

***Distribution Sub-Group (2023) Paper 08 - Recalibrating the Nursery and Primary School Services IBA***

**This discussion paper has been written by officials of the Welsh Government. Ministers have not had an opportunity to comment on the contents. Exemplifications of changes are provided simply to inform discussion by DSG members. They are not Welsh Government proposals or statements of Government policy for or against changes.**

**Recalibrating the Nursery and Primary School Services IBA**

**Summary**

1. This paper summarises the methodology and current situation regarding Recalibrating the Nursery and Primary School Services IBA.

**Views sought:**

2. DSG Members' views are sought on the recommendation on the methodology for updating the '**Nursery and Primary School Teaching and Other Services**' IBA using the 2011 Census settlement threshold data and the 2021 Census settlement threshold data (when available).
3. DSG are also asked to discuss the key questions raised? within the paper and presentation.
4. **Note:** The calculations within the paper and presentation are for demonstration purposes only. No decisions will be made at this stage to influence the financial distribution.

**Section 1: Background and Current Situation**

5. The formula for calculating the '**Nursery and Primary School Teaching and Other Services**' IBA was last updated in 2003. Current Formula:

0.815 x Primary school pupils and modelled nursery school pupils
0.098 x Settlement threshold 1,000
0.087 x Primary school pupils eligible for free school meals

6. The current approach is based on a 'need to spend' and there are 3 main drivers. Main client group (Pupil and School Numbers), Deprivation (Free School Meal Eligibility) and Sparsity (Rurality) (Population Settlement Thresholds). The formula uses statistical techniques to derive the weights.
7. The independent needs assessment requires the use of statistical techniques such as ordinary least squares regression<sup>1</sup> analysis and hierarchical multilevel

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1. **<sup>1</sup> Ordinary Least Squares (OLS) Regression** looks at the relationship and correlation between two variables.

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regression techniques. Weightings are derived from the regression equation coefficients<sup>2</sup>.

8. A settlement indicator pattern used in the formula is an appropriate way of capturing the effect that lost economies of scale can have on unit costs when a local authority has to provide multiple service points in order to ensure reasonable access. Either the size of the settlement in which the school is located, or the proportion of a local authority's population in settlements below a threshold level are indicators for lost economies of scale.
9. The formula was updated in 2003 using PLASC and expenditure data.. Further analysis was carried out in 2007 to update the PLASC and expenditure data with more recently available data but the new weights were not carried forward.

**Expenditure Need Indicators and Regression Methods**

<b>Modelled Schools</b>	<u>Dependent Variable</u> - Actual Number of Schools  <u>Independent Variables</u> - Number of pupils in Nursery and Primary schools  - Population in small settlements (Settlement threshold Indicators)	<u>Unit of Observation</u> Local Authority  <u>Regression Method</u> Ordinary Least Squares
<b>Nursery and Primary School Teaching and Other Services</b>	<u>Dependent variable:</u> - Expenditure  <u>Independent variables considered:</u> - Number of pupils in nursery and primary schools  - Pupils entitled to free school meals  - Actual number of schools  - Settlement (threshold 10,000)	<u>Unit of Observation</u> School  <u>Regression Method</u> Hierarchical Modelling

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<sup>2</sup> Regression coefficients represent the average change in the dependent variable for one unit of change in the independent variable while holding all other independent variables in the model constant.

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### **Section 2: Datasets Overview**

#### **Expenditure Data**

10. As part of the SSA Review, DSG agreed that the Section 52 individual schools' data should be used for multilevel modelling analysis and that the formula should be averaged over three years. Section 52 and RO1 returns for the years 2019-20, 2020-21 and 2021-22 have been used in the calculations.
11. Following the review of the revenue outturn forms the RO1 returns are closely aligned with the Section 52 returns. A small number of authorities delegated part of their school meals and milk budget to schools. Expenditure for school meals have been subtracted from the schools using the distribution of free school meals within the authority as part of the calculations.
12. [Annex A](#) shows the expenditure per pupil by number of pupils at Nursery and primary schools for the years 2019-20, 2020-21 and 2021-22. It shows that on average expenditure per pupil is £4,400, £4,600 and £4,800 respectively.
13. It also shows that there are some schools with an unusual amount of expenditure per pupil. This will skew the regression results slightly. Hence we should either impute the anomalies with the average expenditure per pupil or remove the anomalies.

#### **PLASC Data and FSM**

14. The PLASC is the most accurate and robust source of data for pupil numbers and using this as a proxy for need to spend on education services ensures that the Settlement remains reactive to real movements in the number of pupils requiring education. Nursery and Primary School pupil numbers for PLASC years 2020, 2021 and 2022 have been used as part of this analysis.
15. Eligibility for Free School Meals (eFSM) is used as a proxy of deprivation in the assessment of relative need to spend on Nursery and Primary School Teaching and Other Services. PLASC years 2020, 2021 and 2022 have been used as part of this analysis. [Annex B](#) shows the share of pupil numbers and FSM by local authority.

#### **Settlement Threshold Data**

16. The settlement threshold indicators measure sparsity and are designed to account for costs of delivering services to rural areas. Urban areas (large settlements) can achieve economies of scale in provision of services to large populations that are not available in rural areas due to the need to duplicate provision in providing access.
17. The proportion of the population outside large settlements provides a broad indicator of the extent of economies of scale lost, or the additional cost burden in supplying comparable services in rural areas.
18. Settlement Threshold Indicators using the Census 2011 data (Census 2021 when available) have been produced to measure the population in an authority living outside settlements above a certain population threshold. [Annex C](#) shows the settlement threshold data.

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### **Modelled Schools**

#### **Definition:**

19. **Ordinary Least Squares (OLS) Regression** looks at the relationship and correlation between two variables. If the relationship between two variables can be presented with a linear function, the slope (R-Square) will denote the strength of the impact and linear correlation.
20. To use school numbers that reflect the number **needed** in Wales, we need to model the number of schools for Nursery and Primary using the settlement indicators from 2011 Census (2021 Census when available). The school numbers and population settlement threshold numbers are divided by the number of pupils for each local authority.
21. The process then involves using ordinary Least Squares (OLS) regression analysis. This will find out the closest relationship between the actual number of schools and the population in small settlements and the number of pupils. We use the actual number of schools as the dependent variable and the settlement indicators as the independent variable. We analyse which settlement threshold is the best fit (highest R square).
22. In 2003 the settlement threshold of 1,000 was used based on the 1991 Census. This implied that the relationship between the number of schools and the population in settlement thresholds of 1,000 and under had the strongest correlation.
23. Similar analysis using the 2011 Census shows that a settlement threshold of 10,000 now provides a stronger positive correlation. [Annex D](#) shows the results of the regression analysis for the years 2019-20, 2020-21 and 2021-22.

### **Section 3: Methodology multi-level modelling (MLM)**

#### **Definition**

24. **Multilevel modelling (MLM)** looks at relationships between variables whilst taking into account differences between hierarchical levels in the data.
25. In the Nursery and Primary School Teaching and Other Services IBA, the model analyses the relationship between expenditure data (dependent variable) and school numbers, FSM and settlement threshold data (independent variables) across all authorities, but also takes into account the differences between schools in each authority.
26. The method considers a dataset for each of the pupil, FSM and Expenditure data at **school level** and then merges the settlement threshold and actual school numbers at **local authority level**. The settlement indicators are divided by the number of pupils and number of schools. The total expenditure, actual number of schools and FSM are divided by the number of pupils.
27. The data is summarised in a single dataset, and we use SAS (Statistical Analytical Software) for the Multi-level Modelling (MLM). The software uses a

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'PROC MIXED' function which fits a wider class of multiple mixed linear models and considers the **maximum likelihood** for the relationship.

28. The variables tested are actual schools, Free School Meal Eligibility, pupils and the settlement threshold indicators. The results are summarised through a co-efficient (CPI) for each variable. This measures the dependency of each of the variables and the degree of change for every single unit. The settlement threshold indicators usually produce a negative co-efficient, hence are removed. A standard error is also produced, the coefficient should be at least twice as large to ensure more precise results. [Annex E](#) summarises the results.

### **Section 4: Methodology weights calculation**

29. The weights used in the formula are calculated using the coefficients from the Statistical Analytical Software (SAS) outputs. The coefficients from both the Ordinary Least squares (OLS) regression analysis used to model schools and the hierarchical modelling are considered.
30. The weighted co-efficient is calculated by multiplying the Wales total for each dataset and the coefficient. The CPI weight is calculated as the percentage of the total weighted coefficient. The total CPI weight is the sum of all weights. The OLS weight is taken from the regression analysis. The complete model weight is calculated by multiplying the schools' weight by the OLS weight. This is done for the pupils and the settlement indicator. The schools CPI weight is then added into the pupil CPI and the settlement CPI. [Annex F](#) summarises the results.

### **Section 5: Results, Next Steps and Proposals**

31. For the result a 3-year average of the Nursery and Primary school weights is taken. The exemplification is carried out on the data used in the 2023-24 settlement. [Annex G](#) summarises the results.
32. As part of the DSG work programme GIS expertise has produced Census 2021 settlement threshold data (**Agenda item 2**). In this paper analysis has been drafted for the 2011 settlement threshold data and methodology has been discussed during the workshop. **Key questions** to consider are:
- There are a small number of schools where there is zero expenditure allocated to each pupil. Should these schools be removed during the regression calculations?
  - In 2007, analysis was also tested limiting the expenditure to small schools. There is no definition for a small school, but schools with less than 40 pupils and less than 50 pupils were tested. Does this seem appropriate?
  - The analysis excludes middle schools – should it?. The methodology for the Census 2021 settlement threshold indicators provides a slightly different approach using smaller area squares to measure built up areas. Do DSG agree replicating the analysis in this paper for the Census 2021 settlement threshold indicators under the caveat of the new methodology?

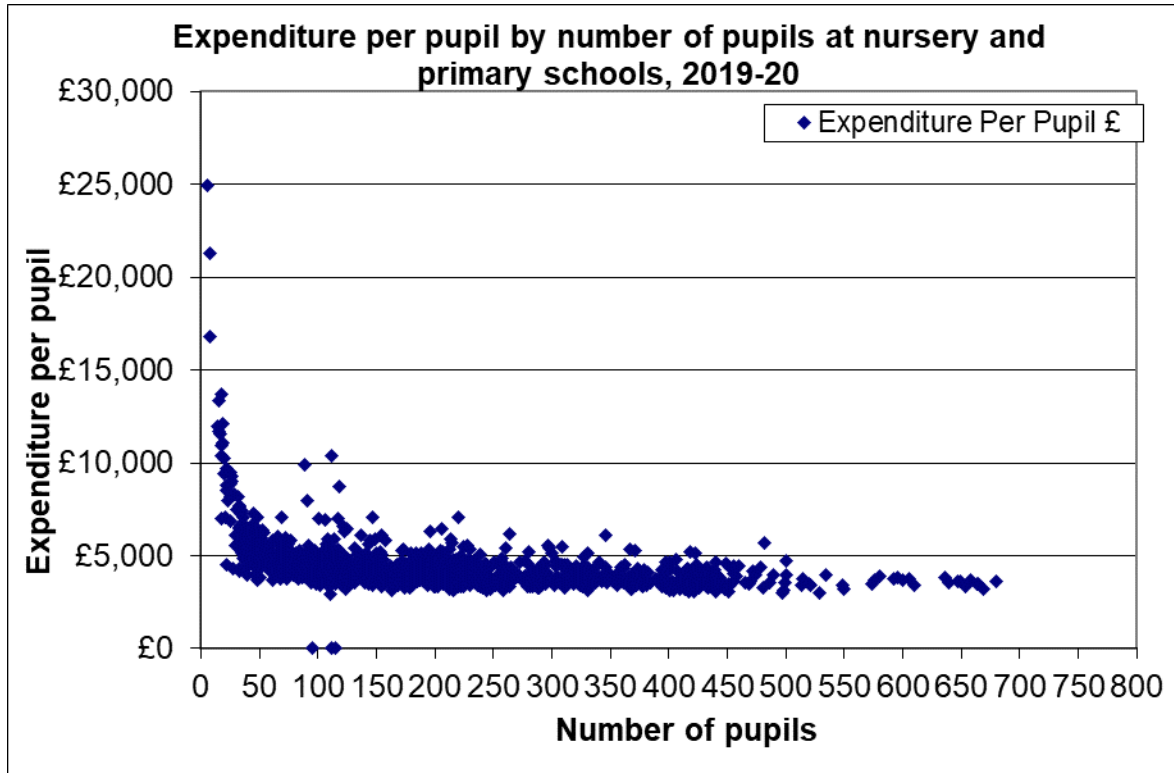
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- The analysis for the CPI weights uses a 3-year average of the weights calculated for each year. Are we content with this approach?

32. **Next Step** is to complete the analysis for the Nursery and Primary School IBA using the latest Census 2021 settlement threshold data based on the proposed solutions to the key questions raised above. The analysis can be carried out during 2024 and beyond. The methodology can then be brought forward into other service IBAs.

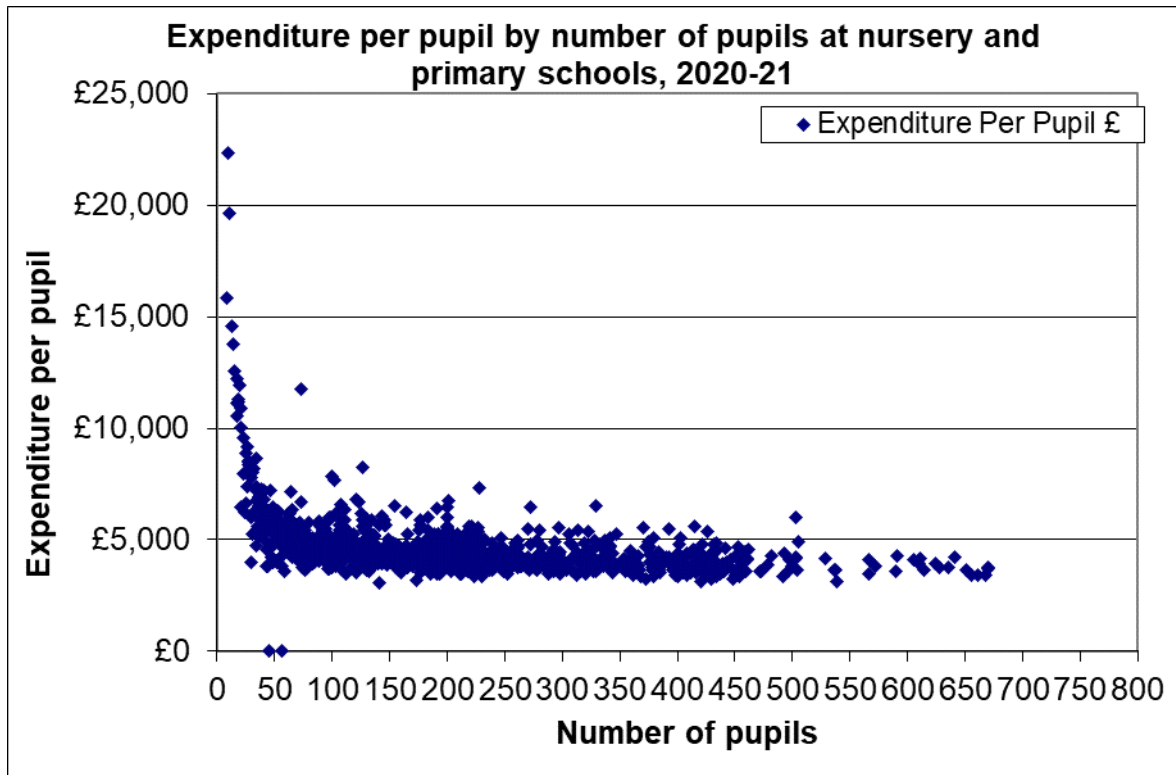
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**Chart 1: Expenditure per pupil by number of pupils at Nursery and Primary Schools, 2019-20**



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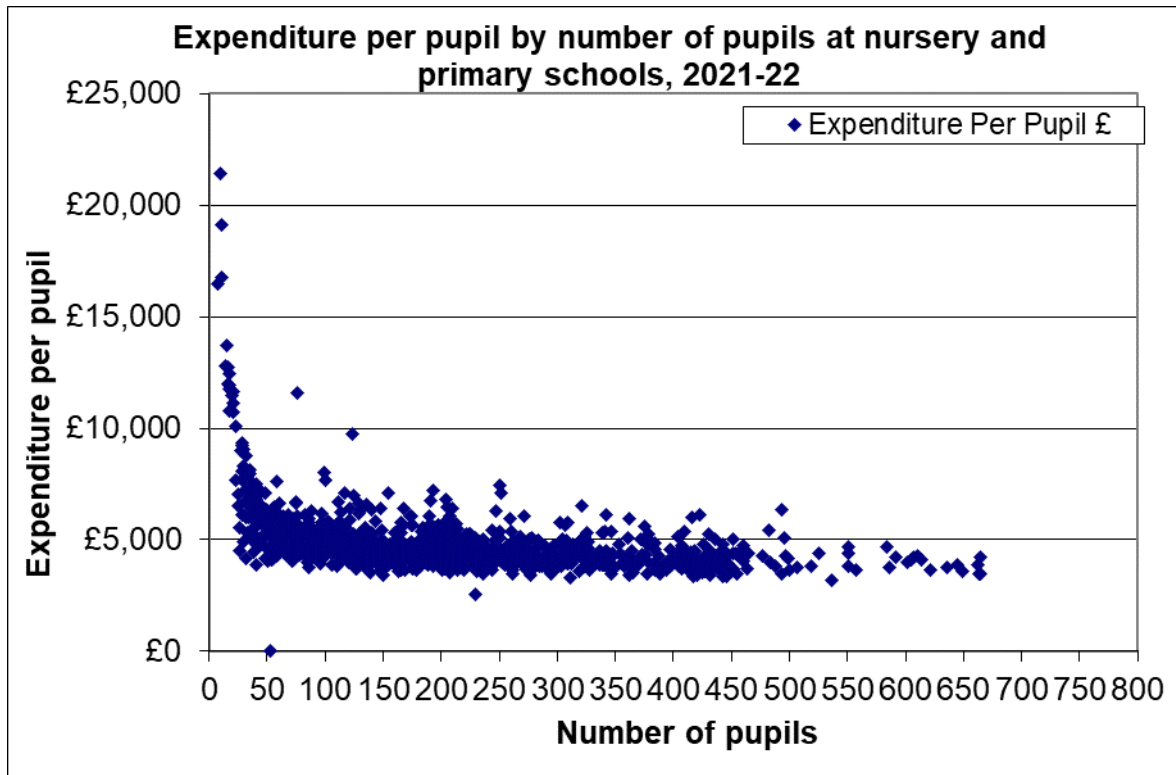
**Chart 2: Expenditure per pupil by number of pupils at Nursery and Primary Schools, 2020-21**



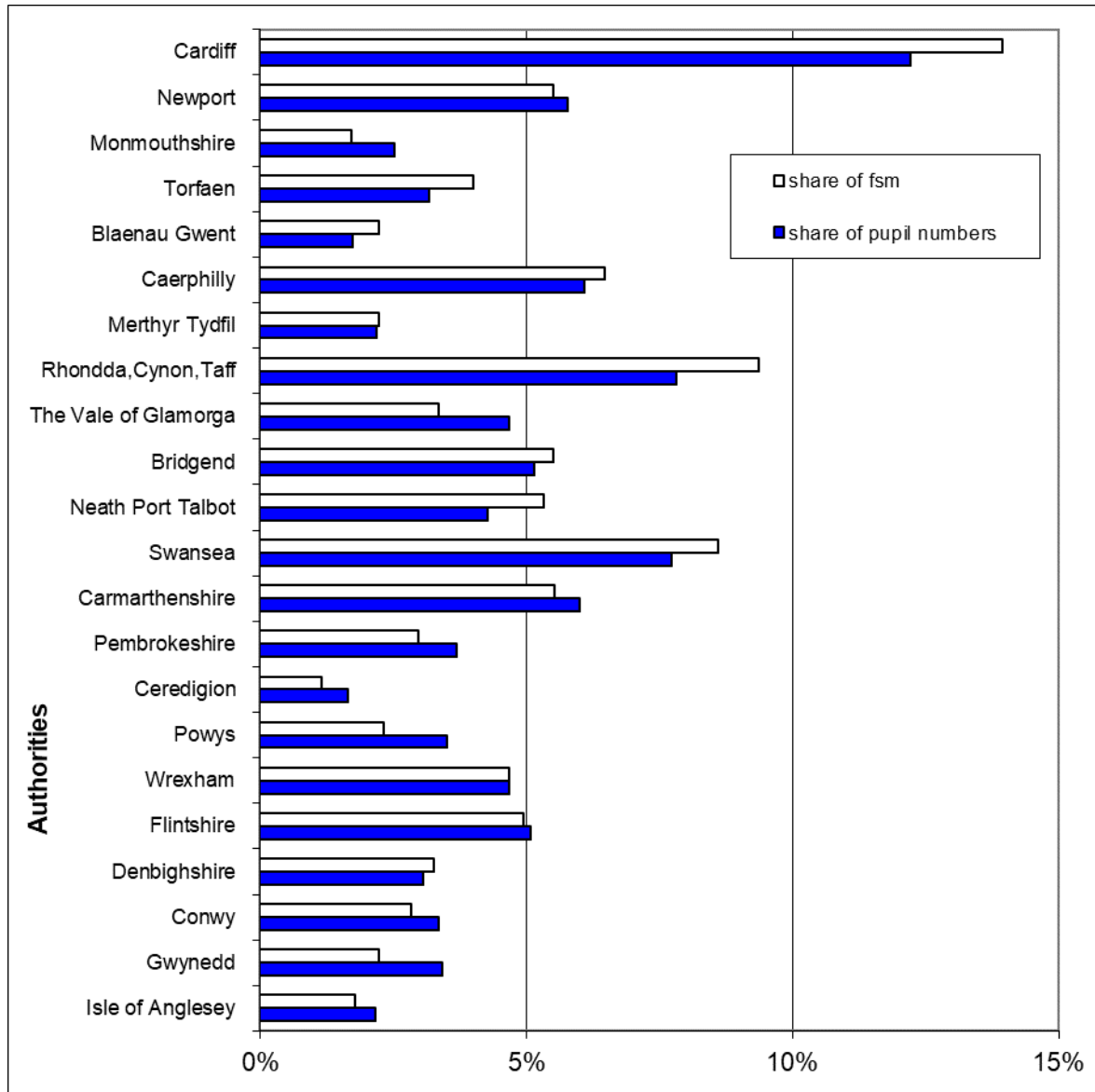


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**Chart 3: Expenditure per pupil by number of pupils at Nursery and Primary Schools, 2021-22**

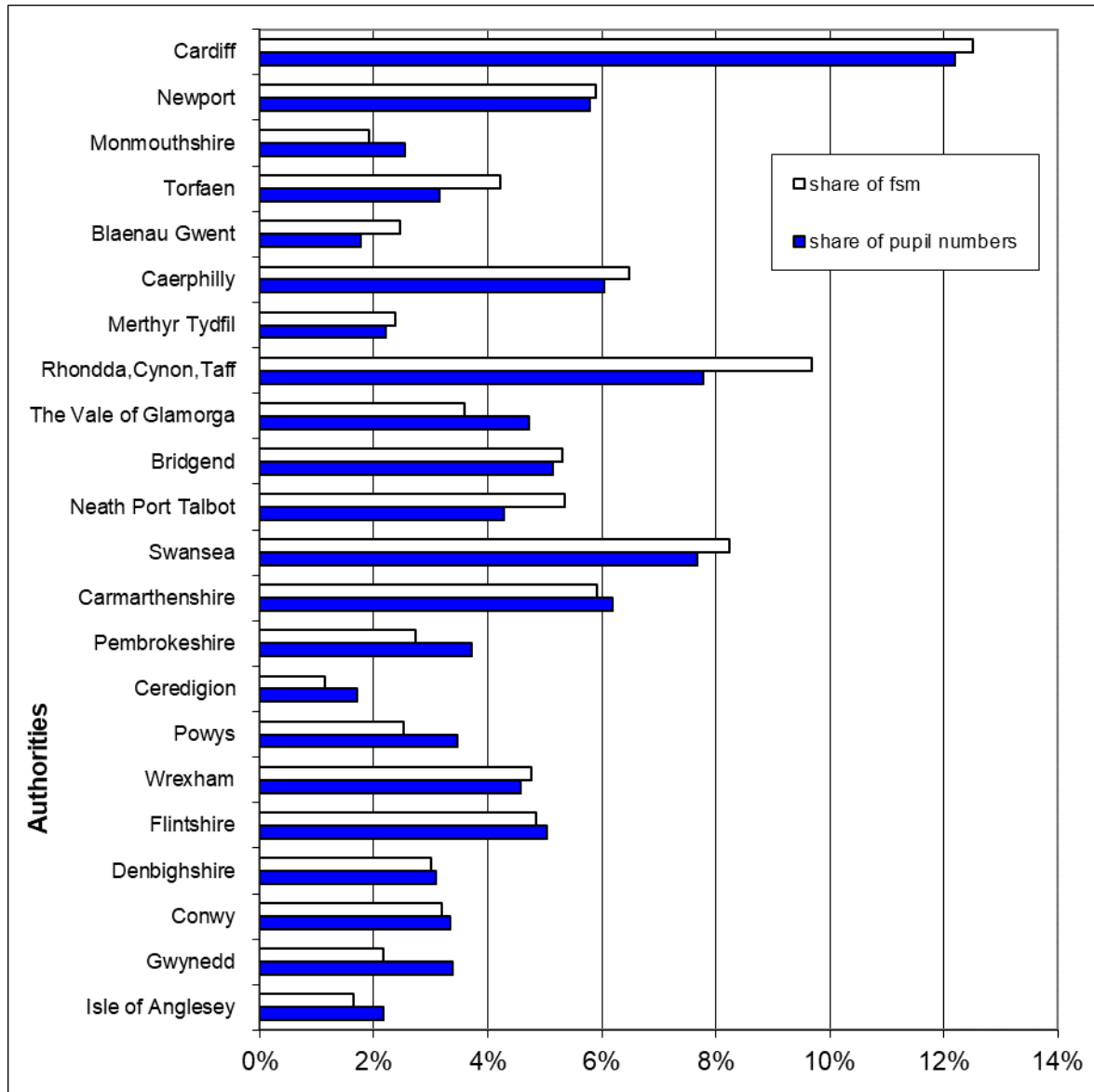


**Chart 4: Nursery and Primary school pupil and FSM share, 2019-20**



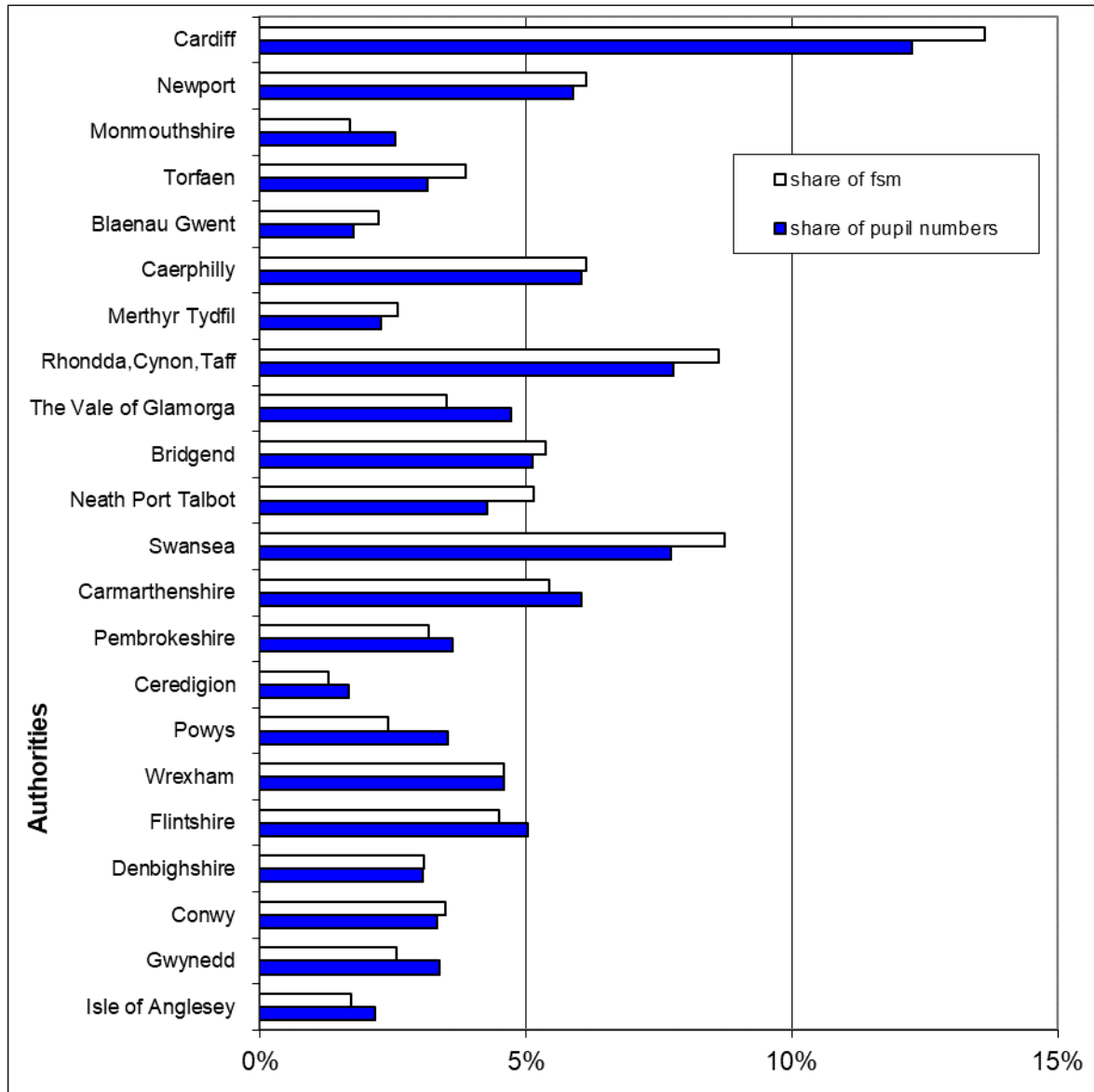
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**Chart 5: Nursery and Primary school pupil and FSM share, 2020-21**



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**Chart 6: Nursery and Primary school pupil and FSM share, 2021-22**



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Annex C

**Table 1: Population living outside built-up areas with 2011 Census population above that given threshold**

Unitary Authority	300	500	1,000	2,500	5,000	7,500	10,000	12,500	15,000	20,000	25,000	30,000	40,000	50,000
Isle of Anglesey	19,932	21,467	29,137	42,180	58,320	58,320	58,320	69,751	69,751	69,751	69,751	69,751	69,751	69,751
Gwynedd	35,175	35,560	47,857	74,090	94,393	94,393	103,886	103,886	103,886	121,874	121,874	121,874	121,874	121,874
Conwy	15,264	17,250	17,855	23,289	41,089	41,089	59,794	70,452	70,452	85,823	85,823	115,228	115,228	115,228
Denbighshire	17,241	18,024	21,168	27,297	37,827	43,288	51,802	51,802	51,802	68,585	68,585	93,734	93,734	93,734
Flintshire	12,840	13,578	20,911	38,877	46,715	59,413	69,221	79,279	94,186	147,374	147,374	147,374	147,374	147,374
Wrexham	11,482	12,512	16,957	27,145	41,956	59,740	59,740	59,740	73,241	73,241	73,241	73,241	73,241	73,241
Powys	54,255	57,815	69,572	86,793	95,558	106,815	115,065	132,976	132,976	132,976	132,976	132,976	132,976	132,976
Ceredigion	30,051	31,316	39,610	50,675	57,829	57,829	57,829	57,829	57,829	75,922	75,922	75,922	75,922	75,922
Pembrokeshire	28,990	32,186	50,252	62,366	76,956	76,956	94,261	94,261	122,439	122,439	122,439	122,439	122,439	122,439
Carmarthenshire	43,647	45,200	54,683	77,060	101,435	113,308	124,045	124,045	139,899	139,899	139,899	139,899	139,899	139,899
Swansea	6,440	7,244	10,352	20,993	29,317	29,317	43,781	43,781	43,781	59,538	59,538	59,538	59,538	59,538
Neath Port Talbot	6,105	6,408	9,432	22,563	30,515	35,851	35,851	51,878	51,878	51,878	51,878	51,878	89,154	89,154
Bridgend	4,211	4,682	8,399	16,784	24,189	24,189	33,355	44,160	57,861	92,421	92,421	92,421	92,421	139,178
Vale of Glamorgan	8,960	10,172	13,812	14,967	18,771	37,975	46,402	46,402	46,402	46,402	46,402	71,375	71,375	71,375
Rhondda Cynon Taf	6,876	6,876	8,279	15,518	29,717	64,911	90,158	101,388	156,416	174,205	174,205	203,953	234,410	234,410
Merthyr Tydfil	1,576	1,576	1,576	3,730	7,277	7,277	14,982	14,982	14,982	14,982	14,982	14,982	14,982	58,802
Caerphilly	4,458	4,458	7,302	20,789	33,390	50,397	67,663	79,200	94,158	113,362	137,404	137,404	137,404	178,806
Blaenau Gwent	2,116	2,116	2,116	3,672	18,844	24,374	25,918	36,864	51,719	69,814	69,814	69,814	69,814	69,814
Torfaen	1,246	1,246	1,246	1,246	1,246	6,893	15,826	15,826	15,826	15,826	15,826	44,160	44,160	91,075
Monmouthshire	18,892	21,187	25,046	35,492	38,326	44,240	44,240	77,900	91,323	91,323	91,323	91,323	91,323	91,323
Newport	4,139	4,515	5,994	10,289	10,289	10,289	17,676	17,676	17,676	17,676	17,676	17,676	17,676	17,676
Cardiff	1,246	1,246	1,246	5,913	5,913	8,980	8,980	8,980	8,980	8,980	8,980	11,233	11,233	11,233
<b>Wales</b>	<b>335,142</b>	<b>356,634</b>	<b>462,802</b>	<b>681,728</b>	<b>899,872</b>	<b>1,055,844</b>	<b>1,238,795</b>	<b>1,383,058</b>	<b>1,551,609</b>	<b>1,794,291</b>	<b>1,818,333</b>	<b>1,958,195</b>	<b>2,025,928</b>	<b>2,248,700</b>

**Table 2: Percentage shares of population living outside built-up areas with 2011 Census population above that given threshold**

Unitary Authority	300	500	1,000	2,500	5,000	7,500	10,000	12,500	15,000	20,000	25,000	30,000	40,000	50,000
Isle of Anglesey	5.9%	6.0%	6.3%	6.2%	6.5%	5.5%	4.7%	5.0%	4.5%	3.9%	3.8%	3.6%	3.4%	3.1%
Gwynedd	10.5%	10.0%	10.3%	10.9%	10.5%	8.9%	8.4%	7.5%	6.7%	6.8%	6.7%	6.2%	6.0%	5.4%
Conwy	4.6%	4.8%	3.9%	3.4%	4.6%	3.9%	4.8%	5.1%	4.5%	4.8%	4.7%	5.9%	5.7%	5.1%
Denbighshire	5.1%	5.1%	4.6%	4.0%	4.2%	4.1%	4.2%	3.7%	3.3%	3.8%	3.8%	4.8%	4.6%	4.2%
Flintshire	3.8%	3.8%	4.5%	5.7%	5.2%	5.6%	5.6%	5.7%	6.1%	8.2%	8.1%	7.5%	7.3%	6.6%
Wrexham	3.4%	3.5%	3.7%	4.0%	4.7%	5.7%	4.8%	4.3%	4.7%	4.1%	4.0%	3.7%	3.6%	3.3%
Powys	16.2%	16.2%	15.0%	12.7%	10.6%	10.1%	9.3%	9.6%	8.6%	7.4%	7.3%	6.8%	6.6%	5.9%
Ceredigion	9.0%	8.8%	8.6%	7.4%	6.4%	5.5%	4.7%	4.2%	3.7%	4.2%	4.2%	3.9%	3.7%	3.4%
Pembrokeshire	8.7%	9.0%	10.9%	9.1%	8.6%	7.3%	7.6%	6.8%	7.9%	6.8%	6.7%	6.3%	6.0%	5.4%
Carmarthenshire	13.0%	12.7%	11.8%	11.3%	11.3%	10.7%	10.0%	9.0%	8.0%	7.8%	7.7%	7.1%	6.9%	8.2%
Swansea	1.9%	2.0%	2.2%	3.1%	3.3%	2.8%	3.5%	3.2%	2.8%	3.3%	3.3%	3.0%	2.9%	2.6%
Neath Port Talbot	1.8%	1.8%	2.0%	3.3%	3.4%	3.4%	2.9%	3.8%	3.3%	2.9%	2.9%	2.6%	4.4%	4.0%
Bridgend	1.3%	1.3%	1.8%	2.5%	2.7%	2.3%	2.7%	3.2%	3.7%	5.2%	5.1%	4.7%	4.6%	6.2%
Vale of Glamorgan	2.7%	2.9%	3.0%	2.2%	2.1%	3.6%	3.7%	3.4%	3.0%	2.6%	2.6%	3.6%	3.5%	3.2%
Rhondda Cynon Taf	2.1%	1.9%	1.8%	2.3%	3.3%	6.1%	7.3%	7.3%	10.1%	9.7%	9.6%	10.4%	11.6%	10.4%
Merthyr Tydfil	0.5%	0.4%	0.3%	0.5%	0.8%	0.7%	1.2%	1.1%	1.0%	0.8%	0.8%	0.8%	0.7%	2.6%
Caerphilly	1.3%	1.3%	1.6%	3.0%	3.7%	4.8%	5.5%	5.7%	6.1%	6.3%	7.6%	7.0%	6.8%	8.0%
Blaenau Gwent	0.6%	0.6%	0.5%	0.5%	2.1%	2.3%	2.1%	2.7%	3.3%	3.9%	3.8%	3.6%	3.4%	3.1%
Torfaen	0.4%	0.3%	0.3%	0.2%	0.1%	0.7%	1.3%	1.1%	1.0%	0.9%	0.9%	2.3%	2.2%	4.1%
Monmouthshire	5.6%	5.9%	5.4%	5.2%	4.3%	4.2%	3.6%	5.6%	5.9%	5.1%	5.0%	4.7%	4.5%	4.1%
Newport	1.2%	1.3%	1.3%	1.5%	1.1%	1.0%	1.4%	1.3%	1.1%	1.0%	1.0%	0.9%	0.9%	0.8%
Cardiff	0.4%	0.3%	0.3%	0.9%	0.7%	0.9%	0.7%	0.6%	0.6%	0.5%	0.5%	0.6%	0.6%	0.5%
<b>Wales</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

**Nursery and Primary Education – Number of Schools Index (OLS Regression)**

Dependent variable:

- Number of schools

Independent variables:

- Number of pupils in Nursery and Primary schools
- Settlement indicators (threshold 10,000)

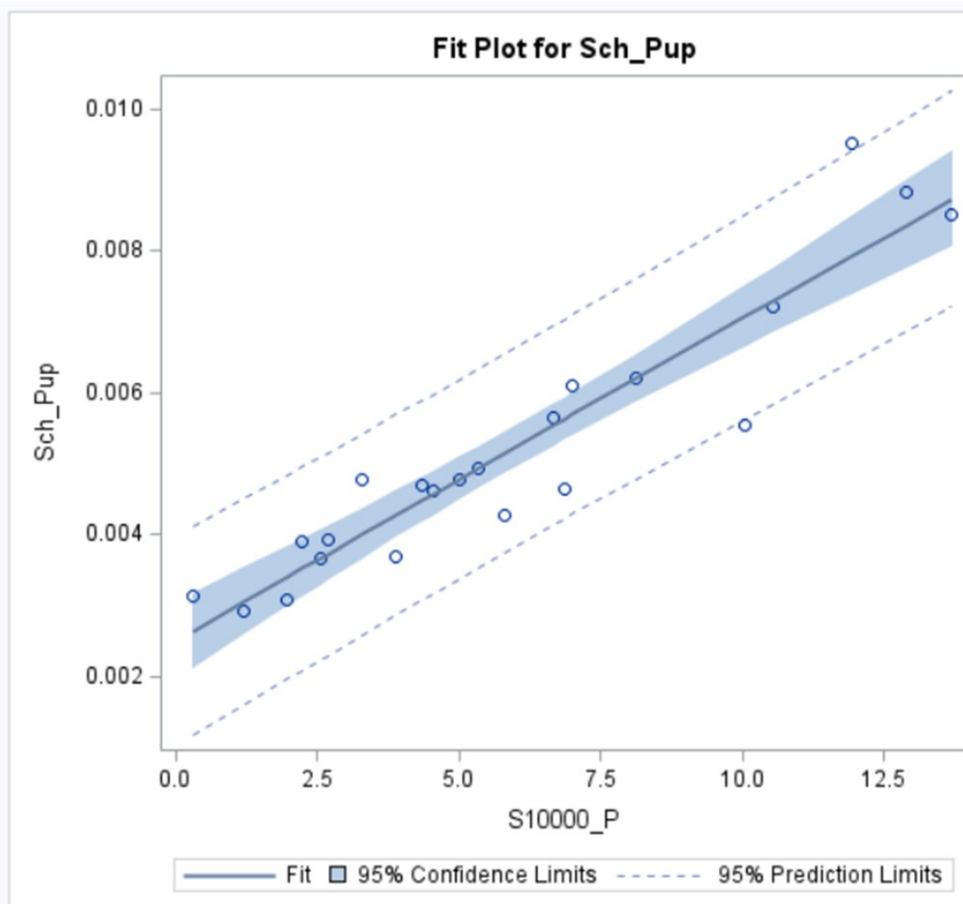
**2019-20**

Ordinary Least Squares Regression analysis results:

Estimated schools = 0.00251 (number of pupils) + 0.00045468 (settlement 10,000)

$R^2 = 0.8819$

CPI weights = 0.00251 x number of pupils  
0.00045468 x settlement 10,000



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**Table 1: Primary education number of schools index, 2019-20**

	Number of Schools (Actual)	Number of Schools (Modelled)	Difference	Schools per 1,000 pupils (Actual)	Schools per 1,000 pupils (Modelled)
Isle of Anglesey	40	41	1	7	7
Gwynedd	83	70	-13	10	8
Conwy	52	50	-2	6	6
Denbighshire	44	44	0	6	6
Flintshire	64	65	1	5	5
Wrexham	57	58	1	5	5
Powys	79	76	-3	9	9
Ceredigion	36	38	2	9	9
Pembrokeshire	52	68	16	6	7
Carmarthenshire	95	97	2	6	6
Swansea	77	71	-6	4	4
Neath Port Talbot	52	44	-8	5	4
Bridgend	48	49	1	4	4
The Vale of Glamorgan	44	52	8	4	4
Rhondda Cynon Taff	92	93	1	5	5
Merthyr Tydfil	22	21	-1	4	4
Caerphilly	73	71	-2	5	5
Blaenau Gwent	19	23	4	4	5
Torfaen	25	28	3	3	3
Monmouthshire	30	37	7	5	6
Newport	43	46	3	3	3
Cardiff	98	84	-14	3	3
<b>Total Unitary Authorities</b>	<b>1,225</b>	<b>1,225</b>	<b>0</b>	<b>5</b>	<b>5</b>

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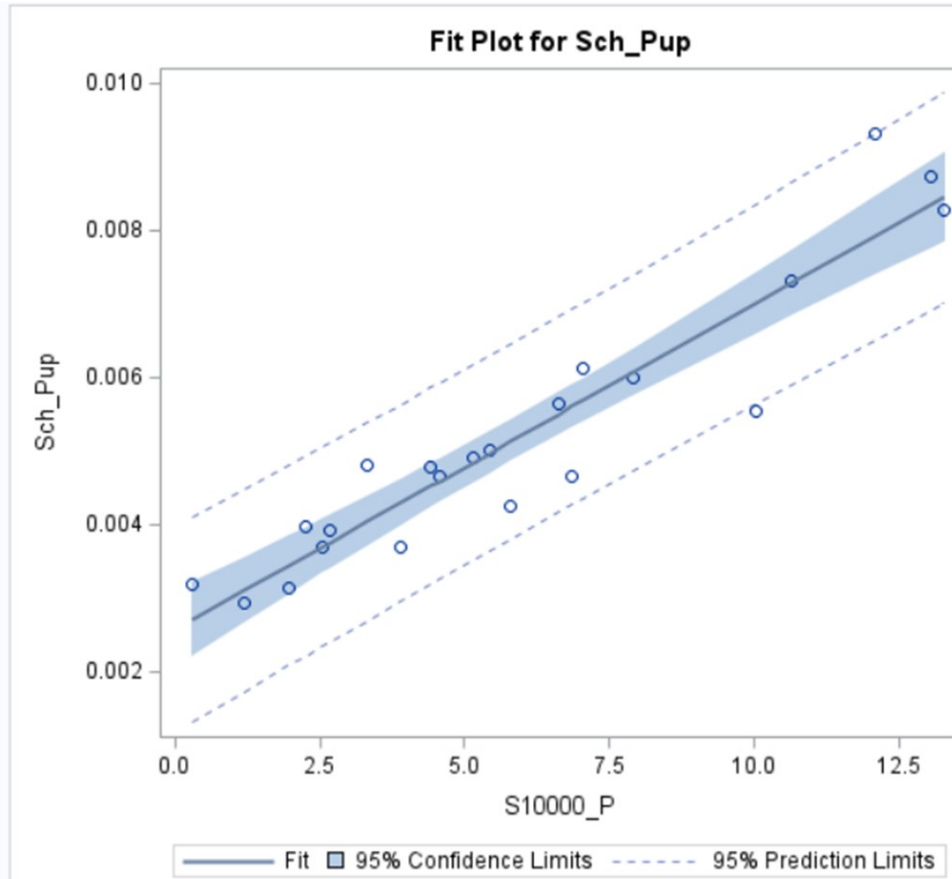
**2020-21**

Ordinary Least Squares Regression analysis results:

Estimated schools = 0.00257 (number of pupils) + 0.00044235 (settlement 10,000)

$R^2 = 0.8862$

CPI weights = 0.00257 x number of pupils  
0.00044235 x settlement 10,000





**Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps**

**Table 2: Primary education number of schools index, 2020-21**

	Number of Schools (Actual)	Number of Schools (Modelled)	Difference	Schools per 1,000 pupils (Actual)	Schools per 1,000 pupils (Modelled)
Isle of Anglesey	40	41	1	7	7
Gwynedd	80	69	-11	9	8
Conwy	52	49	-3	6	6
Denbighshire	44	44	0	6	6
Flintshire	64	64	0	5	5
Wrexham	57	57	0	5	5
Powys	77	75	-2	9	8
Ceredigion	36	37	1	8	9
Pembrokeshire	52	67	15	6	7
Carmarthenshire	94	97	3	6	6
Swansea	77	70	-7	4	4
Neath Port Talbot	52	44	-8	5	4
Bridgend	48	49	1	4	4
The Vale of Glamorgan	44	52	8	4	4
Rhondda Cynon Taff	92	92	0	5	5
Merthyr Tydfil	22	21	-1	4	4
Caerphilly	73	70	-3	5	5
Blaenau Gwent	19	23	4	4	5
Torfaen	25	28	3	3	4
Monmouthshire	30	37	7	5	6
Newport	43	46	3	3	3
Cardiff	98	85	-13	3	3
<b>Total Unitary Authorities</b>	<b>1,219</b>	<b>1,219</b>	<b>0</b>	<b>5</b>	<b>5</b>

**Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps**

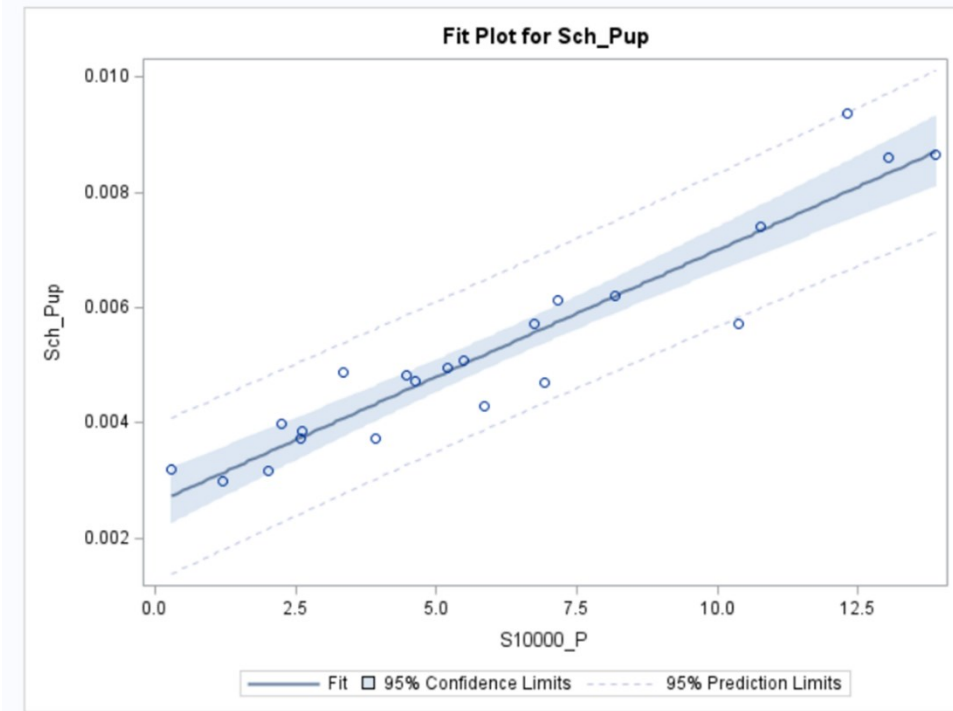
**2021-22**

Ordinary Least Squares Regression analysis results:

Estimated schools = 0.002605796 (number of pupils) + 0.0004390673 (settlement 10,000)

$R^2 = 0.8948$

CPI weights = 0.002605796 x number of pupils  
0.0004390673 x settlement 10,000



**Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps**

**Table 3: Primary education number of schools index, 2021-22**

	Number of Schools (Actual)	Number of Schools (Modelled)	Difference	Schools per 1,000 pupils (Actual)	Schools per 1,000 pupils (Modelled)
Isle of Anglesey	40	40	0	7	7
Gwynedd	79	69	-10	9	8
Conwy	51	49	-2	6	6
Denbighshire	44	44	0	6	6
Flintshire	64	64	0	5	5
Wrexham	57	57	0	5	5
Powys	76	75	-1	9	8
Ceredigion	36	37	1	9	9
Pembrokeshire	52	66	14	6	7
Carmarthenshire	94	96	2	6	6
Swansea	77	71	-6	4	4
Neath Port Talbot	52	44	-8	5	4
Bridgend	48	49	1	4	4
The Vale of Glamorgan	44	52	8	4	4
Rhondda Cynon Taff	92	92	0	5	5
Merthyr Tydfil	22	22	0	4	4
Caerphilly	73	70	-3	5	5
Blaenau Gwent	19	23	4	4	5
Torfaen	25	28	3	3	4
Monmouthshire	30	37	7	5	6
Newport	44	47	3	3	3
Cardiff	98	85	-13	3	3
<b>Total Unitary Authorities</b>	<b>1,217</b>	<b>1,217</b>	<b>0</b>	<b>5</b>	<b>5</b>

***Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps***

**Annex E**

**Primary school teaching and other services (Multilevel Modelling)**

Dependent variable:

- Expenditure

Independent variables considered:

- Number of pupils in nursery and primary schools
- Pupils entitled to free school meals
- Actual number of schools
- Settlement (threshold 10,000)

**2019-20**

Multilevel Modelling results:

Expenditure = 2,950.69627848 (number of pupils)  
+ 2,449.5801027 (free school meals)  
+ 120,493.24547778 (actual schools)

CPI weights = 0.735 x number of pupils  
0.121 x free school meals  
0.144 x modelled schools

With modelled school index multiplied out:

CPI weights = 0.812 x number of pupils  
0.121 x free school meals  
0.068 x settlement 10,000

**2020-21**

Multilevel Modelling results:

Expenditure = 3,135.51661372 (number of pupils)  
+ 2056.26972626 (free school meals)  
+ 126670.32081706 (actual schools)

CPI weights = 0.747 x number of pupils  
0.108 x free school meals  
0.145 x modelled schools

With modelled school index multiplied out:

CPI weights = 0.825 x number of pupils  
0.108 x free school meals  
0.066 x settlement 10,000

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**2021-22**

Multilevel Modelling results:

Expenditure = 3362.86782909 (number of pupils)  
+ 1744.98983899 (free school meals)  
+ 123589.38734128 (actual schools)

CPI weights = 0.761 x number of pupils  
0.103 x free school meals  
0.136 x modelled schools

With modelled school index multiplied out:

CPI weights = 0.835 x number of pupils  
0.103 x free school meals  
0.062 x settlement 10,000

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**Annex F**

**Primary school teaching and other services (Weights Calculation)**

**2019-20**

	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	
<b>Wales Total</b>	254,766	1,225	50,323	1,238,795	

	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	<b>Total</b>
<b>MLM Coeff</b>	2,950.70	120,493.25	2,449.58	-	-
<b>CPI</b>	751,735,613	147,604,226	123,270,220	-	1,022,610,058
<b>Weights %</b>	<b>73.5%</b>	<b>14.43%</b>	<b>12.05%</b>		

<b>Schools weight from above</b>			14.43%		
<b>OLS</b>	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	
<b>Pupils</b>	0.531680816			0.468319184	
<b>Sett Area</b>	<b>7.7%</b>			<b>6.8%</b>	

<b>Pupils</b>	<b>FSM</b>	<b>Sett 10000</b>		
<b>81.2%</b>	<b>12.1%</b>	<b>6.8%</b>	<b>100.0%</b>	

**2020-21**

	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	
<b>Wales Total</b>	253,470	1,219	56,041	1,238,795	

	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	<b>Total</b>
<b>MLM Coeff</b>	3,135.52	126,670.32	2,056.27	-	-
<b>CPI</b>	794,759,396	154,411,121	115,235,412	-	1,064,405,929
<b>Weights %</b>	<b>74.7%</b>	<b>14.51%</b>	<b>10.83%</b>		

<b>Schools weight from above</b>			14.51%		
<b>OLS</b>	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	
<b>Pupils</b>	0.543120322			0.456879678	
<b>Sett Area</b>	<b>7.9%</b>			<b>6.6%</b>	

<b>Pupils</b>	<b>FSM</b>	<b>Sett 10000</b>		
<b>82.5%</b>	<b>10.8%</b>	<b>6.6%</b>	<b>100.0%</b>	

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**2021-22**

	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>
<b>Wales Total</b>	250,286		1,217	65,083
				1,238,795

<b>MLM</b>	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>	<b>Total</b>
<b>Coeff</b>	3,362.87	123,589.39	1,744.99	-	
<b>CPI</b>	841,677,056	150,408,284	113,568,301	-	1,105,653,642
<b>Weights %</b>	<b>76.1%</b>	13.60%	<b>10.27%</b>		

<b>Schools weight from above</b>			13.60%	
<b>OLS</b>	<b>Pupils</b>	<b>Schools</b>	<b>FSM</b>	<b>Sett 10000</b>
<b>Pupils</b>	0.54526296			0.45473704
<b>Sett Area</b>	<b>7.4%</b>			6.2%

<b>Pupils</b>	<b>FSM</b>	<b>Sett 10000</b>
<b>83.5%</b>	<b>10.3%</b>	<b>6.2%</b>
		<b>100.0%</b>

**Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps**

**Annex G**

**Table 4: Average (2019-20 to 2021-22) of CPI weights**

	Primary school pupils and modelled nursery school pupils	Primary school pupils eligible for free school meals	Settlement threshold 1,000	Settlement threshold 10,000
<b>Old</b>	81.5%	8.7%	9.8%	
<b>2020</b>	81.2%	12.1%		6.8%
<b>2021</b>	82.5%	10.8%		6.6%
<b>2022</b>	83.5%	10.3%		6.2%
<b>Latest 3 Year Average</b>	<b>82.4%</b>	<b>11.1%</b>		<b>6.5%</b>

**Table 5: Nursery and Primary Education Indicator Data**

	Primary school pupils and modelled nursery school pupils	Proportion %	Primary school pupils eligible for free school meals	Proportion %	Settlement threshold 10,000 (Census 2011)	Proportion %	Settlement threshold 1,000 (Census 1991)	Proportion %
Isle of Anglesey	5,476	2.1%	862	1.7%	58,320	4.7%	50,353	4.8%
Gwynedd	9,009	3.5%	1,235	2.4%	103,886	8.4%	83,755	8.0%
Conwy	8,396	3.3%	1,554	3.0%	59,794	4.8%	44,876	4.3%
Denbighshire	8,204	3.2%	1,642	3.2%	51,802	4.2%	38,810	3.7%
Flintshire	12,736	4.9%	2,315	4.5%	69,221	5.6%	59,553	5.7%
Wrexham	11,620	4.5%	2,299	4.5%	59,740	4.8%	36,240	3.5%
Powys	9,572	3.7%	1,304	2.5%	115,065	9.3%	91,018	8.7%
Ceredigion	4,951	1.9%	694	1.4%	57,829	4.7%	52,260	5.0%
Pembrokeshire	9,656	3.8%	1,542	3.0%	94,261	7.6%	69,575	6.7%
Carmarthenshire	14,924	5.8%	2,836	5.5%	124,045	10.0%	109,168	10.5%
Swansea	19,484	7.6%	4,214	8.2%	43,781	3.5%	47,135	4.5%
Neath Port Talbot	11,432	4.4%	2,824	5.5%	35,851	2.9%	45,593	4.4%
Bridgend	12,265	4.8%	2,556	5.0%	33,355	2.7%	34,106	3.3%
The Vale of Glamorgan	12,133	4.7%	1,740	3.4%	46,402	3.7%	33,798	3.2%
Rhondda Cynon Taff	20,228	7.9%	4,713	9.2%	90,158	7.3%	67,607	6.5%
Merthyr Tydfil	5,432	2.1%	1,140	2.2%	14,982	1.2%	11,392	1.1%
Caerphilly	15,367	6.0%	3,434	6.7%	67,663	5.5%	52,835	5.1%
Blaenau Gwent	5,521	2.1%	1,474	2.9%	25,918	2.1%	17,627	1.7%
Torfaen	8,056	3.1%	1,834	3.6%	15,826	1.3%	17,658	1.7%
Monmouthshire	6,673	2.6%	886	1.7%	44,240	3.6%	42,994	4.1%
Newport	15,059	5.9%	2,913	5.7%	17,676	1.4%	18,916	1.8%
Cardiff	31,108	12.1%	7,318	14.3%	8,980	0.7%	16,850	1.6%
<b>Total Unitary Authorities</b>	<b>257,302</b>	<b>100.0%</b>	<b>51,329</b>	<b>100.0%</b>	<b>1,238,795</b>	<b>100.0%</b>	<b>1,042,119</b>	<b>100.0%</b>



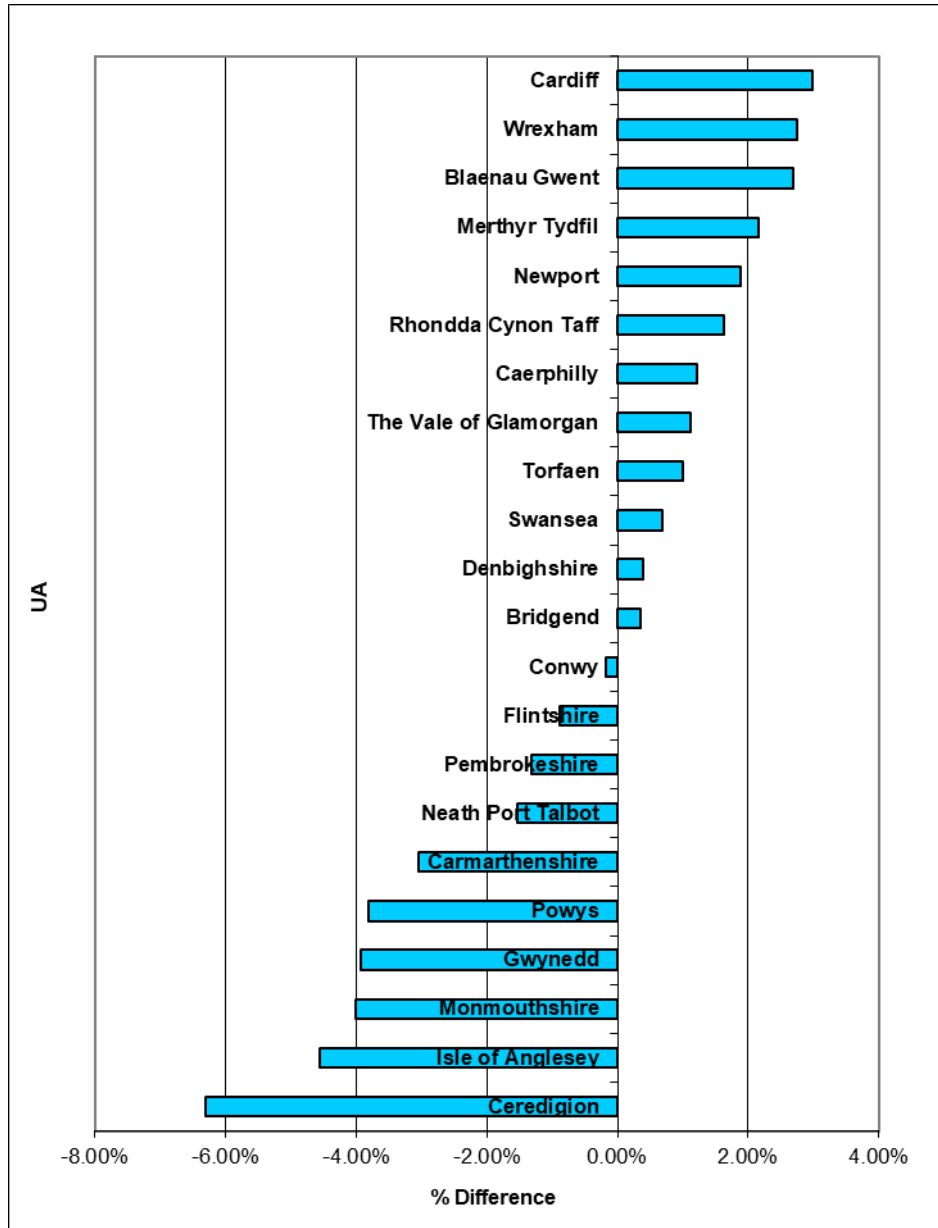
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**Table 6: Nursery and Primary school teaching and other services IBA, (recalibrated)**

	Existing Formula £000s	Recalibrated Formula £000s	Difference £000s	Difference %
Isle of Anglesey	30,882	29,475	-1,406	-4.6%
Gwynedd	50,511	48,523	-1,988	-3.9%
Conwy	43,877	43,802	-75	-0.2%
Denbighshire	42,527	42,692	165	0.4%
Flintshire	65,413	64,840	-573	-0.9%
Wrexham	57,865	59,450	1,586	2.7%
Powys	53,907	51,857	-2,051	-3.8%
Ceredigion	28,562	26,761	-1,801	-6.3%
Pembrokeshire	52,133	51,444	-689	-1.3%
Carmarthenshire	81,783	79,294	-2,489	-3.0%
Swansea	96,142	96,803	660	0.7%
Neath Port Talbot	59,397	58,493	-905	-1.5%
Bridgend	60,853	61,064	211	0.3%
The Vale of Glamorgan	58,452	59,106	654	1.1%
Rhondda Cynon Taff	102,869	104,543	1,674	1.6%
Merthyr Tydfil	26,511	27,081	571	2.2%
Caerphilly	78,004	78,949	945	1.2%
Blaenau Gwent	28,392	29,154	762	2.7%
Torfaen	39,730	40,126	397	1.0%
Monmouthshire	35,001	33,600	-1,400	-4.0%
Newport	71,382	72,730	1,348	1.9%
Cardiff	147,607	152,011	4,405	3.0%
<b>Total Unitary Authorities</b>	<b>1,311,799</b>	<b>1,311,799</b>		

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**Chart 7: Nursery and Primary school IBA (Recalibrated), difference (%)**



**Distribution Sub-Group (2014) Paper 06 – Measuring Sparsity within the Settlement: Background, Principles and Initial Steps**

**Table 7: Nursery and Primary school teaching and other services IBA breakdown, (recalibrated)**

	Existing Formula £000s	Recalibrated Formula £000s	Existing			Recalibrated			Difference		
			Pupils 81.5%	FSM 8.7%	Sparsity 9.8%	Pupils 82.4%	FSM 11.1%	Sparsity 6.5%	Pupils +0.9%	FSM +2.4%	Sparsity -3.3%
Isle of Anglesey	30,882	29,475	22,753	1,917	6,212	23,011	2,434	4,029	258	518	-2,182
Gwynedd	50,511	48,523	37,433	2,746	10,332	37,858	3,488	7,178	425	742	-3,155
Conwy	43,877	43,802	34,886	3,455	5,536	35,282	4,389	4,131	396	934	-1,405
Denbighshire	42,527	42,692	34,088	3,651	4,788	34,475	4,637	3,579	387	986	-1,209
Flintshire	65,413	64,840	52,919	5,147	7,346	53,520	6,538	4,783	600	1,391	-2,564
Wrexham	57,865	59,450	48,282	5,112	4,471	48,830	6,493	4,127	548	1,381	-343
Powys	53,907	51,857	39,773	2,899	11,228	40,224	3,683	7,950	451	783	-3,278
Ceredigion	28,562	26,761	20,572	1,543	6,447	20,805	1,960	3,995	233	417	-2,451
Pembrokeshire	52,133	51,444	40,122	3,429	8,583	40,577	4,355	6,513	455	926	-2,070
Carmarthenshire	81,783	79,294	62,011	6,306	13,467	62,714	8,009	8,570	704	1,704	-4,897
Swansea	96,142	96,803	80,958	9,370	5,815	81,877	11,901	3,025	919	2,532	-2,790
Neath Port Talbot	59,397	58,493	47,501	6,279	5,624	48,040	7,976	2,477	539	1,697	-3,147
Bridgend	60,853	61,064	50,962	5,683	4,207	51,541	7,219	2,305	578	1,536	-1,903
The Vale of Glamorgan	58,452	59,106	50,414	3,869	4,169	50,986	4,914	3,206	572	1,045	-963
Rhondda Cynon Taff	102,869	104,543	84,049	10,479	8,340	85,003	13,311	6,229	954	2,831	-2,111
Merthyr Tydfil	26,511	27,081	22,571	2,535	1,405	22,827	3,220	1,035	256	685	-370
Caerphilly	78,004	78,949	63,851	7,635	6,518	64,576	9,698	4,675	724	2,063	-1,843
Blaenau Gwent	28,392	29,154	22,940	3,277	2,174	23,201	4,163	1,791	260	886	-384
Torfaen	39,730	40,126	33,474	4,078	2,178	33,853	5,180	1,093	380	1,102	-1,085
Monmouthshire	35,001	33,600	27,727	1,970	5,304	28,042	2,502	3,057	315	532	-2,247
Newport	71,382	72,730	62,572	6,477	2,333	63,282	8,227	1,221	710	1,750	-1,112
Cardiff	147,607	152,011	129,257	16,271	2,079	130,723	20,668	620	1,467	4,397	-1,458
<b>Total Unitary Authorities</b>	<b>1,311,799</b>	<b>1,311,799</b>	<b>1,069,116</b>	<b>114,127</b>	<b>128,556</b>	<b>1,081,246</b>	<b>144,964</b>	<b>85,589</b>			