interpretations of data may differ (LE Wales, 2008), formal approaches and models for statistical analysis that can be scrutinised are also seen as useful.

Table A1_4: Desirable Criteria for Needs Indicators

LE Wales (2008)	Smith (2008)	Johnson (2022)
• Correlated with the target measure and with justification of how the indicator is expected to relate to the level of need. • Free from local authority influence • Measured consistently across local authorities • Frequency of the indicator update should be considered • Stable • Should not provide an incentive for local authorities to behave perversely to secure a higher grant allocation	• Feasible, with low administrative cost • Consistently, reliably, verifiably, and universally recorded • Not vulnerable to manipulation or fraud • Legitimate predictors of expended health service expenditure • Encourage efficient delivery of services and be free from perverse incentives • Respect confidentiality requirements • Parsimonious and plausible, thereby promoting transparency and accountability	• Technical robustness • Objectivity • Flexibility • Parsimony and plausibility • Clarity of contribution of indicators • Reliable of data • Free from perverse incentives • Durability and stability • Updateable

10.8.3 Identifying Indicators to capture Need

Johnston et al (2022) state that there is no standardised approach to needs-based funding formulae and therefore no consensus about the indicators that should be included in the modelling, or which analytical approach should be employed. Penno et al (2013) reviewed seven healthcare systems with needs-based formulae and found seven core components used to capture need: age, sex, socio-economic status, ethnicity, geography, and clinical and epidemiological measures. Foley (2018) found that area-based deprivation measures can be used to effectively target health resources based on social risk factors. Clifton's (2016) exploration of the devolution of the custody budget using data on offenders suggests that deprivation weightings should be considered. Asthana et al (2009) state that the distribution of English local government funding for social services, police, fire, and environmental services is all strongly weighted for deprivation. Public Health England's (2015) research into the causes of offending behaviour in young people states that poverty and socioeconomic status is one of the most important determinants of health and criminal behaviour, and that there is a recognised link between offending and homelessness (Public Health England, 2015)

However, Hewson et al (2009) warn that there is an inherent urban bias in the conceptualisation of poverty and vulnerability and that existing deprivation measures may not adequately capture rural poverty, which does not correspond so closely with benefits data. Asthana et al (2009) suggest that using deprivation as synonymous with service need may work better for funding formulae which have equity of outcome as the goal rather than equity of access. Undue emphasis on deprivation should also not obscure the needs associated with other legitimate influences such as demography (Asthana et al, 2009). Indeed, Asthana et al (2009) found the extent to which 'shire areas' receive less than urban areas because of deprivation weightings to be 'excessive', making public expenditure clearly targeted at urban England.

In 2013 deprivation was restored to the funding formula for local Care Commissioning Groups alongside population growth and the effects of an aging population, on the basis that the main drivers of health inequalities are not lack of healthcare but the conditions in which people are born, grow, live, work, and age (Limb, 2013).

10.8.4 Calculating Costs

Smith (2008) suggests that if there are inescapable variations in the input process used by local areas, it is important that this is reflected in funding formulae. Some funding formulae, such as those for the Fire and Rescue Service and the police, aim do this by making an Area Cost Adjustment (ACA) which takes account of differences in wages and business rates across the country (Hewson et al, 2009). However, Elliott et al (2021) warn of the dangers of trying to include cost of service delivery in modelling, stating that unless data on variables like these is up to date formulae can become skewed, with some areas being overcompensated and others undercompensated because of changing wage differentials between regions. Indeed, Asthana (2014) suggests that the police formula is one example of this,

where the inclusion of costs of delivering services has heavily favoured London and the South East because they have the highest wages, neglecting the fact that rural forces may need to employ a greater proportion of their staff on higher grades. Asthana (2014) proports that rural areas are systematically disadvantaged by the police formula.

Hewson et al (2009) believe that it is common to suggest that sparsity is not adequately modelled in resource allocation models. However, Penno et al (2013) found that in sparsely populated jurisdictions such as New Zealand, rurality was the central factor in determining cost of supply in the health funding formula, with attempts made to offset the additional costs that arise from providing services to remote areas with small populations. There, health plans receive a pecuniary subsidy for material differences in fixed operational costs related to accessing services. Penno et al (2013) also highlight the example of Scotland, where rurality drove the development of an ‘excess costs of supply’ index which reflects the relative costs of supply across the country, allowing for differential costs of providing services in urban and rural areas.

10.8.5 Calculating Unmet Need

Regression approaches use expenditure or past utilisation for example as proxies for need, though more recent models have attempted to account for ‘unmet need’ on the basis that some social groups under-utilise services relative to their needs (Asthana and Gibson, 2008). Penno et al (2013) suggests that since ‘unmet need’ is concealed by prevailing utilisation patterns, the implication is that formulae must engage in some form of normative comparison between sub-populations if equity of outcomes is to be achieved. This may be through policy-based measures targeting those populations, or by trying to identify quantifiable, demonstrable, and plausible indicators of unmet need (Penno et al, 2013). Asthana and Gibson (2008) describe the difficulties of this, finding that an assumption that under-utilisation of services was overwhelmingly concentrated in deprived, or minority ethnic groups led to an underestimation of the unmet need of older, less deprived groups. Penno et al warn (2013) that any adjustment for unmet need must be based on clear definitions and robust methodology.

10.8.6 Political Interference – adjustments to Formula Outcomes

Political input can occur in the development of formulae but can also come in the way adjustments are made to formulae outcomes. Many formulae have ‘damping’ mechanisms in place to limit the impact of changes in formula funding or significant swings in expenditure allocations year on year (Smith, 2008). However, these provide an opportunity for political interference where ‘losers’ are overcompensated (LE Wales, 2008). In relation to the police funding formula, Asthana (2014) states that damping has created ‘greater division than consensus’ about how police are funded. Smith (2008) suggests that the political ramifications of any geographic funding choice can be acute in parliamentary democracies.

However, Allers and Ishemoi’s (2011) analysis of the move from discretionary methods of grant allocation to allocation formulae in Tanzania found that allocation formulae did not prevent the malapportionment that took place under the previous

system. This was because grant allocation was not ruled by the formulae, but by politicians who could simply override the results.

10.9 Annex 1: Scoping Search

10.9.1 Places to search:

10.9.1.1 Databases:

- EBSCO Criminal Justice Abstracts [OA]
- ProQuest Criminology Collection (includes Criminal Justice Database and National Criminal Justice Reference Service (NCJRS) Abstracts Database) [UoN]
- ProQuest EconLit [UoN]
- Ovid Social Policy and Practice [OA]
- EBSCO Business Source Corporate Plus [OA]

10.9.1.2 Websites:

- Google scholar
- Children and Young People's Centre for Justice (Scottish): https://www.cycj.org.uk/
- Department of Justice (Irish): https://www.justice-ni.gov.uk/topics/youth-justice
- Justice (London): https://justice.org.uk/our-work/publications/
- GOV.Scot: https://www.gov.scot/policies/youth-justice/
- Youth Justice journal: https://journals.sagepub.com/home/yjj
- Youth Violence and Juvenile Justice journal: https://journals.sagepub.com/home/yvja
- Policing & Society journal: https://www.tandfonline.com/toc/gpas20/current
- Youth Justice Board (English): https://www.gov.uk/government/organisations/youth-justice-board-for-england-and-wales

10.9.2 Terms:

Search 1

"youth justice" OR "youth criminal justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*"

AND

funding OR financing OR "financial backing"

AND

formula OR formulae OR equity OR weighting OR "fair share" OR "resource allocat*" OR "resource efficiency"

Search 2

(clinical OR health* OR hospital OR medical OR care OR domiciliary OR nursing) N2 (employee OR personnel OR professional* OR staff OR worker*)
(social OR critical OR school* OR education* OR support OR advocacy OR rehabilitation OR youth OR reablement OR teach*) N2 (employee OR personnel OR professional* OR staff OR worker*)
anesthetist* OR dentist* OR doctor* OR nurse* OR midwife OR midwives OR "birth* attendant*" OR pharmacist* OR physician* OR therapist*
public N2 (sector* OR service* OR domain* OR enterprise*)
"personal assistant*" OR "care coordinator*" OR "care co-ordinator*" OR "child* protection officer*" OR "safeguard* officer*"

teacher* OR "university lecturer*" OR administrator* OR secretar* OR "administrative assistant*" OR "admin assistant*"
police* OR "law enforcement" OR firefighter* OR fireman* OR paramedic* OR "emergency responder*" OR "emergency medical technician*" OR "emergency care assistant*" OR "ambulance personnel*"
"state sector*" OR education OR "emergency service*" OR "refuse collection" OR "social care" OR "civil service*" OR "diplomatic service*" OR "armed force*" OR "bank of England" OR "british broadcasting corporation" OR BBC OR "national health service" OR NHS OR military OR navy
AND
funding OR financing OR "financial backing"
AND
formula OR formulae OR equity OR weighting OR "fair share" OR "resource allocat*" OR "resource efficiency"

Google Scholar

"youth justice" AND "funding formula" – 176 results
"youth justice" AND "funding formulae" – 33 results
"youth justice" AND "funding equity" – 5 results
"youth justice" AND "resource allocat*" – 1,170 results
"youth justice" AND "fair share" – 334 results
"youth justice" AND "resource efficiency" – 43 results

"public sector" AND "funding formula" – 6,020 results
"public sector" AND "funding formulae" – 1,160 results
"public sector" AND "funding equity" – 812 results
"public sector" AND "resource allocation" (since 2010) – 28,100 results
"public sector" AND "fair share" (since 2010) – 15,300 results
"public sector" AND "resource efficiency" (since 2010) – 12,400 results

10.10 Annex 2: Search Report

10.10.1 Search 1: Youth Justice

Table A1_5: Databases Searched

Name of Database	Platform	Date searched	# of results
Criminal Justice Abstracts with Full Text	EBSCOhost Research Databases	26th May 2022	2
Business Source Corporate Plus	EBSCOhost Research Databases	26th May 2022	1
Criminology Collection	ProQuest	26th May 2022	15
EconLit	ProQuest	26th May 2022	0
Social Policy and Practice	Ovid	26th May 2022	1
		Total number of results	19
		Duplicates found	5
		Results after duplicates removed	14

Table A1_6: Website Searching

Name of website	Link	Date searched	# new results
Google Scholar		26th May 2022	17
Children and Young People's Centre for Justice	https://www.cycj.org.uk/	26th May 2022	0
Department of Justice	https://www.justice-ni.gov.uk/	26th May 2022	0
Justice	https://justice.org.uk/our-work/publications/	26th May 2022	0
GOV.Scot	https://www.gov.scot/	26th May 2022	0
Youth Justice Board Resource Hub	https://yjresourcehub.uk/	26th May 2022	0
GOV.UK	https://www.gov.uk/	26th May 2022	0
United States Department of Justice	https://www.justice.gov/	26th May 2022	0
Total number of results			17

Table A1_7: Journal Hand Searching

Name of Database	Link	Date searched	# new results

Youth Justice Journal	https://journals.sagepub.com/home/yjj	26th May 2022	0
Youth Violence and Juvenile Justice Journal	https://journals.sagepub.com/home/yvj	26th May 2022	0
Policy & Society Journal	https://www.tandfonline.com/toc/rpas20/current	26th May 2022	0
Total number of results			0

Table A1_8: Search Results Total

Search	# of results
Database search	14
Website search	17
Journal hand searching	0
Total # of results	**31**

10.10.2 Search 2: Public Sector

Table A1_9: Database Searching

Name of Database	Platform	Date searched	# of results
Criminal Justice Abstracts with Full Text	EBSCOhost Research Databases	26th May 2022	4
Business Source Corporate Plus	EBSCOhost Research Databases	26th May 2022	177
Criminology Collection	ProQuest (Includes Criminal Justice Database and National Criminal Justice Reference Service (NCJRS) Abstracts Database)	26th May 2022	4
EconLit	ProQuest	26th May 2022	22
Social Policy and Practice	Ovid	26th May 2022	13
		Total number of results	220
		Duplicates found	36
		Results after duplicates removed	184

Table A1_10: Website Searching

Name of website	Link	Date searched	# of new results
Google Scholar		26th May 2022	29
		Total number of results	29

Table A1_11: Search Results Total

Search	# of results
Database search	184
Website search	29
Total # of results	213

10.10.3 Search history for databases for published literature

Platform and database: EBSCOhost Research Databases Criminal Justice Abstracts with Full Text

Date searched: 26-05-2022

Table A1_12: Searches

#	Search term(s)	Result(s)
S1	TI ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice") OR AB ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice") OR SU ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice")	46,262
S2	TI (funding OR finance OR "financial backing") OR AB (funding OR finance OR "financial backing") OR SU (funding OR finance OR "financial backing")	19,025
S3	TI (formula OR formulae) OR AB (formula OR formulae) OR SU (formula OR formulae)	1,387
S4	S1 AND S2 AND S3	2
S4	S1 AND S2 AND S3 Limiters - Publication Date: 20080101-20221231	2

#	Search term(s)	Result(s)
S1	TI (public N2 (sector* OR service* OR domain* OR enterprise* OR health)) OR AB (public N2 (sector* OR service* OR domain* OR enterprise* OR health)) OR SU (public N2 (sector* OR service* OR domain* OR enterprise* OR health))	17,556
S2	TI ("state sector*" OR healthcare OR "health care" OR "emergency service*") OR AB ("state sector*" OR healthcare OR "health care" OR "emergency service*") OR SU ("state sector*" OR healthcare OR "health care" OR "emergency service*")	21,029
S3	S1 OR S2	36,039
S4	TI (funding OR finance OR "financial backing") OR AB (funding OR finance OR "financial backing") OR SU (funding OR finance OR "financial backing")	19,025
S5	TI (formula OR formulae) OR AB (formula OR formulae) OR SU (formula OR formulae)	1,387
S6	S3 AND S4 AND S5	6
S7	S3 AND S4 AND S5 Limiters - Publication Date: 20080101-20221231	4

Platform and database: EBSCOhost Research Databases Business Source Corporate Plus
Date searched: 26-05-2022

#	Search term(s)	Result(s)
S1	TI ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice") OR AB ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice") OR SU ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice") OR KW ("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice")	39,173
S2	DE "CRIMINAL justice system"	12,991
S3	S1 OR S2	39,173
S4	TI (funding OR finance OR "financial backing") OR AB (funding OR finance OR "financial backing") OR SU (funding OR finance OR "financial backing") OR KW (funding OR finance OR "financial backing")	2,224,016
S5	TI (formula OR formulae) OR AB (formula OR formulae) OR SU (formula OR formulae) OR KW (formula OR formulae)	136,264
S6	S3 AND S4 AND S5	10
S7	S1 AND S2 AND S3 Limiters - Publication Date: 20080101-20221231	1

#	Search term(s)	Result(s)
S1	TI (public N2 (sector* OR service* OR domain* OR enterprise* OR health)) OR AB (public N2 (sector* OR service* OR domain* OR enterprise* OR health)) OR SU (public N2 (sector* OR service* OR domain* OR enterprise* OR health)) OR KW (public N2 (sector* OR service* OR domain* OR enterprise* OR health))	343,625
S2	TI ("state sector*" OR healthcare OR "health care" OR "emergency service*") OR AB ("state sector*" OR healthcare OR "health care" OR "emergency service*") OR SU ("state sector*" OR healthcare OR "health care" OR "emergency service*") OR KW ("state sector*" OR healthcare OR "health care" OR "emergency service*")	779,244
S3	DE "PUBLIC sector"	19,564
S3	S1 OR S2 OR S3	1,090,761
S4	TI (funding OR finance OR "financial backing") OR AB (funding OR finance OR "financial backing") OR SU (funding OR finance OR "financial backing") OR KW (funding OR finance OR "financial backing")	2,224,016
S5	TI (formula OR formulae) OR AB (formula OR formulae) OR SU (formula OR formulae) OR KW (formula OR formulae)	136,264
S6	S3 AND S4 AND S5	265
S7	S3 AND S4 AND S5 Limiters - Publication Date: 20080101-20221231	177

Platform and database: Ovid Social Policy and Practice
Date searched: 26-05-2022

#	Search term(s)	Result(s)
1	("youth justice" or "youth offend*" or "young offend*" or "juvenile delinquen*" or "criminal justice").ab,hw,ti.	10104
2	(funding or finance or "financial backing").ab,hw,ti.	23023
3	(formula or formulae).ab,hw,ti.	404
4	1 and 2 and 3	3
5	limit 4 to yr="2008 -Current"	1

#	Search term(s)	Result(s)
1	(public adj3 (sector* or service* or domain* or enterprise* or health)).ab,hw,ti.	16835
2	("state sector*" or healthcare or "health care" or "emergency service*").ab,hw,ti.	23597
3	1 or 2	38553
4	(funding or finance or "financial backing").ab,hw,ti.	23597
5	(formula or formulae).ab,hw,ti.	404
6	3 and 4 and 5	34
7	limit 6 to yr="2008 -Current"	13

Platform and database: ProQuest Criminology Collection (Includes Criminal Justice Database and National Criminal Justice Reference Service (NCJRS) Abstracts Database)
Date searched: 26-05-2022

#	Search term(s)	Result(s)
S1	ti,ab("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice")	54,651
S2	MAINSUBJECT.EXACT("Criminal justice")	20,699
S3	S1 OR S2	67,262
S4	ti,ab(funding OR finance OR "financial backing")	18,102
S5	ti,ab(formula OR formulae)	3,286
S6	S3 AND S4 AND S5	91
5	S3 AND S4 AND S5 Narrowed by:Entered date: 2008 - 2022	15

#	Search term(s)	Result(s)
S1	ti,ab(public NEAR/2 (sector* OR service* OR domain* OR enterprise* OR health))	16,281
S2	ti,ab("state sector*" OR healthcare OR "health care" OR "emergency service*")	17,956
S3	MAINSUBJECT.EXACT("Public enterprise") OR MAINSUBJECT.EXACT("Public sector")	1,940
S4	S1 OR S2 OR S3	33,685
S5	ti,ab(funding OR finance OR "financial backing")	18,102
S6	ti,ab(formula OR formulae)	3,286
S7	S4 AND S5 AND S6	11
S8	S3 AND S4 AND S5	4

	Narrowed by:Entered date: 2008 - 2022	

Platform and database: ProQuest EconLit
Date searched: 26-05-2022

#	Search term(s)	Result(s)
S1	ti,ab("youth justice" OR "youth offend*" OR "young offend*" OR "juvenile delinquen*" OR "criminal justice")	697
S2	ti,ab(funding OR finance OR "financial backing")	53,923
S3	ti,ab(formula OR formulae)	7,473
S4	S1 AND S2 AND S3	0

#	Search term(s)	Result(s)
S1	ti,ab(public NEAR/2 (sector* OR service* OR domain* OR enterprise* OR health))	24,339
S2	ti,ab("state sector*" OR healthcare OR "health care" OR "emergency service*")	16,779
S3	S1 OR S2	39,148
S4	ti,ab(funding OR finance OR "financial backing")	53,923
S5	ti,ab(formula OR formulae)	7,473
S6	S3 AND S4 AND S5	44
5	S3 AND S4 AND S5 Narrowed by:Entered date: 2008 - 2022	22

Website: Google Scholar
Date searched: 26-05-2022

Exclude patients and citations, first 100 results searched, published since 2008

"funding formula" AND "youth justice"
"funding formulae" AND "youth justice"
"funding formula" AND "criminal justice"
"funding formulae" AND criminal justice"
"funding formula" AND "youth offending"
"funding formulae" AND "youth offending"

"funding formula" AND "public sector"
"funding formulae" AND "public sector"
"funding formula" AND "public service"
"funding formulae" AND "public service"
"funding formula" AND healthcare
"funding formulae" AND healthcare

Total records kept (after checking for duplicates)
Youth Justice: 17
Public Sector: 29

Terms used for website searching and journal hand searching
"funding formula"
"funding formulae"
"formula funding"

10.11 Annex 3: References

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11 Appendix 2: Review of Data Sources

11.1 Availability of Data

11.1.1 Society

Table A2_1: Society

Risk Factor	Metric	Data Source
Deprivation	Index of Multiple Deprivation (IMD) Score	IMD
High Unemployment	Employment Score (rate) IMD	IMD - multiple sources used to create the indicator
Homelessness or Poor Housing	Barriers to Housing and Services Score IMD	IMD - multiple sources used to create the indicator
Homelessness or Poor Housing	Homelessness indicator (rate per 1000 households)	Ministry of Communities and Local Government - used in IMD
Homelessness or Poor Housing	Owner-occupation affordability (component of housing affordability indicator)	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents. - Used in IMD
Homelessness or Poor Housing	Private rental affordability (component of housing affordability indicator)	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents. - Used in IMD
Homelessness or Poor Housing	Housing affordability indicator	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents. - Used in IMD
Homelessness or Poor Housing	Housing in poor condition indicator	Estimated from the English Housing Survey, 2015 - Used in IMD
Homelessness or Poor Housing	Houses without central heating indicator	Estimated from the English Housing Survey, 2015 - Used in IMD
Difficulty in Accessing Services	Barriers to Housing and Services Score IMD	IMD - multiple sources used to create the indicator
Difficulty in Accessing Services	Road distance to a post office indicator (km) The indicator is defined as an average road distance measured in kilometres.	Post Office Ltd - used in IMD

Risk Factor	Metric	Data Source
Difficulty in Accessing Services	Road distance to a primary school indicator (km) The indicator is defined as an average road distance measured in kilometres.	Department for Education Edubase- used in IMD
Difficulty in Accessing Services	Road distance to general store or supermarket indicator (km). The indicator is defined as an average road distance measured in kilometres.	Ordnance Survey - used in IMD
Difficulty in Accessing Services	Road distance to a GP surgery indicator (km) The indicator is defined as an average road distance measured in kilometres.	NHS Digital - used in IMD
Culture of Violence, norms and values which accept, normalise, and glorify violence	None found	NA
Discrimination	None found	NA
Opportunities of Valued Social Roles	None found	NA
Geo Variation in Sparsity	Population Density	Mid-year (30 June) population density of Lower layer Super Output Areas (LSOAs) in England and Wales based on estimates of the usual resident population. The analysis used a population weighted average population density for a Local Authority instead of the authority's overall population density, because population density is a neighbourhood effect.[16]

11.1.2 Community

Table A2_2: Community

Risk factor	Metric	Data source

[16] See for example Manley, David. van Ham, Maarten. Bailey, Nick. Simpson, Ludi. and Maclennan, Duncan. (2013). Neighbourhood Effects or Neighbourhood Based Problems?: A Policy Context.

Unsafe or Violent Communities	Crime Score IMD	IMD
Insufficient Infrastructure for the satisfaction of needs and interests of young people/ Lack of possibilities for recreation	Travel time, destination, and origin indicators for town centres by mode of travel,	Department for Transport
Sense of Belonging and Connectedness	None found	NA
Community Cohesion	None found	NA
Opportunities for Sports and Hobbies	None found	NA
Opportunities for Sports and Hobbies	None found	NA

11.1.3 Individual

Table A2_3: Individual

Risk Factor	Metric	Data Source
Alcohol or Substance misuse	Estimates of opiate and crack cocaine use prevalence	Public Health England
Alcohol or Substance misuse	Admission episodes for alcohol-specific conditions	Calculated by OHID: Population Health Analysis (PHA) team using data from NHS Digital - Hospital Episode Statistics (HES) and Office for National Statistics (ONS) - Mid Year Population Estimates.
Alcohol or Substance misuse	Admission episodes for alcohol-specific conditions - Under 18s	Calculated by OHID: Population Health Analysis (PHA) team using data from NHS Digital - Hospital Episode Statistics (HES) and Office for National Statistics (ONS) - Mid Year Population Estimates.
Alcohol or Substance misuse	Alcohol-related mortality	Calculated by OHID: Population Health Analysis (PHA) team from the Office for National Statistics (ONS) Annual Death Extract Public Health Mortality File and ONS Mid-Year Population Estimates.
Alcohol or Substance misuse	Alcohol-specific mortality	Calculated by OHID: Population Health Analysis (PHA) team from the Office for National Statistics (ONS) Annual Death Extract Public Health Mortality

Risk Factor	Metric	Data Source
		File and ONS Mid-Year Population Estimates.
Alcohol or Substance misuse	Number in treatment at specialist alcohol misuse services	National Drug Treatment Monitoring System, Alcohol, and drug treatment statistics: young people
School Readiness	School readiness: percentage of children achieving a good level of development at the end of Reception	Department for Education (DfE), Early years foundation stage profile results
Behavioural and Learning difficulty	Pupils with special educational needs (SEN): % of school pupils with special educational needs	Department for Education special educational needs statistics
Alcohol or Substance misuse	Smoking prevalence at age 15 - current smokers (WAY survey)	What About YOUth (WAY) survey, 2014/15
Perinatal Trauma	PTSD in perinatal period: Estimated number of women	Births, deaths, and marriages, ONS (original publication not found, sourced from “Fingertips” https://fingertips.phe.org.uk/)
Genetic or Biological	None found	NA
Early Malnutrition	None found	NA
Traumatic Brain Injury	None found	NA
Good Communication Skills	None found	NA
Healthy Social Relationships	None found	NA
Genetic or Biological	None found	NA
Early Malnutrition	None found	NA
Traumatic Brain Injury	None found	NA
Good Communication Skills	None found	NA
Healthy Social Relationships	None found	NA

11.1.4 Relationships

Table A2_4: Relationships

Risk Factor	Metric	Data Source
Low Income	Income Score (rate) IMD	IMD - multiple sources used to create the indicator
Low Income	Income Deprivation Affecting Children Index (IDACI) numerator	Department for Work and Pensions, Her Majesty's Revenue and Customs and the Home Office - used in IMD score
Low Income	Income Deprivation Affecting Older People Index (IDAOPI) numerator	Department for Work and Pensions, Her Majesty's Revenue and Customs and the Home Office – used in IMD score
Family Size	Household overcrowding indicator	Office for National Statistics - used in IMD score
Mental Illness	Mood and anxiety disorders indicator - The mood and anxiety disorders indicator is a broad measure of levels of mental ill health in the local population.	Health and Social Care Information Centre; Department for Work and Pensions; Office for National Statistics - IMD score
Abuse	Hospital admissions because of self-harm	Hospital Episode Statistics (original publication not found, sourced from fingertips)
Abuse/Neglect	Children subject to a child protection plan with initial category of neglect: rate per 10,000 children aged under 18	Children in need statistics
Abuse/Neglect	Children who started to be looked after, due to abuse or neglect rate per 10,000 children aged under 18	Department for Education (original publication not found, sourced from fingertips)
Abuse/Neglect	Children in need due to abuse or neglect rate per 10,000 children aged under 18 years	Children in need statistics
Poor Parenting	Children who started to be looked after due to family stress or dysfunction or absent	Department for Education

Risk Factor	Metric	Data Source
	parenting: rate per 10,000 children aged under 18	
Household Offending	First time entrants to the youth justice system	Figures calculated by OHID's Population Health Analysis team using crime data supplied by the MoJ and population data supplied by Office for National Statistics
Family Violence	None found	NA
Family Breakdown	None found	NA
Frequent Shared Activities with Parents	None found	NA
Family Violence	None found	NA
Family Breakdown	None found	NA
Frequent Shared Activities with Parents	None found	NA

11.2 Critical Appraisal

Table A2_5: Critical Appraisal

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
Index of Multiple Deprivation (IMD) Score	IMD	LSOA	Yes	2019	High	Yes
Employment Score (rate) IMD	IMD - multiple sources used to create the indicator	LSOA	No	2019	High	Yes - England and Wales IMD Combined for 2019
Barriers to	IMD - multiple	LSOA	No	2019	High	No - different

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
Housing and Services Score IMD	sources used to create the indicator					measures used in Wales
Homelessness Indicator (rate per 1000 households)	Ministry of Communities and Local Government - used in IMD	LSOA	No	2019	High	No
Owner-Occupation Affordability (component of housing affordability indicator)	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents. - Used in IMD	LSOA	No	2019	High	No
Private Rental Affordability (component of housing affordability indicator)	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents. - Used in IMD	LSOA	No	2019	High	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
Housing Affordability Indicator	Estimated primarily from the Family Resources Survey, Land Registry house prices, and Valuation Office Agency market rents - Used in IMD	LSOA	No	2019	High	No
Housing in Poor Condition Indicator	Estimated from the English Housing Survey, 2015 - Used in IMD	LSOA	No	2019	High	No - different measures used in Wales
Houses without Central Heating Indicator	Estimated from the English Housing Survey, 2015 - Used in IMD	LSOA	No	2019	High	No
Barriers to Housing and Services Score IMD	IMD - multiple sources used to create the indicator	LSOA	No	2019	High	No - different measures used in Wales
Road Distance to a Post Office Indicator (km) - the indicator is defined	Post Office Ltd - used in IMD	LSOA	No	2019	High	No - different measures used in Wales

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
as an average road distance measured in kilometres						
Road Distance to a Primary School Indicator (km) - the indicator is defined as an average road distance measured in kilometres	Department for Education Edubase- used in IMD	LSOA	No	2019	High	No - different measures used in Wales
Road Distance to General Store or Supermarket Indicator (km) - the indicator is defined as an average road distance measured in kilometres.	Ordnance Survey - used in IMD	LSOA	No	2019	High	No - different measures used in Wales
Road Distance to a GP Surgery Indicator	NHS Digital - used in IMD	LSOA	No	2019	High	No - different measures used in Wales

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
(km) - the indicator is defined as an average road distance measured in kilometres						
Crime Score IMD	IMD	LSOA	Yes	2019	High	Yes
Travel Time, Destination and Origin Indicators for town centres by mode of travel	Department for Transport	LSOA	No	2021	High	No
Income Score (rate) IMD	IMD - multiple sources used to create the indicator	LSOA	No	2019	High	Yes - England and Wales IMD Combined for 2019
Income Deprivation Affecting Children Index (IDACI) numerator	Department for Work and Pensions, Her Majesty's Revenue and Customs and the Home Office – used in IMD score	LSOA	No	2019	High	No - different measures used in Wales
Income Deprivati	Department for	LSOA	No	2019	High	No - different

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
on Affecting Older People Index (IDAOPI) numerator	Work and Pensions, Her Majesty's Revenue and Customs and the Home Office – used in IMD score					measures used in Wales
Household Overcrowding Indicator	Office for National Statistics - used in IMD score	LSOA	No	2019	High	No - different measures used in Wales
Mood and Anxiety Disorders Indicator - the mood and anxiety disorders indicator is a broad measure of levels of mental ill health in the local population	Health and Social Care Information Centre; Department for Work and Pensions; Office for National Statistics - IMD score	LSOA	No	2019	High	No - different measures used in Wales
Hospital Admissions because of self-harm	Hospital Episode Statistics (original publication not found, sourced from fingertips)	LA	No	2021	High	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
Children subject to a child protection plan with initial category of neglect: rate per 10,000 children aged under 18	Children in need statistics	LA	Yes	2018	Medium	No
Children who started to be looked after due to abuse or neglect rate per 10,000 children aged under 18	Department for Education (original publication not found, sourced from fingertips)	LA	Yes	2018	Medium	No
Children in need due to abuse or neglect rate per 10,000 children aged under 18 years	Children in need statistics	LA	Yes	2018	Medium	No
Children who started to be looked after due to family stress or dysfunction or absent parenting:	Department for Education	LA	Yes	2018	Medium	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
rate per 10,000 children aged under 18						
First time entrants to the youth justice system	Figures calculated by OHID's Population Health Analysis team using crime data supplied by the MoJ and population data supplied by Office for National Statistics	LA	Yes	2020	High	No
Estimates of opiate and crack cocaine use prevalence	Public Health England	LA	Yes	2019	High	No
Admission episodes for alcohol-specific conditions	Calculated by OHID: Population Health Analysis (PHA) team using data from NHS Digital - Hospital Episode Statistics (HES)	LA	No	2021	High	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
	and Office for National Statistics (ONS) - Mid Year Population Estimates					
Admission episodes for alcohol-specific conditions - Under 18s	Calculated by OHID: Population Health Analysis (PHA) team using data from NHS Digital - Hospital Episode Statistics (HES) and Office for National Statistics (ONS) - Mid Year Population Estimates.	LA	Yes	2021	High	No
Alcohol-related Mortality	Calculated by OHID: Population Health Analysis (PHA) team from the Office for National Statistics (ONS) Annual	LA	No	2019	High	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
	Death Extract Public Health Mortality File and ONS Mid-Year Population Estimates					
Alcohol-specific Mortality	Calculated by OHID: Population Health Analysis (PHA) team from the Office for National Statistics (ONS) Annual Death Extract Public Health Mortality File and ONS Mid-Year Population Estimates	LA	No	2019	High	No
Number in treatment at specialist alcohol misuse services	National Drug Treatment Monitoring System, Alcohol, and drug treatment statistics: young people	LA	Yes	2021	High	No

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
School readiness: percentage of children achieving a good level of development at the end of Reception	Department for Education (DfE), Early years foundation stage profile results	LA	No	2019	High	No
Pupils with special educational needs (SEN): % of school pupils with special educational needs	Department for Education special educational needs statistics	LA	No	2018	Medium	No
Smoking prevalence at age 15 - current smokers (WAY survey)	What About YOUth (WAY) survey, 2014/15	LA	Yes	2018	Medium	No
PTSD in perinatal period: Estimated number of women	Births, deaths, and marriages, ONS (original publication not found, sourced from fingertips)	LA	No	2018	Medium	No
Population Density	Mid-year (30 June) populatio	LSOA	No	2021	High	Yes

Measure	Data Source	Lowest Geography Level	Can a YJSs influence?	Last published	Likely to be updated?	England and Wales
	n density of Lower layer Super Output Areas (LSOAs) in England and Wales based on estimates of the usual resident population					

12 Appendix 3: Regression Analysis

12.1 Introduction

This technical appendix provides a detailed description of the variables used in the regression model, the themes, process of calculation and data sources. It also explains the policies adopted for data exclusions. It provides a description of the approach taken for the regression and the rationale for key choices made regarding methodology. It includes a description of regression analysis of the England and Wales model and a similar analysis for an expanded English dataset. It concludes with recommendations for dependent variables to include in the Grant Funding Formula.

12.2 Dependent and independent variables used in needs regression analysis

12.2.1 Dependent variables

The main theme used for assessing the patterns of the drivers of needs is the extent to which First Time Entry (FTE) among those aged 10 to 17 varies by YJSs area.

There are three key aspects to consider when deciding which form of FTE metric should be used as the dependent variable.

1. taking account of the **scale of the population** being considered

By using the variables for “FTEs rates” the size of the population of 10 to 17 year olds, is already considered as expressed in hundreds of thousands. This enables a “weighted capitation” approach, since the FTE rate proxies the relative level of risk / need in each area, and the absolute level of risk / need is equal to the FTE rate multiplied by the scale of the youth population.

2. the **time period** for use in the analysis

There are various ways in which the FTE metric could be shaped to different time periods, three key alternatives have been used for the analysis:

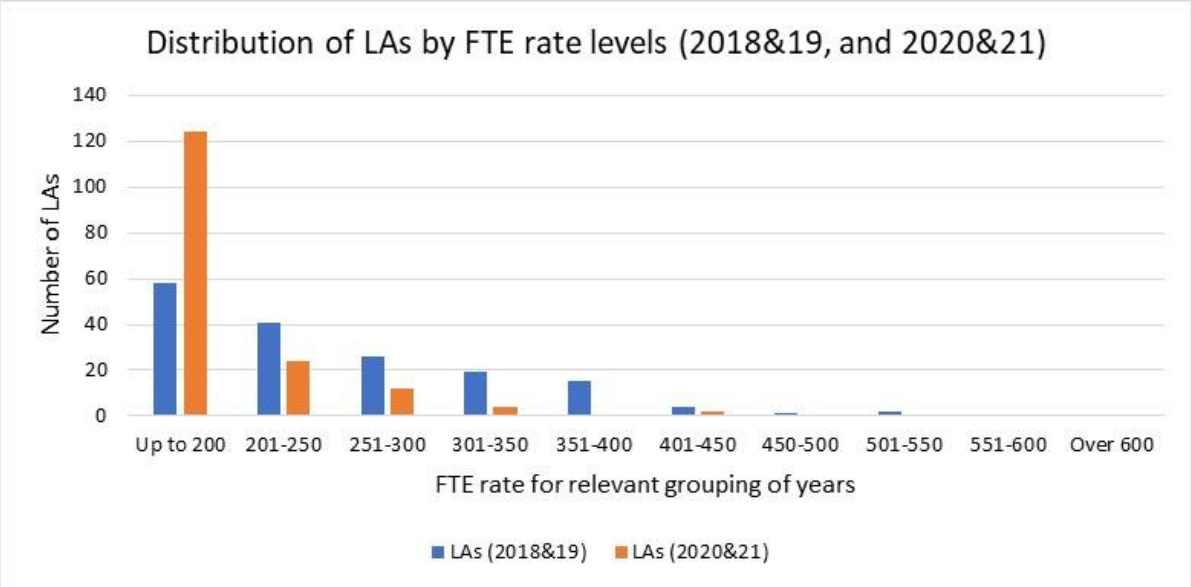
- FTE rate averaged (with a weight of 50% : 50%) over 2020 and 2021
- FTE rate averaged (with a weight of 50% : 50%) over 2018 and 2019
- FTE rate 2019

As can be seen in the Figure below, there has been a substantial difference in the pattern of distribution of FTE rates among local authorities, with a much wider range

of FTE rates prior to the covid pandemic. For example, ONS (2020)[17] reports a 32% decrease in total recorded crime between April and May of 2020, much of which related to "significant falls in theft offences, particularly domestic burglary and other theft of personal property", from which it concluded that the overall change "reflects the increase in time people spent at home during the lockdown period, a reduction in opportunities for theft in public spaces and the closure of the night-time economy".

Since such lockdown measures were highly exceptional, **data immediately prior to the pandemic period (2018 and 2019) has been used as the baseline**, with the newer data (2020 and 2021) being reserved for sensitivity tests.

Figure A3_1: Distribution of LAs by FTE rate levels



A further sensitivity test has been deployed in relation to 2011 data, to check for the stability of the parameters on coefficients over a period in which the number of FTEs has fallen significantly.

3. whether or not to transform (re-shape) the metric by taking the natural log of the terms to fit a "**multiplicative" rather than "additive" model**. This would show if the relationship were curved instead of linear; by converting to logged values and tested using linear regression.

The approach taken to deriving natural log values was to use the log command in Stata, and so for the FTE rate period for 2018&19, the command given was: Generate LN_FTE_18_19 = Log (FTE_18_19), which calculated the (natural log) for the FTE_18_19 variable (which represents the 2018&19 FTE rate).

The same approach was also undertaken in relation to the log of the FTE rate for 2020&21 (for variable FTE_20_21) and FTE rate in 2019 (for variable FTE19).

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17 https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice/bulletins/coronavirusandcrimeinenglandandwales/august2020

12.2.2 Independent variables

Independent variables included the following for England and Wales:

Table A3_2: Independent variables for England and Wales

Driver	Indicator	Source
Low Income	Income domain score weighted to LA (UT)	IMD England and Wales Income
High Unemployment	Employment domain score weighted to LA (UT)	IMD England and Wales Employment
Low Income	IMD income measure relating to children (IDACI)	IMD England and Wales Income
Urbanicity	Population Density	National Statistics
Family Size	Overcrowding	IMD England and Wales Barriers to Housing and Services[18]

And the extended data set for England only:

Table A3_3: Independent variables for England only

Driver	Description	Source
Low Income	Income domain score weighted to LA (UT)	IMD domain scores
High Unemployment	Employment domain score weighted to LA (UT)	IMD domain scores
Homelessness or poor housing	Barriers to housing and services domain score weighted to LA (UT)	IMD domain scores
Poor housing	Living environment domain score weighted to LA (UT)	IMD domain scores
Deprivation	Education domain score weighted to LA (UT)	IMD domain scores
Difficulty in accessing services	Average distance to post office (km)	IMD underlying indicators
	Average distance to primary school (km)	IMD underlying indicators
	Average distance to general store / supermarket (km)	IMD underlying indicators
	Average distance to GP surgery (km)	IMD underlying indicators

[18] Note that these are defined slightly differently for England and Wales – see section 6.4.

Driver	Description	Source
Family size	Proportion of households classed as overcrowded weighted to LA (UT)	IMD underlying indicators
Homelessness or poor housing	Rate of acceptance for housing assistance weighted to LA (UT)	IMD underlying indicators
	Measure of inability to afford to enter owner-occupation of the private rental market weighted to LA (UT)	IMD underlying indicators
	Proportion of social and private homes that fail to meet the Decent Homes standard weighted to LA	IMD underlying indicators
	Proportion homes without central heating weighted to LA	IMD underlying indicators
School readiness	Proportion of young people not staying on in school or non-advanced education above age 16 weighted to LA	IMD underlying indicators
	Proportion of young people aged under 21 not entering higher education weighted to LA	IMD underlying indicators
Mental illness	Measure of the levels of mental ill health in the local population weighted to LA	IMD underlying indicators
Difficulty in accessing services	Average time in minutes to a town centre walking or by public transport	Journey times to town centre by LSOA 2019
Low income	IMD income measure relating to children	IMD domain scores
Urbanicity	Population density	National Statistics

In relation to population density, however, the square-root of population density values by local authority has also been included as an alternative potential driver for FTE rates. The rationale for doing so is that population density values lack an upper boundary (unlike other key variables that are assessed as proportions), and are significantly more variable than the other variables.

12.3 Data exclusions and estimates

Data from the following five local authorities was excluded from the regression analysis due to incomplete data being available – three in England (City of London, Isles of Scilly, Rutland), and two for Wales (Merthyr Tydfil and Monmouthshire).

Missing FTE rate data for local authorities was estimated based on three different types of calculations, depending on the data missing and potential for extrapolation:

1. No data available for 2020, but data is available for 2019 and 2021. Calculate as mid-way point between data for 2019 and 2021.
2. No data available for 2021, but data is available for 2020. 2021 rate estimated as England and Wales (E&W) (weighted) average 2021 ÷ E&W (weighted) average 2020 * LA rate 2020

3. Data is missing on the grounds of suppressed data due to low numbers of FTE for a given year, while other years are not affected by this issue. We have assumed a level of FTE of 9 (the most likely value given that is closest to other values in the area, while still being below the threshold level of 10), and then calculated the associated FTE rate.

Data from (a) Bournemouth, Christchurch, and Poole, and (b) Dorset was excluded on the grounds that the boundary change taking place between them in 2018 meant that the FTE rate for 2018&19 could not be calculated on a consistent basis.

The approach taken to specific local authorities for the given years is shown in the following Table:

Table A3_4: Approaches

	Approach 1	Approach 2	Approach 3
Bath and North East Somerset		√	
Bracknell Forest		√	
Ceredigion	√		
Isle of Anglesey	√		
North Tyneside	√		
Powys		√	√
Richmond-upon-Thames		√	
South Tyneside		√	
Vale of Glamorgan		√	

12.4 Data adjustments

The main issue considered here is the comparability of the *Housing Overcrowding* variable between England and Wales.

Although the two countries use the same ONS definition of overcrowding, England assesses overcrowding based on the proportion of households that it affects, while Wales assesses overcrowding based on the proportion of people that it affects. An adjustment to the reported figures for local authorities in Wales has been made to promote consistency between the two countries.

The underlying basis for such an adjustment is derived from a regression of Housing Overcrowding as explained by population density and dummy variable for whether the local authority was in Wales, which had the following results.

Table A3_5: Data adjustments

	Coefficients	*Standard Error*	*t Stat*
Constant	0.00485	0.0037	1.30
Population density	0.000018	0.0000006	32.52
Wales_LA	0.01367	0.0065	2.11

Note: for this regression, we reviewed the possible inclusion of data from City of London, Isles of Scilly, Merthyr Tydfil, Monmouthshire, and Rutland, as these have overcrowding and population density data available. However, a check for outliers by assessing "Studentized residuals" indicates that of these local authorities, the City of London and Isles of Scilly meet criteria for assessing outliers (with scores of 5.0 and 3.9 respectively), and so these two local authorities were excluded from the model.

This suggests that the difference in methodology between England and Wales does imply a slight difference in calculation of overcrowding. Other things being equal, Wales local authorities' figures are on average some 0.0137 higher than counterparts in England purely based on the difference in methodology.

The data for overcrowding for local authorities in Wales in the regression analysis and grant funding model have been adjusted accordingly, scaling the level down by a factor of 50% (to 0.00683) to reflect a suitable degree of caution in relation to applying the assessment (in line with advice provided on adjustments to cost data for different levels of robustness of evidence set out in the 2014 report "Cost benefit analysis guidance for local partnerships" by HM Treasury, Public Service Transformation Network and New Economy).

12.5 Approach to regression

12.5.1 Underpinning methodological approach

The most important choice relates to the choice of statistical approach to undertake. The evidence suggests three types of approach each with advantages and disadvantages, as summarised in the Table below.

Table A3_6

	Conceptual clarity	Transparent results	Robustness
Linear regression	xxx	xxx	xx
Multi-level regression	xx	xx	xxx
Factor analysis	xx	x	xx
Principal components analysis	xx	x	xx

Compared to linear regression, multi-level regression, factor analysis and principal components analysis are slightly less clear conceptually, as they introduce an additional level of complexity into their formulae.

Multi-level regression has less transparent results for the same reason, while factor analysis has a significant flaw in that while the clusters that it reports may have an intuitive interpretation, this is far from necessarily being the case. Multi-level regression does, however, have the advantage of being a more robust methodology than linear regression (and factor analysis), as it provides a more flexible assessment of possible interactions between variables.

Of the three potential candidates, linear regression was selected as the preferred approach, on the grounds that linear regression approaches are a relatively neutral technical procedure that is relatively transparent and provides stability in its assessments (compared to approaches such as factor analysis). In addition, it is the method referred to most in the literature, and is the most used approach in the UK according to the REA.

There are, however, disadvantages in that it assumes that variations in the drivers of need are independent of operational practices; and reported results can over-estimate the strength of the relationships if they have been derived from "data mining", in which a wide range of datasets have been included initially with little or no consideration of their appropriateness as an indicator. Since the data used for this regression are derived from evidence from the literature, this should not apply here.

12.6 Key parameters in methodology

12.6.1 Methodology for variable selection

In undertaking linear regression, a first consideration is how to decide on the inclusion of explanatory variables. Choices are to use:

- an automated basis, known as stepwise regression, that starts with the inclusion of all variables in the dataset and then reduces the included variables to those that are statistically significant; or
- judgement in checking against a theory of change in deciding which variables to include, and which to reject, though the final model should include only those that meet at least some standard of statistical robustness.

A "stepwise" regression analysis approach has been adopted for this RGFF on the grounds that, by allowing all variables that have passed a Theory of Change review to be included at the initial phase; this reduces the level of subjectivity in the choice of variables.

There are, nonetheless, potential flaws in stepwise regression, and several steps have therefore been taken to reduce these potential risks:

- by only including those variables that are evidenced from the literature the risk of "data mining" is substantially reduced
- where variables have provided counter-intuitive coefficients in terms of their effect on FTE rates, these have been checked to establish whether the coefficients still show the suggested relationships to FTE rates in a time series approach when

the correlation is contrasting the change in the variable and the change in FTE rates by local authority

- sensitivity tests have been undertaken to the check on whether it is possible to improve on the main regression model, by re-introducing variables on a one-off basis to test if they achieve statistical significance in the context of a much more streamlined set of variables than the regression initially undertaken with the full set of variables.

12.6.2 Statistical parameter for assessing robustness of relationship

The statistical parameter for assessing whether a given variable counts as "statistically significant" as a driver of FTE rates is a 95% confidence interval, which equates to a 5% significance level. By using a t-statistic, and the more stringent two-tailed assumption, variables are considered statistically significant when they have a t-statistic that is greater than 1.96 or lower than -1.96.

It is entirely possible to adopt both more rigorous standards (such as the 99% confidence interval) or less rigorous standards (such as the 90% confidence interval). However, a 95% confidence interval is the conventional approach – both in the literature[19], and in policy assessments[20]. The choice of a 95% confidence interval is therefore very much in line with standard practice.

12.7 Regression analysis of the England and Wales needs model

A stepwise regression was undertaken for six variants of the England and Wales needs model.
There are potential flaws in step-wise regression, and several steps have been taken to reduce these potential risks:

- by only including those variables that met a Theory of Change as per the literature review, the risk of "data mining" is substantially reduced
  where variables have given counter-intuitive coefficients in terms of their effect on FTE rates, these have been checked to see whether the coefficients still show the suggested relationships to FTE rates in a time series approach when the correlation is contrasting the change in the variable and the change in FTE rates by local authority.

The variants tested using the stepwise regression related to:

[19] see for instance Sim and Reid, 1999, "Statistical Inference by Confidence Intervals: Issues of Interpretation and Utilization", Physical Therapy, 79(2)
[20] a 95% confidence interval is used, for example, in "Reforms to the adult out of court disposals framework in the Police, Crime, Sentencing and Courts Bill: Equalities Impact Assessment", revised May 2022, Ministry of Justice (https://www.gov.uk/government/publications/police-crime-sentencing-and-courts-bill-2021-equality-statements/reforms-to-the-adult-out-of-court-disposals-framework-in-the-police-crime-sentencing-courts-bill-equalities-impact-assessment)

- the three approaches to time period for the FTE rate - average over 2018 and 2019; average over 2020 and 2021; and 2019

- the choice of unadjusted additive model, or log-adjusted multiplicative model.

The initial variables considered were:

- Employment domain of IMD 2019 and WIMD 2019
- Income domain of IMD 2019 and WIMD 2019
- IDACI score from IMD 2019 and WIMD 2019
- Housing overcrowding from IMD 2019 and WIMD 2019
- Population density (and in a sensitivity test the square root of population density was also examined).

The Table below summarises the models in terms of:

- "goodness of fit", as assessed by the R^2 statistic (both unadjusted and adjusted[21] versions), with a higher R^2 statistic representing a better fit
- conceptual clarity, in which a better model has coefficients for the variables that align well with the theory of change.

Table A3_7

		R-squared	Adj. R-squared	Conceptual	Variables
	2018 and 2019 data				
Model 1	FTE_18_19 (1)	0.445	0.438	Yes	IDACI, Overcrowding
Model 2	LN_FTE_18_19 (2)	0.446	0.439	Yes	IDACI Overcrowding

[21] The adjusted R-squared is a modified version of R-squared that adjusts for the number of predictors in a regression model. Adjusted $R^2 = 1 – [(1-R^2)*(n-1)/(n-k-1)]$, where n is the number of observations, and k is the number of predictor variables. R-squared will always rise with the increase of a variable, but adjusted R^2 only rises if the predictive power of the model is improved by the inclusion of that variable.

	2020 and 2021 data				
Model 3	FTE_20_21 (3)	0.374	0.363	Yes	IDACI Pop density Overcrowding
Model 4	LN_FTE_20_21 (4)	0.384	0.372	Yes	IDACI Pop density Overcrowding
	2019 data				
Model 5	FTE19 (5)	0.344	0.336	Yes	IDACI Overcrowding
Model 6	LN_FTE19 (6)	0.402	0.391	Yes	IDACI Pop density Overcrowding

For details of coefficients on variables, standard errors and t-statistics see **Annex 1**. Full reporting of the model is shown in **Annex 2**.

As can be seen, the population density variable passed statistical significance tests in relation to the 2020&2021 FTE rates, and to the Log of 2019 FTE rates, but not in relation to the equation for the 2018&2019 FTEs, which is the form of equation with the best "goodness of fit".

Note also that a test for multicollinearity for the preferred model using the variance inflation factor (VIF) methodology in Stata gives a score of 1.03. This is well below the level of 5 that indicates potentially severe correlation[22], and the results are not affected by multicollinearity.

The conclusion in relation to the above is that, of variables available at both England and Wales to required standards, the most suitable regression model is based on an unlogged function for 2018&19 FTE rates (model 1). It has a goodness-of-fit that is better than other timescales, while also not being affected by the covid pandemic. The R^2 values are similar for the logged and unlogged versions, however an unlogged relationship is selected as the preferred approach since it is easier to explain than a logged model.

The chosen approach has the following characteristics in linear regression:

Table A3_8

	Coefficient	Std. err.	T	P>|t|	[95% confidence interval]	
IDACI	825.9	89.5	9.23	0.000	649	1002
Overcrowding	353.9	68.6	5.16	0.000	218	489
Constant	54.6	17.5	3.11	0.002	20	89

One further test has been applied, which relates to heteroskedasticity, the risk that the distribution of the residuals does not fit the assumption of a Gaussian distribution

[22] Bobbitt, Z. (2020) "How to Test for Multicollinearity in Stata", Statology.org

(sometimes known as the Normal distribution). The Breusch–Pagan/Cook–Weisberg test for heteroskedasticity (H0: Constant variance) in relation to the main model has chi2(1) = 4.74, with probability > chi2 equal to 0.0295.

As this falls below the standard 5% significance level, this means that the null hypothesis of constant variance is not accepted. Instead, the “Robust standard errors” command in Stata is used, which adjusts for heteroscedasticity. The t-statistics and confidence interval are only slightly altered.

Table A3_9

	Coefficient	Robust Std. err.	t	P>|t|	[95% confidence interval]	
IDACI	825.9	92.0	8.97	0.000	644	1008
Overcrowding	353.9	60.5	5.85	0.000	234	473
Constant	54.6	14.6	3.73	0.000	26	84

(R-squared = 0.445, Adjusted R-squared is not available with this statistical approach)

12.7.1 Applying regression analysis to a wider data set for England

The calculations resulting from a stepwise regression process for the wider data set for England are shown in the table below.

The variables “distance to primary school”, and “population density” are statistically significant in some models, though on an inconsistent basis, and on a basis that affects the risk scores much less than IDACI and overcrowding. This leaves IDACI and overcrowding as the variables that are consistently seen as important in the regressions using England-only data, which is the same model as that observed using England and Wales data. It does, however, point to a useful agenda for future revamps of the needs formula, which would be to obtain travel / rurality data on a consistent basis for England and Wales.

Table A3_10

	R-squared	Adj. R-squared	Conceptual	Variables
Model 7 FTE rate (2018&19) (FTE_18_19)	0.517	0.507	Yes	IDACI Overcrowding Distance to primary school
Model 8 FTE rate (2020&21) (FTE_19_20)	0.464	0.449	Yes	IDACI Overcrowding, Population density Housing without central heating

Model 9 **LN_FTE_18_19** **(log of FTE_18_19)**	0.520	0.509	Yes	IDACI Overcrowding Distance to primary school
Model 10 **LN_FTE_rate_20_21** **(log of FTE_20_21)**	0.456	0.441	Yes	IDACI Overcrowding, Household without central heating Population density

12.8 Recommendations for prototype modelling

The RGFF recommendations are:

- dependent variables to be based on 2018&19 data, as not biased by covid pandemic
- dependent variables based on unlogged FTE rate, as easier to explain, while still providing a “goodness of fit” in line with the logged FTE rate models
- explanatory variables of IDACI (from IMD / WIMD score 2019) and Housing Overcrowding (derived as part of IMD / WIMD 2019 process) to be used as the key drivers for the prototype modelling.

12.9 Annex 1: Regression results for England and Wales models

The Table below presents coefficients, standard errors, and t-statistics for the different variants of the dependent variable using a standard linear regression approach.

Table A3_11: Model Summary

Model 1: FTE_18_19	Coefficients	Standard Error	t Stat	P>|t|
Model 1: FTE_18_19				
IDACI	825.94	89.46	9.23	0.000
Overcrowding (adjusted)	353.86	68.56	5.16	0.000
Constant	54.59	17.55	3.11	0.002
Model 2: LN_FTE_18_19				
Overcrowding (adjusted)	1.438	.292	4.93	0.000
IDACI	3.582	.381	9.41	0.000
Constant	4.619	.0747	61.84	0.000
Model 3: FTE_20_21				
Overcrowding (adjusted)	704.91	144.51	4.88	0.000
IDACI	470.18	70.01	6.72	0.000
Pop_density	-.00823	.00281	-2.92	0.004
Constant	52.176	13.51	3.86	0.000
Model 4: LN FTE_20_21				
IDACI	3.023	.416	7.27	0.000
Overcrowding (adjusted)	4.278	.859	4.98	0.000
Pop_density	-.0000532	.0000167	-3.18	0.002
Constant	4.337	.0803	53.99	0.000
Model 5: FTE_2019				
Overcrowding (adjusted)	331.92	81.90	4.05	0.000
IDACI	806.34	106.86	7.55	0.000
Constant	46.71	20.96	2.23	0.027
Model 6: LN FTE_2019				
Overcrowding (adjusted)	3.551	.941	3.77	0.000
IDACI	3.920	.456	8.60	0.000
Pop_density	-.0000423	.0000183	-2.31	0.022
Constant	4.488	.088	51.00	0.000

12.10 Annex 2 Full reporting for England and Wales preferred model

. stepwise, pr(.20): regress fte_18_19 income_domain idaci employment_domain pop_density overcrowding_adj

Wald test, begin with full model:

p = 0.874 >= 0.2000, removing income_domain

Table A3_12

Number of obs	=	166
F(4, 161)	=	38.68
Prob > F	=	0.0000
R-squared	=	0.4901
Adj R-squared	=	0.4774
Root MSE	=	63.402

Table A3_13

FTE_18_19	Coefficients	Standard Error	t Stat	P>|t|
Overcrowding adjusted	353.21	189.11	1.87	0.064
IDACI	1712.67	254.81	6.72	0.000
Employment domain	-1466.92	404.65	-3.63	0.000
Pop density	-.005037	.00356	-1.41	0.159
Constant	76.569	18.276	4.19	0.000

Note: Population density is not statistically significant, so excluded from next iteration of the regression model; Employment domain is statistically significant, but the results are counter-intuitive and is also excluded; there may be a complex relationship between this and other variables in the model.

Table A3_14

FTE_18_19	Coefficients	Standard Error	t Stat	P>|t|	[95% conf.	interval]
IDACI	825.94	89.46	9.23	0.000	649.3	1002.6
Overcrowding (adjusted)	353.86	68.56	5.16	0.000	218.47	489.25
Constant	54.59	17.55	3.11	0.002	19.95	89.24

. regress fte_18_19 idaci overcrowding_adj, vce(robust)

Number of obs	=	166
F(4, 161)	=	38.68
Prob > F		0.000
R-squared		0.490
Adj R-squared		0.477
Root MSE		63.40

FTE_18_19	Coefficients	Robust Standard Error	t Stat	P>|t|	[95% conf.	interval]
IDACI	825.94	92.04	8.97	0.000	644.2	1007.7
Overcrowding (adjusted)	353.86	60.50	5.85	0.000	234.4	473.3
Constant	54.59	14.65	3.73	0.000	25.7	83.5

12.11 Annex 3 Correlations of key variables

The Figures below show correlations between FTE rates (2018 and 2019 average) and the preferred model various key variables for local authorities in England and Wales.

Figure A3_15: IDACI

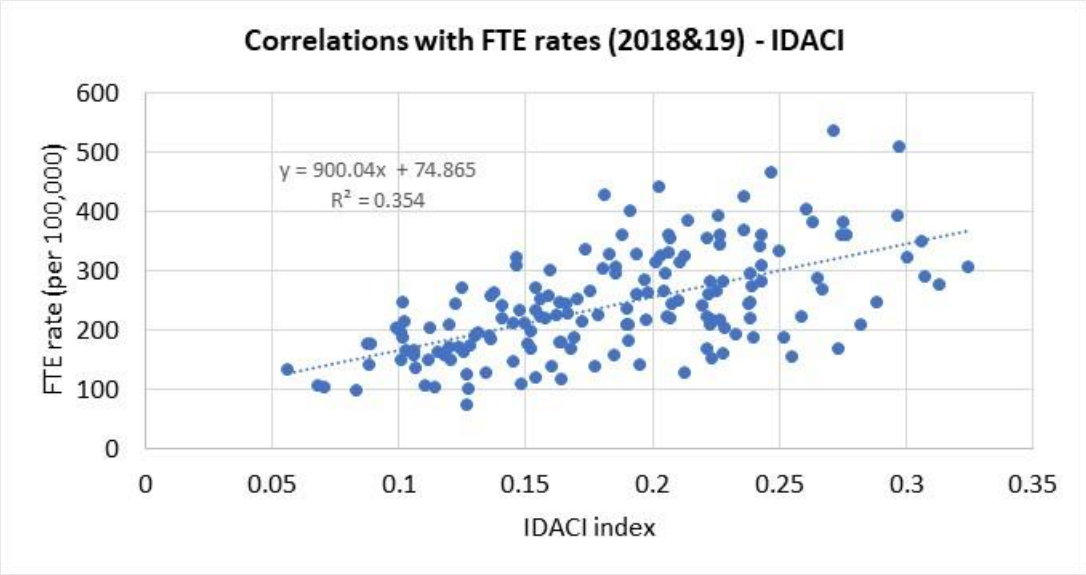


Figure A3_16: Income Deprivation

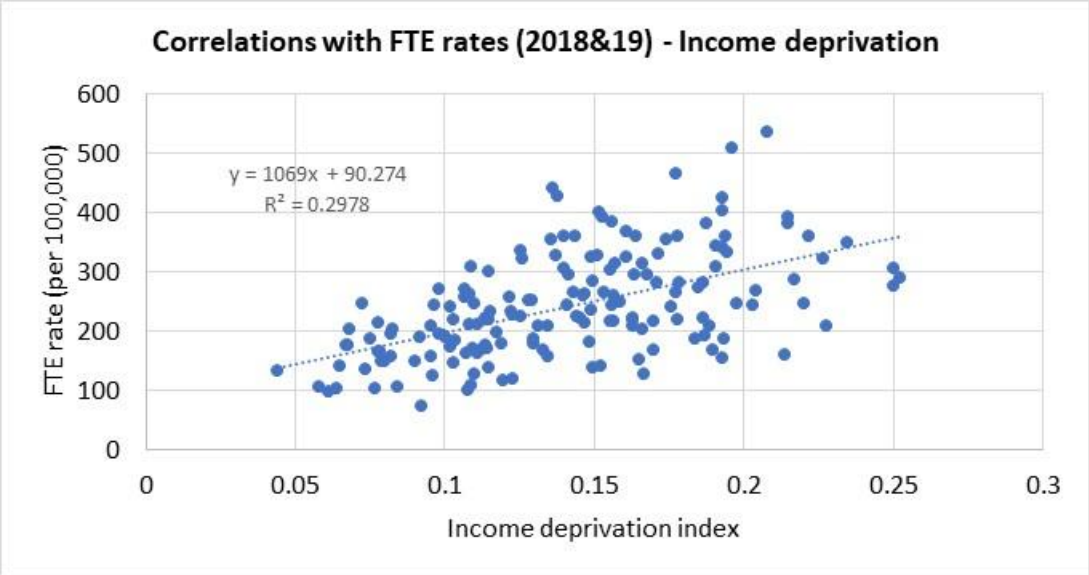


Figure A3_1617: Employment Deprivation

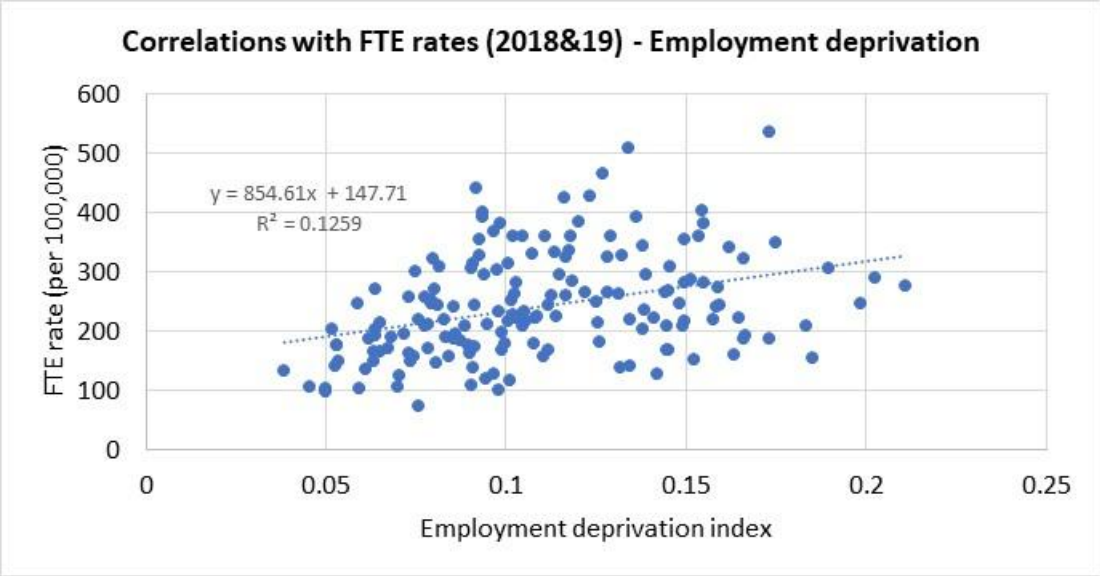


Figure A3_18: Overcrowding (adjusted)

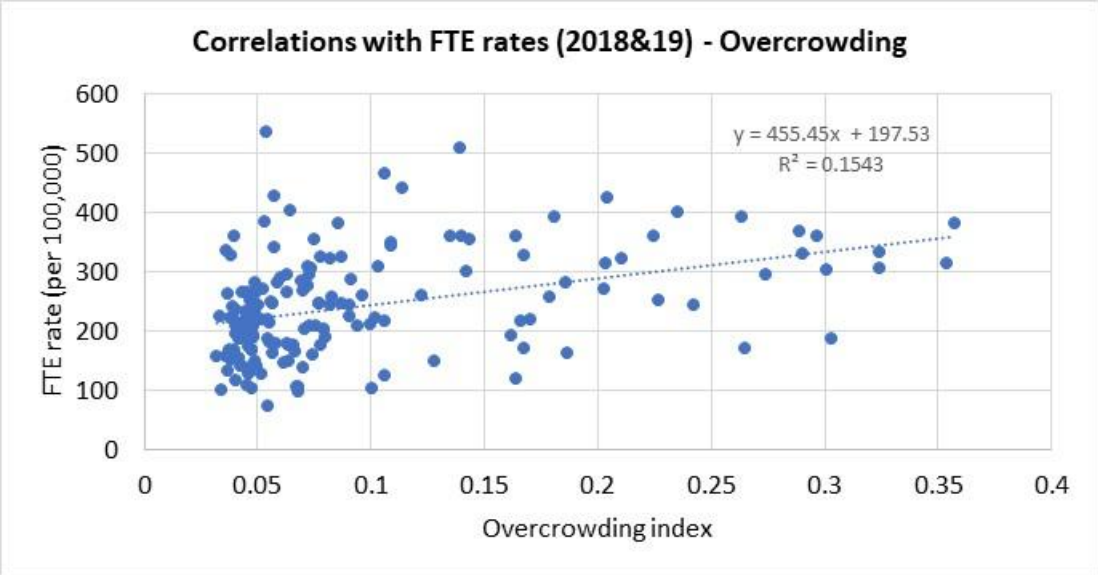
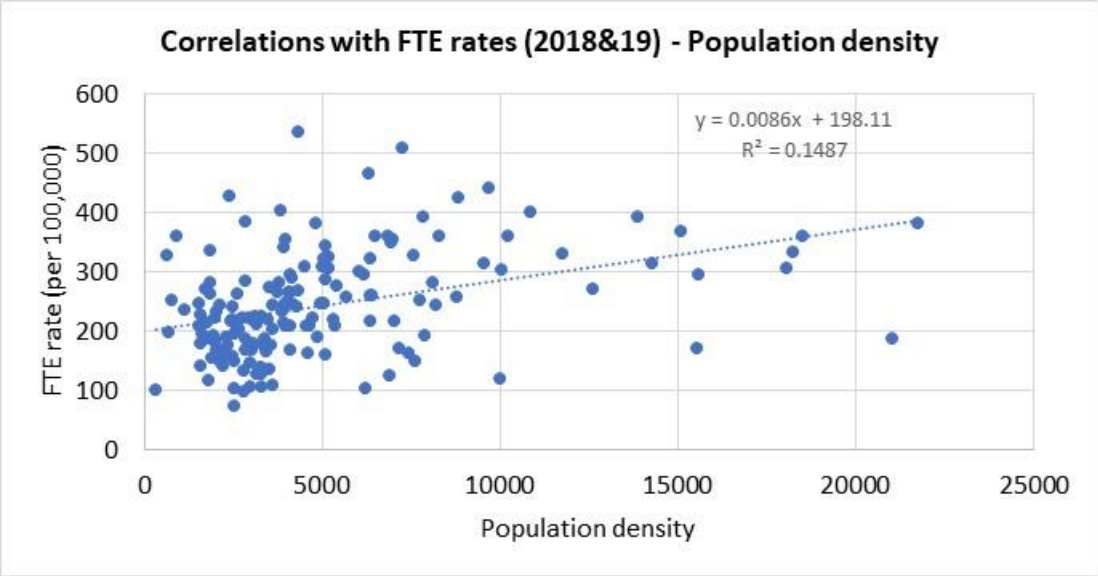


Figure A3_19: Population density



12.12 Annex 4 Sensitivity tests

12.12.1 Effectiveness of regression on absolute FTE numbers – without population variable

A regression on absolute FTE numbers for the average of 2018 and 2019 has been undertaken (using Stata) without the inclusion of a population variable as a dependent variable either explicitly or implicitly (such as by the use of FTE rates). Coefficients and t-statistics are as shown below.

Table A3_1720

	Coefficients	Standard Error	t Stat	P-value
Intercept	60.00	14.34	4.18	0.00
IDACI	48.37	74.06	0.65	0.52
Pop_density	-0.0060	0.0030	-2.00	0.05
Overcrowding(adjusted)	342.58	152.90	2.24	0.03

No. of local authorities = 165 (Bournemouth, Dorset, and Powys excluded due to missing data).

The R^2 is 0.032, and the adjusted R^2 is 0.014. In other words, it explains just 3% of the variance between absolute FTE numbers; a far worse fit than that associated with the set of regressions that take population size into account, which have R^2 of the order of 0.4 or so, explaining 40% or more of the variance between relative FTE rates.

12.12.2 Effectiveness of regression on absolute FTE numbers – with population variable

The next test related to the inclusion of a population variable (using Excel). A multiplicative approach is adopted to the regression, applying the equation: ln(FTE)= constant + B1*ln(pop) + B2*ln(overcrowd) + B3*ln(IDACI) [where ln standards for natural logarithm].

The reason that this equates to a multiplicative approach is that, by applying the exponential function to both sides, this translates to an equation in which the terms are multiplied together: FTE = exp(constant) * pop ^{B1} * overcrowd ^{B2} * IDACI ^{B3}.

A key issue is whether B1 (the coefficient on LN_pop_10_17) is close to 1, in which case the regression on full FTE data is equivalent to the regression on FTE rate data. The coefficients and t-statistics of the regression are shown below.

Table A3_18

	Coefficients	Standard Error	t Stat	P-value
Intercept	6.574	0.174	37.86	0.000
ln(Pop_10_17)	0.952	0.041	23.17	0.000
ln(Overcrowd)	0.115	0.041	2.82	0.005
ln(IDACI)	0.560	0.078	7.21	0.000

No. of local authorities = 165 (Bournemouth, Dorset, and Powys excluded due to missing data).

The R^2 is 0.78, and the adjusted R^2 is 0.77, which represents a far better fit than the equation without a population variable. The coefficient on the log of the youth population variable is close to one, and so we can interpret the equation as modelling FTE actual as: 716.16 * population (approx.) * overcrowd $^{0.115}$ * IDACI $^{0.560}$

12.12.3 Effect of retaining original Housing Overcrowding data

A regression has been undertaken that uses the original Housing Overcrowding data for Wales. It provides the coefficients set out below.

Table A3_19

FTE_18_19	Coefficients	Standard Error	t Stat	P>|t|
IDACI	823.94	89.70	9.19	0.000
Overcrowding	352.70	69.19	5.10	0.000
Constant	54.79	17.58	3.12	0.002

These coefficients are slightly different from those in the main equation; when these values are input into the draft Grant Funding Formula for local authorities in Wales, they imply an increase in target grant of the order of £0.04m, slightly under £2,000 per local authority.

12.12.4 Interaction between explanatory variables

The scope for building a better model that includes interaction terms between the explanatory variables has also been explored. After undertaking a stepwise regression process, a potential approach was identified, namely a model which had IDACI, an interaction term between IDACI and overcrowding, and overcrowding as the explanatory variables. The first two of these variables were statistically significant (at the 5% level), while the third was not. This model is rejected since it fails to meet the required statistical significance.

When the coefficients are placed into the Grant Funding Formula, they result in an average difference in allocations of the order of 4%.

12.12.5 Effect of 2011 coefficients on distribution

Finally, a regression using 2011 FTE rates on the explanatory variables of Child Poverty (IDACI) and Overcrowding has also been undertaken.

This analysis provided the following results:

Table A3_24

	Coefficient	Standard error	t-statistic	Probability
IDACI	2,011.2	306.4	6.56	0.000
Overcrowding	761.8	234.8	3.24	0.001
Constant	305.7	60.10	5.09	0.000

These coefficients are significantly higher than those observed in relation to the 2018&19 FTE rate data – which is unsurprising, given that they relate to prediction of FTE rates that were substantially higher in 2011 than in 2018&19.

The R-squared is 0.276, and the adjusted R^2 is 0.267, which are lower than those of the main model and indicate greater variation between fitted model and actual data.

The effect of replacing the coefficients of the main model by these coefficients in the prototype funding model is that the distributions for local authorities vary from +£141,000 to -£188,000 compared to the target allocations, though the interquartile range is from +£16,000 to -£19,000. The average normed proportional difference in funding levels is 5%, which suggests a good level of stability even over a long time period.

13 Appendix 4: Equality Impact Assessment

Equality Impact Assessment (EqIA):	
Proposal / Policy	RGFF for YJSs
Description	The current allocations of Grant Funding to Local YJSs is based on historical allocations. These historical allocations consolidate funds from different sources. These include formula-based distributions, separately for YJSs in England and Wales, originally intended to promote good practice, and funding awarded to prevailing projects and initiatives. In recent years, the funds have been combined and the values rolled-over each year. The data used for the original formula-based distributions has not been updated since 2011. The proposed new formula will distribute grant funds on a "fair shares" basis to reflect the size of the population covered by each youth justice service, and the risk that the population may require support from the youth justice service. The formula has been developed by independent advisors (Economics by Design Ltd, Get The Data Ltd, and Nottingham University, based on a review of the available evidence and a statistical analysis of published data. A move from current allocations to target allocations will involve a redistribution of resources in favour of those areas facing the highest levels of population aged 10-17, adjusted to reflect additional need for YJSs. The needs adjustments are based on measures of Child Poverty and Housing Overcrowding. This EqIA examines the impact of the RGFF on equity for populations with protected characteristics as set out in the Equality Act 2010.

Assessment of Impact					
Protected Characteristic	Draft Responses	Positive Impact	Minor Negative Impact	Major Negative Impact	No Impact
Age	The Youth Justice Service is focused on providing support to Children aged between 10 and 17. The new formula will improve the targeting of resources on this specific age				

	group. This is likely to have a positive impact on access to services for the target age group across the population of England and Wales.				
Disability	The current formula and the proposed new formula are neutral regarding disability. The adoption of the new formula is not expected to have any impact on children with disabilities, their risk of offending, and access to youth justice service.				✓
Gender Reassignment	The current formula and the proposed new formula are neutral regarding gender reassignment. The adoption of the new formula is not expected to have any impact on children commencing gender reassignment (legally permitted from aged 17), their risk of offending, and access to youth justice service.				✓
Marriage and Civil Partnership	The current formula and the proposed new formula are neutral regarding marriage and civil partnership. The adoption of the new formula is not expected to have any impact on the married or civil partnership population aged 16-17, their risk of offending, and access to youth justice service.				✓
Pregnancy and Maternity	The current formula and the proposed new formula are neutral regarding pregnancy and maternity. The adoption of the new formula is not expected to have any impact on pregnant children or				✓

	young parents, their risk of offending, and access to youth justice service.				
Race / Ethnicity	The current formula and the proposed new formula are neutral regarding race/ethnicity. Black children and children with a mixed ethnicity are over-represented in the Youth Justice Service. YJB research suggests that some of this is explained by the factors which influence offending generally (such as income deprivation). However, there are still differences which are not accounted for by these risk drivers. The proposed new formula will redistribute resources in favour of those areas with higher risk factors. This may impact on access to resources for black and mixed ethnicity children and hence reduce over-representation. The adoption of the new formula is not expected to have any negative impact on the treatment of children in terms of race/ethnicity, their risk of offending, and access to youth justice service.	✓			
Religion or Belief	The current formula and the proposed new formula are neutral regarding religion or belief. The adoption of the new formula is not expected to have any impact on children with				✓

	particular religions or beliefs, their risk of offending, and access to youth justice service.				
Gender	The current formula and the proposed new formula are neutral regarding gender. The adoption of the new formula is not expected to have any impact on children of a particular gender, their risk of offending, and access to youth justice service.				✓
Sexual Orientation	The current formula and the proposed new formula are neutral regarding sexual orientation. The adoption of the new formula is not expected to have any impact on children depending on their sexual orientation, their risk of offending, and access to youth justice service.				✓
Overall Assessment	The new formula should enable funds to be targeted on areas of greatest need. This is likely to improve the targeting of resources to the target age group (10-17) and to areas with the highest levels of risk factors in relation to offending. This should improve access to services for 10-17 year olds and for black and mixed ethnicity backgrounds insofar as they are more likely to live in areas of high deprivation.	✓			
Mitigating Actions	None Required				
Supporting Material	The current formula does not reflect variation in the size of the target population: children aged 10-17.				

	Statistical analysis shows that variation in population size is a very important driver of need for Youth Justice Services. The number of FTEs is strongly correlated with the size of the population aged 10-17, especially once additional drivers' variation in the "need" or "risk of need" for YJSs are taken into account (Child Poverty and Housing Overcrowding). The new formula will increase the targeting of limited resources to those areas with the highest number of children aged 10-17, adjusted for additional drivers of variation in need or risk of need for Youth Justice Services. Current per capita allocations range from £6.42 to £49.54. With the new formula, each Youth Justice Service will receive £15.5 per child aged 10-17, adjusted to reflect variation in rates of Child Poverty and Housing Overcrowding (2022-23 Grant). The new range is expected to be from £7.76 per child for the most affluent areas to £26.83 for the least affluent areas. Government research suggests that in 2019, people from all ethnic minority groups, except the Indian, Chinese, White Irish, and White Other groups, were more likely than White British people to live in the most overall deprived 10% of neighbourhoods in England. https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/people-living-in-deprived-neighbourhoods/latest Neither the current nor the new formula makes explicit reference to ethnicity as a factor which should be taken into account in setting grant funding allocations. The new formula will increase funding allocations for geographies which have higher rates of deprivation as measured by Child Poverty, and Housing Overcrowding. This should increase access to services for children from ethnic minority backgrounds.