



National Evaluation of Local Public Service
Agreements

The impact of LPSA targets: multivariate analysis



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The impact of LPSA targets: multivariate analysis

Introduction

The aim of this report is to provide an assessment of the impact of LPSA targets on local service performance. We address the following questions:

- Do authorities that set a LPSA target on a specific indicator perform better than those without a target?
- Does the level of 'stretch' associated with a LPSA target influence the extent of service improvement?
- Does the number of LPSA targets that are set in the same service area influence the extent of service improvement?

We answer these questions by including measures of these variables (target/no-target, stretch and number of targets) in multivariate models of local service performance. The modelling strategy and data are summarised in the technical annexes.

Data

We used 20 nationally comparable performance indicators for which we have sufficient cases for statistical analysis. The data set includes eight indicators for education, seven for social services, two for crime reduction, and one for each of transport, waste and electronic service delivery (see annex 1). The database for our analysis consists of two parts: target data and performance data. The target data were derived from a database and LPSA documents provided to the researchers by the Department for Communities and Local Government. The database contains target information for 144 'first generation' LPSAs signed between 2001 and 2004. In parallel, we built up a local public services performance database from three sources: Best Value Performance Indicators (BVPI), the Performance Assessment Framework (PAF) of the Department of Health and DfES¹ statistical returns. These data were downloaded online from the official websites of the Audit Commission (www.audit-commission.gov.uk), Department of Health (www.doh.gov.uk) and Department for Education and Skills (www.dfes.gov.uk) respectively. The descriptive statistics for the LPSA performance indicators are presented in annex 2.

We distinguish the performance of authorities that selected an LPSA target on a specific indicator from those that did not have an LPSA target on the indicator. This is a two dimensional classification as shown in diagram 1. We first differentiate those local authorities adopting a target in a particular year from those that did not. Then

¹ The Department for Education and Skills is now the Department for Children, Schools and Families (DCSF).

we identify the beginning year of LPSAs for the local authorities that adopted the target, and distinguish those years without a target from those with a target. This leaves a quadrant of cases with 'target-oriented performance' (TOP)². The rest of the cases are NTOP (non-target-oriented performance).

Diagram 1. The Classification of TOP and NTOP observations

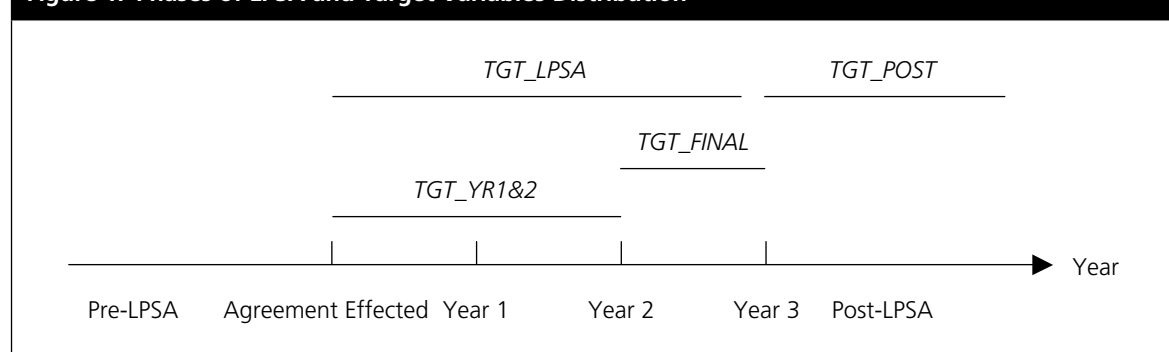
		144 Local Authorities	
		Authorities that adopted a target on the indicator	Authorities that did not adopt a target on the indicator
Time Series	Cross Sections		
	Years (2000/01–2005/06)	LPSA in operation Target-oriented (TOP)	LPSA in operation NTOP
		Pre-LPSA Non-target-oriented (NTOP)	Pre-LPSA NTOP

Results

The model and method we used for the empirical study are elaborated in annex 3. The detailed regression results of testing our multivariate model are presented in annex 4. The estimation method we used in the research is justified through multiple tests on data distribution and model specifications.

Using a 'performance pool' of 144 local authorities which signed an LPSA during the six year 'window period' of 2000/01–2005/06, our model assesses the performance of 20 targeted indicators in different phases (see figure 1): the first two years of an LPSA agreement (TGT_YR1&2), the final year of an LPSA agreement (TGT_FINAL), the three years of an LPSA agreement (TGT_LPSA) and the years after an LPSA was concluded (TGT_POST). We compare each of these against the rest of years/authorities with no target on the particular indicator. The introduction of the post-LPSA variable captures lagged or long-term effects that may be attributable to the inputs or institutional changes in the LPSA implementation process.

Figure 1. Phases of LPSA and Target Variables Distribution



² The target on a particular indicator is not standardised across local authorities. Some may have more than one target on the same indicator. We choose the target closest to the indicator.

Controlling for the baseline and unique individual time-invariant environmental effects (such as population size and location), our models provide a comparison between target-oriented performance (TOP) and non-target-oriented performance (NTOP) with the same baseline performance level and with the same baseline environmental conditions. If the coefficients of the relevant variables are significantly positive (for indicators like pupils' exam results) or negative (for indicators like truancy rate or crime rate), TOP cases are likely to have improved more than NTOP cases. If the coefficient is significant in the opposite direction, then the target has an adverse impact. If the coefficient is not significant, there is no real difference between TOP and NTOP cases, and therefore no effect of LPSA targets on performance.

The pattern of the evidence is summarised in table 1 and table 2. We show the full results of the models in annex 4.

Table 1. How Targets Affected Performance (20 Indicators)		
	Significantly Better Performance	No Significant Difference
TGT_YR1&2	16 (80%)	4 (20%)
TGT_FINAL	18 (90%)	2 (10%)
TGT_LPSA	16 (80%)	4 (20%)
TGT_POST	17 (85%)	3 (15%)

Notes:

TGT_YR1&2= A dummy variable indicating whether the performance is with LPSA year 1 or 2. 1 stands for yes and 0 otherwise.

TGT_FINAL= A dummy variable indicating whether the performance is with the final year of LPSA. 1 for yes and 0 otherwise.

TGT_POST= A dummy variable indicating whether the performance is with the following year of the conclusion of LPSA. 1 for yes and 0 otherwise.

TGT_LPSA= A dummy variable indicating whether the performance is within LPSA agreement period. 1 for yes and 0 otherwise.

The percentage of the total of 20 indicators is shown in parentheses.

The empirical evidence shows that:

- Targets had a significant³ positive impact on 16 out of 20 the LPSA performance indicators during the LPSA agreement period. The number of targets with a significant positive impact increased to 18 in the final year of the LPSA period. We find no significant adverse target effect. That is, there is no evidence of performance deterioration because of LPSA targets on any indicator.
- The size of performance improvement differs across phases of the LPSA period. The final year of LPSA shows much stronger performance improvement than the first two years of performance. Post-LPSA performance is even better than

³ 'Significant' means larger than would be likely to occur by chance alone.

the final year of LPSA in 70 per cent of targets (12/17) in which a significant positive post-LPSA effect is identified. In other words, performance continues to improve even after the end of the LPSA, and that the benefits of the regime outlive the payment of the reward grant. Moreover, from the perspective of central government, this can be interpreted as 'free' service improvement.

- A higher level of stretch does not enhance the positive impact of LPSAs on targeted performance. It shows a slight adverse impact (reducing the size of performance improvement) on one indicator (pupils' absence rate).
- The balance of the evidence suggests that the number of LPSA targets in the same service area has a non-linear impact: performance at first improves with the number of targets, but, after reaching the 'optimum' number, declines with more targets. The optimum number of targets for education is two to three. Social services needed to have three to four targets to reach the best performance level. Other service areas such as environment and road safety performed better with only one or two targets. However, we cannot find a satisfactory explanation for this pattern from our qualitative research. It may simply be a product of some unrepresentative cases, given the very small sample size. Accordingly we would caution against too much weight being put on this result.

Conclusion

These results suggest that LPSAs have been effective in driving service improvement on the targeted indicators. The positive impact on performance was stronger in the final year of LPSA than in the first two years. The upward trend of performance accelerated in the post-LPSA period, indicating a strong lagged effect. The underlying explanation for the positive impact of LPSAs is further examined through our survey data, in "The impact of target formulation and implementation processes on reward rate" (published alongside this document on the Communities and Local Government website).

Table 2. Target Effect on the Performance on 22 National Indicators (2000/01–2005/06)

No.	INDICATOR	LPSA Years 1 & 2	LPSA Final Year	Post-LPSA Years (1, 2)	LPSA Year 1, 2 & 3	N_TGTS Curve Shape	Optimum Target Number
1	KS24E	+ 1.3%	+ 2.6%	+ 3.9%	+ 1.7%	∩	2.3
2	KS24M	+ 1.5%	+ 2.5%	+ 4.1%	+ 1.8%	∩	2.3
3	KS35E	+ 2.0%	+ 2.7%	+ 5.0%	+ 2.2%	∩	2.8
4	KS35M	+ 1.2%	+ 1.7%	+ 1.3%	+ 1.3%	∩	2.6
5	KS35S	+ 0.9%	+ 1.5%	+ 2.9%	+ 1.1%	∩	2.5
6	GCSE5AC	+ 1.1%	+ 2.4%	+ 3.4%	+ 1.4%	∩	2.9
7	UNAUTH1*	–	– 0.2%	– 0.3%	–	∪	3.0
8	UNAUTH2*	–	– 0.2%	– 0.3%	–	∪	1.3
9	LAC_G1AG	+ 6.0%	+ 8.5%	+ 13.4%	+ 6.7%		
10	LAC_ENGAGE	+ 13.6%	+ 30.3%	+ 26.5%	+ 16.6%	∪	3.4
11	LAC_TRUANCY*	–	–	–	–		
12	ADOPTION	+ 1.0%	+ 2.4%	+ 1.3%	+ 1.4%		
13	OLDCARE	+ 0.846 per 1,000 aged 65 or over	+ 1.911 per 1,000 aged 65 or over	+ 1.833 per 1,000 aged 65 or over	+ 1.101 per 1,000 aged 65 or over	∪	3.6
14	HOMEHELP	–	–	–	–		
15	ADMISSION*	– 13.299 per 10,000 aged 65 or over	– 19.067 per 10,000 aged 65 or over	– 20.732 per 10,000 aged 65 or over	– 14.731 per 10,000 aged 65 or over		
16	BURGLAR*	– 2.362 per 1,000 households	– 5.270 per 1,000 households	– 7.264 per 1,000 households	– 3.169 per 1,000 households		
17	VEHICLE*	– 1.817 per 1,000 population	– 2.364 per 1,000 population	– 2.604 per 1,000 population	– 1.960 per 1,000 population	∩	3.4
18	ROAD_KS I*	– 4.552 per 100,000 population	– 7.662 per 100,000 population	– 12.255 per 100,000 population	– 5.475 per 100,000 population	∩	1.6
19	WASTE	+ 2.3%	+ 4.5%	+ 4.4%	+ 2.8%	∪	1.4
20	ESD	+ 7.3%	+ 14.6%	–	+ 9.2%	∪	1.0

Notes:

* 'Negative' indicators (such as pupils' truancy rate and crime rate) are marked with an asterisk. For these indicators, performance is better if the score on the indicator becomes lower, – stands for no significant target effect; + 1.3% means TOP is significantly higher than NTOP by 1.3%; – 1.3% means TOP is significantly lower than NTOP by 1.3%.

∩ Performance first increases then decreases with target number. Performance reaches highest value at turning point. ∪ Performance first decreases then increases with target number. Performance reaches lowest value at turning point.

Annex 1: Target performance indicator list

Policy Area	Variable	Definition	Number of Authorities that adopted the indicator in their LPSA				
			2001/02	2002/03	2003/04	2004/05	Total
Education	KS24E	BVPI 40 – The percentage of pupils achieving level 4+ at Key Stage 2 in English	5	9	16	2	32
Education	KS24M	BVPI 41 – The percentage of pupils level 4+ at Key Stage 2 in Maths	5	8	15	2	30
Education	KS35E	BVPI 181a – The percentage of 14 year olds achieving level 5 in English	13	21	22	4	60
Education	KS35M	BVPI 181b – The percentage of 14 year olds achieving level 5 in Maths	13	21	22	4	60
Education	KS35S	BVPI 181c – The percentage of 14 year olds achieving level 5 in Science	13	21	22	4	60
Education	GCSE5AC	BVPI 38 – The percentage of pupils attaining 5 or more GCSEs grades A*-C	16	29	30	1	76
Education	UNAUTH2 ^a	BVPI 45 – The percentage of half days missed due to unauthorised absence in secondary schools	7	23	40	5	75
Education	UNAUTH1 ^b	BVPI 46 – The percentage of half days missed due to unauthorised absence in primary schools	5	15	34	3	57

Policy Area	Variable	Definition	Number of Authorities that adopted the indicator in their LPSA				
			2001/02	2002/03	2003/04	2004/05	Total
Social Services	LAC_G1AG	BVPI 50 (DH PAF A2) – The percentage of young people aged 16 or over leaving care with at least 1 GSCSE (grade A*-G) or a GNVQ	7	23	32	2	64
Social Services	LAC_ENGAGE	BVPI 161 (PAF A4) – The percentage of young people who were looked after on 1 April in their 17th year (aged 16) who were engaged in education, training or employment at the age of 19	0	15	32	2	49
Social Services	LAC_TRUANCY	DH PAF C24 – The percentage of children looked after absent from school (who missed 25 days+ of schooling for any reason during the previous school year)	0	11	11	0	22
Social Services	ADOPTION	BVPI 163 (DH PAF C23) – The number of children who ceased to be looked after during the year as a result of the granting of an adoption or special guardianship order, as a percentage of the number of children looked after at 31 March who had been looked after for 6 months or more on that day.	7	24	14	2	47

Policy Area	Variable	Definition	Number of Authorities that adopted the indicator in their LPSA				
			2001/02	2002/03	2003/04	2004/05	Total
Social Services	OLDCARE	DH PAF C28 – Number of households receiving intensive home care per 1,000 population aged 65 and over	8	16	31	4	59
Social Services	HOMEHELP	DH PAF C32 – Number of older people helped to live at home per 1,000 population aged 65 or over	5	15	26	2	48
Social Services	ADMISSION ^c	DH PAF C26 – Number of supported admissions of people aged 65 and over to permanent residential and nursing care per 10,000 population aged 65 and over	8	15	23	3	49
Crime Reduction	BURGLAR	BVPI 126 – Number of burglaries per 1,000 households	7	15	27	4	53
Crime Reduction	VEHICLE	BVPI 128 – Number of vehicle crimes per 1,000 population	4	6	12	3	25
Transport	ROAD_KSI ^d	BVPI 99 – Number of road accident casualties (killed or seriously injured) per 100,000 population	15	36	36	3	90
Waste	WASTE ^e	BVPI 82 – The percentage of household waste recycled and composted	10	20	18	0	48
Electronic Service Delivery	ESD	BVPI 157i – The percentage of services delivered electronically	10	7	1	0	18

Notes:

^a The indicator definition was amended in 2002/03 to measure total absences in primary schools.

^b The indicator definition was amended in 2002/03 to measure total absences in secondary schools.

^c The indicator definition was amended in 2005/06 and recoded as PAF C72.

^d The indicator was amended to measure the absolute number of people killed or seriously injured (KSI) in road traffic collisions since 2004/05. To make the data comparable over time series, we amalgamate BVPI 99a, BVPI 99b, BVPI 99c, BVPI 99d, and BVPI 99e between 2000/01 and 2003/04 and divided this number by the population figure obtained from the ONS 2001 census.

^e The indicator is measured as the sum of BVPI 82a (recycle) & 82 b (composting)

Annex 2: Descriptive statistics for the performance indicators of local authorities with LPSA

BVPI/DH PAF	Variable	Year	N	Mean	Standard Deviation ³	Minimum	Maximum
BVPI 40	KS24E	2000/01	141	73.97%	4.90%	60.10%	84.10%
		2001/02	144	74.41%	4.70%	61.70%	85.00%
		2002/03	144	73.96%	4.61%	62.00%	84.00%
		2003/04	144	74.77%	4.57%	63.20%	87.00%
		2004/05	144	77.13%	4.04%	67.80%	87.00%
		2005/06	144	78.62%	4.03%	66.00%	88.10%
BVPI 41	KS24M	2000/01	141	71.05%	4.70%	58.90%	83.10%
		2001/02	144	70.30%	4.66%	59.70%	82.00%
		2002/03	144	72.74%	4.17%	62.00%	83.00%
		2003/04	144	72.06%	4.16%	62.50%	82.00%
		2004/05	144	73.71%	4.31%	64.00%	84.00%
		2005/06	144	74.69%	4.08%	66.00%	84.90%
BVPI 181a	KS35E	2000/01	144	62.91%	8.13%	41.00%	79.00%
		2001/02	144	63.80%	7.46%	41.00%	79.00%
		2002/03	144	65.88%	6.76%	43.00%	81.00%
		2003/04	144	67.89%	6.69%	46.00%	80.00%
		2004/05	144	69.86%	6.58%	53.00%	83.00%
		2005/06	144	73.12%	6.17%	49.00%	85.00%
BVPI 181b	KS35M	2000/01	144	63.09%	8.30%	42.00%	78.00%
		2001/02	144	64.81%	7.80%	43.00%	78.00%
		2002/03	144	65.90%	7.27%	46.00%	78.00%
		2003/04	144	69.67%	6.52%	52.00%	81.90%
		2004/05	144	72.00%	6.05%	58.00%	83.00%
		2005/06	144	73.04%	5.77%	58.00%	83.44%
BVPI 181c	KS35S	2000/01	144	57.31%	9.64%	31.00%	73.00%
		2001/02	144	63.98%	8.93%	39.00%	79.00%
		2002/03	144	65.10%	8.28%	43.00%	80.00%

BVPI/DH PAF	Variable	Year	N	Mean	Standard Deviation ³	Minimum	Maximum
		2003/04	144	67.00%	7.79%	45.71%	84.30%
		2004/05	144	64.83%	7.65%	46.00%	81.00%
		2005/06	144	68.59%	7.31%	49.50%	82.80%
BVPI 38	GCSE5AC	2000/01	144	45.90%	8.51%	25.00%	63.40%
		2001/02	144	46.75%	8.13%	27.10%	63.40%
		2002/03	144	48.41%	7.94%	30.10%	64.80%
		2003/04	144	50.20%	7.46%	33.50%	67.00%
		2004/05	144	51.12%	6.96%	35.10%	68.10%
		2005/06	144	54.19%	6.39%	36.10%	70.00%
BVPI 45	UNAUTH2	2000/01	141	1.16%	0.62%	0.34%	3.10%
		2001/02	144	1.16%	0.64%	0.30%	3.50%
		2002/03	144	8.87%	1.18%	6.70%	12.40%
		2003/04	144	8.33%	1.08%	2.11%	11.30%
		2004/05	144	8.13%	0.96%	6.13%	11.30%
		2005/06	144	7.88%	0.90%	6.19%	11.50%
BVPI 46	UNAUTH1	2000/01	141	0.51%	0.35%	0.06%	1.60%
		2001/02	144	0.52%	0.35%	0.10%	1.89%
		2002/03	144	5.98%	0.72%	4.70%	8.20%
		2003/04	144	5.89%	0.69%	2.51%	7.50%
		2004/05	144	5.58%	0.56%	4.40%	7.00%
		2005/06	144	5.55%	0.54%	4.60%	6.91%
BVPI 50	LAC_G1AG	2000/01	141	37.69%	12.30%	8.30%	66.70%
		2001/02	144	42.09%	11.53%	16.67%	82.60%
		2002/03	144	43.88%	11.16%	0.00%	80.00%
		2003/04	144	48.94%	14.03%	0.00%	80.00%
		2004/05	144	50.42%	11.79%	0.00%	77.00%
		2005/06	139	53.75%	11.10%	28.00%	91.67%
BVPI 161	LAC_ENGAGE	2000/01	--	--	--	--	--
		2001/02	144	47.28%	17.10%	0.00%	100.00%
		2002/03	144	50.12%	14.72%	0.00%	93.80%
		2003/04	144	56.65%	13.90%	20.00%	89.80%
		2004/05	142	70.48%	17.51%	29.00%	135.00%
		2005/06	133	77.71%	16.88%	30.26%	112.56%

BVPI/DH PAF	Variable	Year	N	Mean	Standard Deviation ³	Minimum	Maximum
DH PAF C24	LAC_TRUANCY	2000/01	119	12.00%	6.01%	0.00%	33.33%
		2001/02	129	12.43%	5.20%	0.00%	28.33%
		2002/03	133	12.55%	5.68%	0.00%	36.11%
		2003/04	133	12.89%	5.24%	0.00%	27.85%
		2004/05	134	12.38%	4.75%	0.00%	23.53%
		2005/06	139	12.51%	4.45%	0.00%	24.17%
BVPI 163	ADOPTION	2000/01	136	5.64%	2.65%	0.00%	14.41%
		2001/02	144	7.31%	3.14%	1.72%	19.50%
		2002/03	144	6.99%	3.16%	0.00%	21.30%
		2003/04	144	7.57%	2.71%	1.60%	18.40%
		2004/05	144	7.60%	2.97%	0.00%	17.80%
		2005/06	135	7.90%	2.89%	3.17%	16.10%
DH PAF C28	OLDCARE	2000/01	141	11.03	6.04	1.60	32.21
		2001/02	144	11.54	5.91	2.10	32.82
		2002/03	144	12.01	6.10	2.20	33.29
		2003/04	144	12.37	5.74	3.10	32.80
		2004/05	144	12.97	5.43	3.60	30.99
		2005/06	144	13.82	5.91	4.25	39.02
DH PAF C32	HOMEHELP	2000/01	141	89.20	32.12	37.10	215.00
		2001/02	144	89.57	27.62	48.87	181.00
		2002/03	144	90.61	26.52	42.55	184.49
		2003/04	144	88.92	24.99	37.80	183.03
		2004/05	144	86.28	25.17	30.50	173.51
		2005/06	144	87.85	23.02	39.16	155.84
DH PAF C26	ADMISSION	2000/01	144	111.89	29.54	52.13	223.30
		2001/02	144	110.94	23.36	63.18	171.67
		2002/03	144	103.11	21.50	43.90	144.38
		2003/04	144	103.01	19.35	45.92	178.84
		2004/05	144	90.87	17.76	20.85	135.71
		2005/06	144	86.76	17.12	41.70	150.50
BVPI 126	BURGLAR	2000/01	141	20.27	10.05	6.90	52.90
		2001/02	143	21.55	10.89	6.20	58.40
		2002/03	144	21.57	11.21	6.60	64.75

BVPI/DH PAF	Variable	Year	N	Mean	Standard Deviation ³	Minimum	Maximum
		2003/04	144	19.83	9.72	6.62	64.10
		2004/05	144	15.64	7.42	3.60	51.07
		2005/06	144	14.79	7.11	4.90	46.10
BVPI 128	VEHICLE	2000/01	141	21.93	11.50	5.90	92.00
		2001/02	143	21.33	10.10	4.89	54.05
		2002/03	144	20.91	9.32	5.60	50.88
		2003/04	144	18.69	8.17	0.00	46.31
		2004/05	144	15.46	6.29	5.20	36.24
		2005/06	144	14.89	6.40	5.10	36.50
BVPI 99	ROAD_KSI	2000/01	139	78.25	68.39	27.00	617.00
		2001/02	144	68.92	26.43	22.49	165.00
		2002/03	144	67.95	25.85	21.00	206.04
		2003/04	144	65.28	22.90	23.63	175.92
		2004/05	144	61.62	21.05	28.53	188.10
		2005/06	144	56.25	19.18	20.05	155.00
BVPI 82	WASTE	2000/01	140	11.73%	6.19%	1.67%	34.70%
		2001/02	144	11.58%	5.58%	1.42%	28.53%
		2002/03	143	13.30%	6.07%	1.87%	30.58%
		2003/04	143	16.48%	6.11%	3.80%	35.00%
		2004/05	144	20.49%	6.74%	6.23%	37.76%
		2005/06	144	24.84%	7.22%	8.85%	43.48%
BVPI 157i	ESD	2000/01	–	–	–	–	–
		2001/02	135	39.05%	14.81%	5.05%	89.90%
		2002/03	144	49.83%	14.62%	10.53%	100.00%
		2003/04	144	66.64%	17.35%	15.79%	100.00%
		2004/05	144	78.84%	16.74%	15.60%	100.00%
		2005/06	144	97.89%	3.65%	81.01%	100.00%

Notes: Among 150 English upper and single tier local authorities, as confirmed by CLG, 6 of them did not sign an LPSA. They are City of London, Isle of Scilly, London Borough of Hackney, Wakefield Metropolitan District, Walsall Metropolitan Borough, and Kingston upon Hull City.

⁴ The standard deviation measures how widely spread the data are. The higher the standard deviation, the wider the dispersion around the mean.

Annex 3: Model and estimation methodology

We constructed the following empirical model⁵ to estimate the impact of a target on local service improvement:

$$\begin{aligned}
 P_{it} = & \beta_0 + \beta_1 TGT_YR1\&2_{it} + \beta_2 TGT_FINAL_{it} + \beta_3 TGT_POST_{it} + \beta_4 STRETCH_{it} \\
 & (+) \qquad \qquad \qquad (+) \qquad \qquad \qquad (+) \qquad \qquad \qquad (+) \\
 & + \beta_5 P_{i(t-1)} + \beta_6 P_{i(t-1)}^2 + \beta_7 N_TGTS_t + \beta_8 N_TGTS_t^2 + \sum_{d=1}^{146} \delta_d LA_DUMMY_{d(it)} + \varepsilon_{it} \\
 & (+/-) \qquad \quad (-/+) \qquad \quad (+/-) \qquad \quad (-/+)
 \end{aligned}$$

where the β s and δ_d are coefficients and ε_{it} is the error term for the equation. The expected signs of the coefficients for the explanatory variables for which we have directional hypotheses are displayed below the equation. *TGT_YR1&2* is a dummy⁶ variable, which is coded 1 for targeted performance during the first two years of agreement, and 0 otherwise. Likewise, *TGT_FINAL* stands for the deadline year for targeted performance and *TGT_POST* for the years after LPSA. Figure 1 shows the allocation of these target variables across the LPSA time period. *STRETCH* is measured as the ratio of the difference between target with LPSA and baseline over the difference between target without LPSA and baseline performance. *N_TGTS* is the number of targets in the same service area such as education and social services. *P* stands for performance on an LPSA indicator; *LA_Dummy* is a set of dummy variables for each authority in the data set.

The local authority dummy variables control for unique fixed effects arising from time-invariant⁷ environmental characteristics of a local authority, such as geographical location, socio-economic conditions, population size and composition. So long as these environmental factors are stable within the individual authorities and along the sample period, we can combine the fixed effects into one time-invariant dummy variable and control their differential effects across local authorities.

The inclusion of the lagged performance variable and its squared term represents a nonlinear relationship between current performance and baseline performance. Realistically, the higher the baseline performance level is, the less the scope for further improvement. This can be attributed to the increasing constraints of the resources and management capacity needed for achieving higher performance. The worst performers should have greater than average scope for performance improvement. In other words, the margin of performance improvement is likely to decrease when lagged performance gets higher. To control for the non-linear

⁵ To avoid perfect multicollinearity, we replace *TGT_YR1&2* and *TGT_FINAL* with *TGT_LPSA* to assess average target effect during three years of LPSA agreement. The results are presented in Appendix 4–2. There could be a high multicollinearity between *STRETCH* and *TGT_LPSA* as the latter contains the effect of the former. We test the model specification for added effect that could be attributed to varying stretch level. The results are presented in Appendix 4–3.

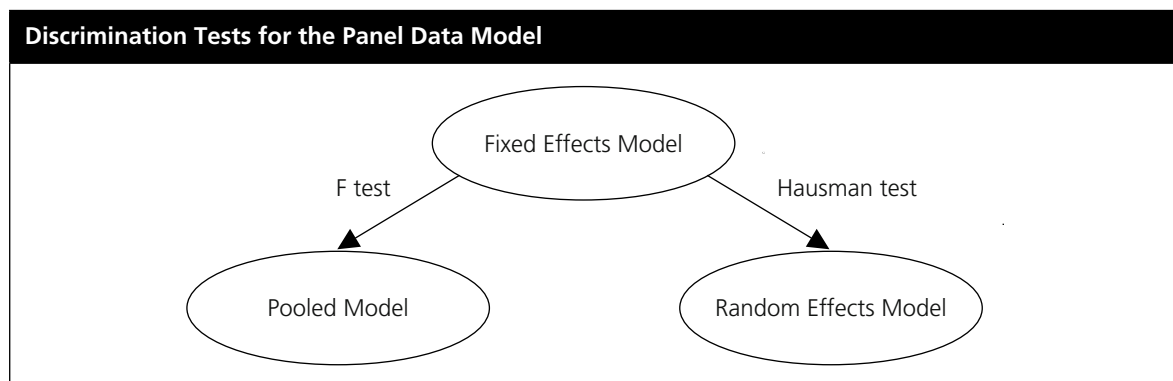
⁶ Also called dichotomous variable. It codes 1 for those observations from a particular local authority, 0 otherwise.

⁷ Some characteristics may change gradually like population size, but the change in the ‘window period’ could be too small to make a effect.

baseline effect on performance improvement, we introduce a quadratic form of baseline performance in the model. We expect an 'inverted U' non-linear relationship between current performance and lagged performance.

Similarly, we assume a non-linear effect for target number. The number of targets in a service area identifies the potential number of sub-areas that need to be prioritised for improvement in the 'window' period of six years. The more targeted sub-areas in the same service area, the more resources and efforts will be invested. This could produce synergistic benefits across related targets. However, a large number of targets in the same area may lead to a 'crowding-out' effect between them. The pattern could be reversed: performance at first declines with more targets, but then improves as target effects complement each other. To strike a balance, we expect the existence of an optimum number of targets in a service area. Therefore, we add a quadratic term for target number into the model.

We have pooled all the cases for each indicator across the years 2000/01 to 2005/06. This panel data model allows us to examine issues that could not be studied in either cross-sectional or time-series settings alone (Greene 2003). The three main estimation techniques for panel data are a pooled model, fixed-effects model and random effects model. The major distinction between the three methods lies in their assumptions. The pooled model assumes the absence of differential fixed effects from individual local authorities, so using local authority dummies would not be necessary. In contrast, both the random effects model and the fixed effects model can handle individual unit effects.



We need to run two discrimination tests before applying a fixed effects model, as shown in diagram I. Firstly, we apply a F test to diagnose whether fixed effects are present. The inclusion of fixed effects allows each local authority to have a unique intercept instead of one common intercept (as in the pooled model). The null hypothesis for the F-test can be expressed as:

$$\delta_1 = \delta_2 = \dots = \delta_{146} = 0$$

which means the coefficients of the local authority dummies are jointly equal to zero⁸. If this test rejects the null that fixed effects are zero, we can reject the pooled model. Next we apply the Hausman test, which is the classical test for discriminating

⁸ The F test is equivalent to assessing whether the overall effect of local authority dummies on performance is distinct.

between fixed effects and random effects models. This test compares the covariance matrix of the regressors in the fixed effects model with those in the random effects model, under the null hypothesis that there is no systematic difference between the two covariance matrices. If the null is rejected, the fixed effects model is superior to the random effects model.

We cannot assume that the observations are identically and independently distributed across local authorities and over time. Heteroskedasticity⁹ is the cross-sectional problem that we need to address. The consequence of this problem is biased standard errors of the coefficients and, in turn, misleading t-statistics. The chance of encountering heteroskedasticity across a panel of local authorities is much higher than that in non-panel data. Therefore, we use a Modified Wald test (Greene 2003) to diagnose heteroskedasticity across individual groups, with the null hypothesis of homoskedasticity. A time series problem that plagues panel data is autocorrelation. This results in underestimated standard errors and thus unreliable t-statistics for the coefficients. We run the first order Arellano–Bond (1991) autocorrelation tests to diagnose the error structure. The null hypothesis of the test is the absence of serial correlation across certain lags.

The presence of heteroskedasticity and autocorrelation calls for the application of robust panel model regression¹⁰. This provides robust standard errors for computing reliable t-test statistics for the estimated coefficients. The most popular robust standard errors used in econometrics are the White standard errors (White 1980) and Newey–West standard errors (Newey and West 1987). The former can deal with heteroskedasticity, and the latter are robust in the presence of both heteroskedasticity and autocorrelation. We performed robust panel data regressions and diagnostic tests with STATA 8. The results of the diagnostic tests we employed justified the use of fixed effects and robust regressions techniques (see annex 4).

⁹ Heteroskedasticity is a non-normal form of error distribution in a regression.

¹⁰ The results of normal (least squares) regressions can be misleading when the error distribution is not normal. One remedy is to remove influential observations from the regression. The other remedy is robust regression, which employ a fitting criterion that is not as vulnerable as least squares to the effects of non-normal error distributions. We prefer the latter because the procedure retains all the cases.

Annex 4

4-1. Target Year 1&2, Final Year and Post-Target Effects on Local Public Service Performance (2001/02-2005/06)

	1	2	3	4	5	6	7	8	9	10
	KS24E	KS24M	KS35E	KS35M	KS35S	GCSE5AC	UNAUTH1 ^a	UNAUTH2 ^a	LAC_G1AG	LAC_ENGAGE
TGT_YR1&2	0.013*** [0.003]	0.015*** [0.004]	0.020*** [0.004]	0.012*** [0.003]	0.009*** [0.003]	0.011*** [0.003]	0.000 [0.001]	0.000 [0.001]	0.060*** [0.017]	0.136*** [0.027]
TGT_FINAL	0.026*** [0.004]	0.025*** [0.004]	0.027*** [0.006]	0.017*** [0.003]	0.015*** [0.005]	0.024*** [0.004]	-0.002*** [0.001]	-0.002** [0.001]	0.085*** [0.021]	0.303*** [0.042]
TGT_POST	0.039*** [0.005]	0.041*** [0.005]	0.050*** [0.007]	0.013*** [0.004]	0.029*** [0.004]	0.034*** [0.005]	-0.003*** [0.001]	-0.003** [0.001]	0.134*** [0.025]	0.265*** [0.059]
P_{t-1}	0.388 [0.689]	0.240 [0.751]	1.592*** [0.367]	1.374*** [0.146]	1.237*** [0.153]	1.717*** [0.215]	-0.176*** [0.033]	-0.242*** [0.042]	0.597*** [0.205]	0.428* [0.253]
P_{t-1}²	0.084 [0.461]	0.027 [0.521]	-0.742** [0.296]	-0.437*** [0.115]	-0.897*** [0.134]	-1.062*** [0.241]	2.034*** [0.501]	1.605*** [0.405]	-0.576** [0.228]	-0.129 [0.201]
N_TGTS	0.027*** [0.007]	0.042*** [0.006]	0.039*** [0.008]	0.021*** [0.004]	0.085*** [0.004]	0.023*** [0.006]	-0.006*** [0.001]	-0.005*** [0.001]	-0.005 [0.064]	-0.121** [0.061]
N_TGTS²	-0.006*** [0.001]	-0.009*** [0.001]	-0.007*** [0.002]	-0.004*** [0.001]	-0.017*** [0.001]	-0.004*** [0.001]	0.001*** [0.000]	0.002*** [0.000]	0.002 [0.008]	0.018** [0.009]
Constant	0.416 [0.259]	0.543** [0.271]	-0.064 [0.116]	-0.041 [0.048]	0.231*** [0.045]	-0.098* [0.051]	0.004*** [0.001]	0.017*** [0.001]	0.365*** [0.100]	0.529*** [0.109]
Hetero. test	2192.7***	13013.6***	18093.1***	8060.4***	406.5***	6866.1***	25.4	30.6	6220.8***	18000***
AR(1) test	-2.38***	-6.10***	-5.79***	-6.31***	-8.4***	-6.93***	-2.04**	-1.2	-3.69***	-4.63***
F test for fixed effects	1.92***	2.45***	1.73***	2.11***	7.34***	3.92***	27.99***	26.4***	4.37***	4.50***
Hausman test	97.9***	189.7***	46.6***	48.9***	695.1***	48.6***	-339.7	312.0***	149.6***	62.07***
N	717	717	720	720	720	720	717	717	712	563
R²	0.85	0.85	0.85	0.94	0.95	0.94	0.98	0.98	0.48	0.53
Adjusted R²	0.81	0.81	0.81	0.93	0.93	0.93	0.98	0.97	0.34	0.36

	11	12	13	14	15	16	17	18	19	20
	LAC_TRUANCY	ADOPTION	OLDCARE	HOMEHLP	ADMISSION ^b	BURGLAR	VEHICLE	ROAD_KSI	WASTE	ESD
TGT_YR1&2	0.004 [0.015]	0.010** [0.004]	0.846*** [0.205]	2.644 [2.042]	-13.299*** [2.700]	-2.362*** [0.452]	-1.817** [0.767]	-4.552*** [1.385]	0.023*** [0.005]	0.073* [0.043]
TGT_FINAL	-0.013 [0.014]	0.024*** [0.006]	1.911*** [0.273]	1.636 [2.672]	-19.067*** [3.554]	-5.270*** [0.745]	-2.364*** [0.891]	-7.662*** [1.458]	0.045*** [0.009]	0.146*** [0.056]
TGT_POST	-0.004 [0.017]	0.013** [0.006]	1.833*** [0.498]	0.344 [3.220]	-20.732*** [4.462]	-7.264*** [1.080]	-2.604*** [0.899]	-12.255*** [1.979]	0.044*** [0.012]	0.052 [0.053]
P_{t-1}	-0.031 [0.174]	0.017 [0.197]	0.611*** [0.140]	0.269 [0.238]	-0.369 [0.265]	0.482*** [0.110]	0.623*** [0.111]	0.309*** [0.085]	1.285*** [0.122]	1.589*** [0.203]
P_{t-1}²	0.372 [0.628]	-1.056 [1.224]	-0.006 [0.006]	0.000 [0.001]	0.002 [0.001]	0.001 [0.002]	-0.001 [0.001]	-0.000*** [0.000]	-1.000** [0.439]	-0.689*** [0.166]
N_TGTS	-0.012 [0.011]	-0.008 [0.016]	-1.463*** [0.298]	3.225 [3.856]	-1.106 [4.670]	6.340* [3.243]	6.083*** [1.707]	168.160*** [13.625]	-0.028** [0.013]	-0.254** [0.108]
N_TGTS²	0.000 [0.002]	0.000 [0.002]	0.205*** [0.039]	-0.925* [0.512]	0.356 [0.784]	-0.748 [0.643]	-0.896*** [0.328]	-53.077*** [4.374]	0.010** [0.004]	0.131** [0.066]
Constant	0.190*** [0.015]	0.139*** [0.021]	6.239*** [0.997]	62.196*** [12.783]	116.901*** [14.907]	4.529*** [0.937]	2.797*** [0.965]	22.657*** [3.213]	0.009 [0.013]	0.109 [0.072]
Hetero. test	7889.7***	5863.3***	15113.0***	54138.3***	13072.9***	31105.5***	130000***	12484.9***	82655.2***	43154.1***
AR(1) test	-2.09**	-2.17**	-1.95**	-2.12**	-3.80***	2.09**	-0.41	-1.18	0.84	-4.88***
F test for fixed effects	178.7***	5.49***	9.13***	8.38***	3.30***	3.11***	2.88***	4.81***	4.01***	2.39***
Hausman test	254.5***	141.9***	105.5***	26.84***	93.86***	98.8***	53.22***	219.7***	28.08***	20.45***
N	625	703	717	717	720	715	715	715	713	567
R²	0.55	0.46	0.94	0.77	0.61	0.88	0.87	0.86	0.87	0.63
Adjusted R²	0.42	0.32	0.93	0.71	0.50	0.85	0.84	0.83	0.84	0.50

Notes: Newey–West robust standard errors are in brackets. * significant at 10% level, ** significant at 5% level, and *** significant at 1% level. P stands for the relevant performance indicator. The coefficients of 143 local authority dummies for fixed-effects are not reported in the table.

^a We add a dummy control for target on either unauthorised absence (=1) or total absence (=0). We also add a dummy control for the indicator change, i.e. 1 for indicator before change in 2002/03, 0 otherwise.

^b We add a dummy control for the indicator change, i.e. 1 for indicator before change in 2005/06, 0 otherwise.

4-2. Target Year and Post-Target Effects on Local Public Service Performance (2001/02–2005/06)^b

	1	2	3	4	5	6	7	8	9	10
	K524E	K524M	K535E	K535M	K535S	GCSE5AC	UNAUTH1 ^a	UNAUTH2 ^a	LAC_G1AG	LAC_ENGAGE
TGT_LP	0.017*** [0.003]	0.018*** [0.004]	0.022*** [0.004]	0.013*** [0.002]	0.011*** [0.003]	0.014*** [0.003]	-0.001 [0.001]	0.000 [0.001]	0.067*** [0.015]	0.166*** [0.026]
TGT_POST	0.038*** [0.005]	0.041*** [0.005]	0.049*** [0.007]	0.012*** [0.004]	0.029*** [0.004]	0.031*** [0.005]	-0.003*** [0.001]	-0.003*** [0.001]	0.133*** [0.025]	0.208*** [0.057]
P_{t-1}	0.361 [0.683]	0.208 [0.746]	1.603*** [0.362]	1.360*** [0.143]	1.244*** [0.152]	1.757*** [0.210]	-0.187*** [0.032]	-0.255*** [0.041]	0.600*** [0.205]	0.430 [0.279]
P_{t-1}²	0.120 [0.457]	0.060 [0.519]	-0.741** [0.291]	-0.418*** [0.112]	-0.900*** [0.132]	-1.058*** [0.235]	2.174*** [0.500]	1.700*** [0.393]	-0.567** [0.229]	-0.054 [0.225]
N_TGTS	0.026*** [0.007]	0.041*** [0.006]	0.038*** [0.008]	0.020*** [0.004]	0.085*** [0.004]	0.020*** [0.005]	-0.006*** [0.001]	-0.005*** [0.001]	-0.006 [0.064]	-0.111** [0.056]
N_TGTS²	-0.005*** [0.001]	-0.009*** [0.001]	-0.007*** [0.002]	-0.004*** [0.001]	-0.017*** [0.001]	-0.003*** [0.001]	0.001*** [0.000]	0.002*** [0.000]	0.002 [0.008]	0.016** [0.008]
Constant	0.417 [0.256]	0.549** [0.269]	-0.071 [0.114]	-0.040 [0.047]	0.227*** [0.045]	-0.117** [0.050]	0.004*** [0.001]	0.017*** [0.001]	0.362*** [0.099]	0.502*** [0.110]
N	717	717	720	720	720	720	717	717	712	563
R²	0.85	0.85	0.85	0.94	0.95	0.94	0.98	0.98	0.48	0.53
Adjusted R²	0.81	0.81	0.81	0.93	0.93	0.93	0.98	0.97	0.34	0.36

	11	12	13	14	15	16	17	18	19	20
	LAC_TRUANCY	ADOPTION	OLDCARE	HOMEHELP	ADMISSION ^c	BURGLAR	VEHICLE	ROAD_KSI	WASTE	ESD
TGT_LP	-0.002 [0.013]	0.014*** [0.004]	1.101*** [0.197]	2.327 [2.061]	-14.731*** [2.499]	-3.169*** [0.439]	-1.960*** [0.746]	-5.475*** [1.296]	0.028*** [0.006]	0.092*** [0.032]
TGT_POST	-0.003 [0.018]	0.013** [0.006]	1.622*** [0.487]	0.361 [3.217]	-19.546*** [4.276]	-6.852*** [1.028]	-2.558*** [0.902]	-12.052*** [1.950]	0.039*** [0.012]	0.033 [0.043]
P_{t-1}	-0.047 [0.177]	0.026 [0.197]	0.690*** [0.137]	0.267 [0.237]	-0.355 [0.267]	0.530*** [0.111]	0.628*** [0.110]	0.325*** [0.084]	1.314*** [0.121]	1.592*** [0.199]
P_{t-1}²	0.453 [0.641]	-1.109 [1.227]	-0.007 [0.006]	0.000 [0.001]	0.002 [0.001]	0.000 [0.002]	-0.001 [0.001]	-0.000*** [0.000]	-0.982*** [0.439]	-0.683*** [0.162]
N_TGTS	-0.012 [0.011]	-0.008 [0.017]	-1.384*** [0.299]	3.229 [3.852]	-1.079 [4.584]	5.631* [3.170]	6.037*** [1.703]	165.836*** [13.549]	-0.029 [0.032]	-0.228*** [0.108]
N_TGTS²	0.000 [0.002]	0.000 [0.002]	0.194*** [0.039]	-0.927* [0.512]	0.337 [0.767]	-0.643 [0.628]	-0.890*** [0.327]	-52.361*** [4.354]	0.010 [0.011]	0.118* [0.066]
Constant	0.190*** [0.015]	0.139*** [0.021]	5.571*** [0.967]	62.261*** [12.747]	116.039*** [15.030]	4.072*** [0.944]	2.748*** [0.957]	22.107*** [3.188]	0.005 [0.012]	0.107 [0.071]
N	625	703	717	717	720	715	715	715	713	567
R²	0.55	0.45	0.94	0.77	0.60	0.88	0.87	0.86	0.87	0.63
Adjusted R²	0.42	0.30	0.93	0.71	0.50	0.85	0.84	0.83	0.84	0.50

Notes: Newey–West robust standard errors are in brackets. * significant at 10% level, ** significant at 5% level, and *** significant at 1% level. P stands for the relevant performance indicator. The coefficients of 143 local authority dummies for fixed-effects are not reported in the table.

^a We add a dummy control for target on either unauthorised absence (=1) or total absence (=0). We also add a dummy control for the indicator change, i.e. 1 for indicator before change in 2002/03, 0 otherwise.

^b As the model specification is based on previous one with the amalgamation of TGT_Yr1&2 and TGT_final, there is no need for examining the discrimination tests for panel data model again like in Appendix 4–1.

^c We add a dummy control for the indicator change, i.e. 1 for indicator before change in 2005/06, 0 otherwise.

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