

Dŵr Cymru – SWC models

Econometric model formula:

1. WSH_SWC1: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{properties per sewer length}_{it}) + \beta_4 \ln(\text{properties per sewer length}_{it})^2 + \varepsilon_{it}$

2. WSH_SWC2: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{weighted average density – LAD from MSOA}_{it}) + \beta_4 \ln(\text{weighted average density – LAD from MSOA}_{it})^2 + \varepsilon_{it}$

3. WSH_SWC3: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{weighted average density – MSOA}_{it}) + \beta_4 \ln(\text{weighted average density – MSOA}_{it})^2 + \varepsilon_{it}$

4. WSH_SWC4: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{properties per sewer length}_{it}) + \beta_4 \ln(\text{properties per sewer length}_{it})^2 + \beta_5 \ln(\text{Urban rainfall per sewer length}_{it}) + \varepsilon_{it}$

5. WSH_SWC5: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{weighted average density – LAD from MSOA}_{it}) + \beta_4 \ln(\text{weighted average density – LAD from MSOA}_{it})^2 + \beta_5 \ln(\text{Urban rainfall per sewer length}_{it}) + \varepsilon_{it}$

6. WSH_SWC6: $\ln(\text{SWC BOTEX+}) = \alpha + \beta_1 \ln(\text{Sewer length}_{it}) + \beta_2 \ln(\text{pumping capacity per sewer length}_{it}) + \beta_3 \ln(\text{weighted average density – MSOA}_{it}) + \beta_4 \ln(\text{weighted average density – MSOA}_{it})^2 + \beta_5 \ln(\text{Urban rainfall per sewer length}_{it}) + \varepsilon_{it}$

Description of the dependent variable

The dependent variable (SWC Botex+) is defined as per Ofwat's consultation analysis file, i.e. the sum of:

- Power
- Income treated as negative expenditure
- Service charges / Discharge
- Bulk Discharge
- Renewals expensed in year (infrastructure)
- Renewals expensed in year (non-infrastructure)
- Other operating expenditure excluding renewals
- Maintaining the long-term capability of assets (infrastructure)

- Maintaining the long-term capability of assets (non-infrastructure)
- Transfer of private sewers and pumping stations
- Atypical expenditure adjustment
- Reducing flood risk for properties (OPEX and CAPEX)
- Network reinforcement (OPEX and CAPEX)

It excludes the following cost categories:

- Costs associated with the Traffic Management Act
- Industrial Emissions Directorate
- NRSWA diversions (non-S185)
- Other non-S185 diversions
- Developer services base cost adjustment

This is consistent with Ofwat's PR24 methodology.

Description of the explanatory variables

- Sewer length (BN13535_21 + N13528)
- Pumping capacity per lengths of sewer (S4029 divided by sewer length)
- Properties per sewer length (properties divided by sewer length)
- Weighted average density LAD from MSOA (code: BN4006), as reported in the published wholesale dataset
- Weighted average density MSOA (code: BN4015), as reported in the published wholesale dataset
- Urban rainfall per sewer length (BN4507 divided by sewer length)

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	WSH_SWC1	WSH_SWC2	WSH_SWC3	WSH_SWC4	WSH_SWC5	WSH_SWC6
Dependent variable	BOTEX+ (SWC)	BOTEX+ (SWC)	BOTEX+ (SWC)	BOTEX+ (SWC)	BOTEX+ (SWC)	BOTEX+ (SWC)
Sewer length (log)	0.794*** (0.000)	0.847*** (0.000)	0.852*** (0.000)	0.827*** (0.000)	0.857*** (0.000)	0.865*** (0.000)
Pumping capacity per sewer length (log)	0.308** (0.033)	0.594*** (0.000)	0.554*** (0.000)	0.290* (0.051)	0.564*** (0.000)	0.526*** (0.000)
Properties per sewer length (log)	-8.635 (0.159)			-13.172* (0.053)		
Properties per sewer length (log) squared	1.302 (0.115)			1.904** (0.037)		
Weighted average density – LAD from MSOA (log)		-2.291** (0.041)			-2.042*** (0.001)	
Weighted average density (log) – LAD from MSOA squared		0.169** (0.021)			0.154*** (0.000)	
Weighted average density - MSOA (log)			-5.051* (0.060)			-4.847*** (0.005)
Weighted average density - MSOA (log) squared			0.336** (0.039)			0.325*** (0.002)
Urban rainfall per sewer length (log)				0.132*** (0.001)	0.153*** (0.000)	0.152*** (0.000)
Constant	10.127 (0.382)	3.016 (0.501)	14.241 (0.195)	18.702 (0.142)	2.363 (0.316)	13.633** (0.049)
Estimation method (OLS or RE)	RE	RE	RE	RE	RE	RE
N (sample size)	110	110	110	110	110	110
Model robustness						
R2 adjusted	0.919	0.897	0.895	0.928	0.918	0.916
RESET test	0.006	0.326	0.399	0.005	0.577	0.824
VIF (max)	2.337	1.914	1.996	2.53	1.918	2.003
Pooling / Chow test	0.9	0.982	0.987	0.965	0.97	0.981
Normality of model residuals	0.248	0.244	0.376	0.007	0.002	0.005
Heteroskedasticity of model residuals	0.183	0.034	0.027	0.04	0.002	0.001
Test of pooled OLS versus Random Effects (LM test)	0	0	0	0	0	0
Efficiency score distribution	Min: 0.91 Max: 1.08 Range: 0.17	Min: 0.88 Max: 1.21 Range: 0.33	Min: 0.86 Max: 1.16 Range: 0.30	Min: 0.92 Max: 1.09 Range: 0.17	Min: 0.89 Max: 1.18 Range: 0.29	Min: 0.87 Max: 1.13 Range: 0.26
Sensitivity of estimated coefficients to removal of most and least efficient company	A [Properties per sewer length and squared	G	A [Weighted average density – MSOA and squared term	A [Properties per sewer length and squared term	G	G

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	term become significant]		become insignificant]	become insignificant]		
Sensitivity of estimated coefficients to removal of first and last year of the sample	A [Properties per sewer length and squared term become significant]	G	G	G	G	G

Efficiency scores

WSH_SWC1		
Rank	Company	Efficiency score
1	WSX	90.7%
2	NES	94.2%
3	SRN	94.6%
4	SVH	95.2%
5	ANH	96.7%
6	TMS	104.4%
7	YKY	104.6%
8	WSH	106.3%
9	SWB	107.5%
10	NWT	108.2%

WSH_SWC2		
Rank	Company	Efficiency score
1	WSX	87.7%
2	ANH	89.0%
3	SWB	96.0%
4	TMS	96.0%
5	SRN	100.2%
6	NES	103.9%
7	SVH	104.1%
8	WSH	106.0%
9	NWT	110.8%
10	YKY	120.6%

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WSH_SWC3		
Rank	Company	Efficiency score
1	WSX	85.6%
2	ANH	89.5%
3	TMS	94.1%
4	SWB	97.5%
5	SRN	99.5%
6	NES	103.5%
7	SVH	107.4%
8	WSH	108.6%
9	NWT	110.4%
10	YKY	115.7%

WSH_SWC4		
Rank	Company	Efficiency score
1	WSX	92.4%
2	SRN	94.8%
3	SVH	96.2%
4	WSH	98.6%
5	NES	99.2%
6	ANH	100.5%
7	NWT	102.7%
8	YKY	104.3%
9	TMS	105.1%
10	SWB	108.8%

WSH_SWC5		
Rank	Company	Efficiency score
1	WSX	89.1%
2	ANH	96.4%
3	WSH	98.2%
4	TMS	98.8%
5	SWB	99.2%
6	SRN	99.6%

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7	NWT	102.3%
8	SVH	103.6%
9	NES	106.5%
10	YKY	118.4%

WSH_SWC6		
Rank	Company	Efficiency score
1	WSX	87.1%
2	ANH	95.9%
3	TMS	96.6%
4	SRN	99.0%
5	WSH	99.4%
6	SWB	101.2%
7	NWT	102.6%
8	NES	106.7%
9	SVH	107.9%
10	YKY	113.2%