THE ROLE OF COST MODELLING IN SETTING PRICES:

How and when does econometrics provide understanding of what drives costs?

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WONDERFUL ON TAP

SEVERN TRENT

IN MY PRESENTATION TODAY I AM GOING TO COVER IN TURN:

1. A reflection on the evolution of cost modelling and econometrics
2. Some background on the changes made at PR14
3. The views of the Competition and Markets Authority on the PR14 models
4. Ofwat’s approach to cost assessment for PR19
5. Opportunities for improving the PR19 models:
   - Engineering and operational factors
   - Avoiding perverse incentives
6. A few concluding thoughts

THE APPROACH TO COST MODELLING AND ECONOMETRICS HAS EVOLVED OVER TIME

<table>
<tr><th></th><th>PR94</th><th>PR99</th><th>PR04</th><th>PR09</th><th>PR14</th><th>PR19</th></tr>
<tr><td>Use of econometric analysis</td><td colspan="4">Econometric analysis used to ‘test’ aspects of companies business plans and derive efficiency challenges to base year costs (and in a number of cases, replace company costs)</td><td colspan="2">Econometric models used to determine Ofwat’s view of forecast expenditure</td></tr>
<tr><td>Scope of econometric analysis</td><td>Opex</td><td>Opex,
Capital maintenance (CM)</td><td>Opex,
Capital maintenance</td><td>Opex</td><td>Totex (Water)
Botex (W & WW)
Enhancement</td><td>Botex
Botex plus?
Enhancement?</td></tr>
<tr><td rowspan="3">Other approaches applied</td><td>Review of standardised asset lives.</td><td>5 Stage assessment approach of CM</td><td colspan="2">Capital maintenance challenge (based on application of ‘common framework’ principles)</td><td colspan="2" rowspan="2">Policy items (costs not suitable for modelling)
Cost adjustment claims (efficient costs not adequately covered by models / adjustments)</td></tr>
<tr><td colspan="4">Cost base (stylised unit costs) to determine capex efficiency challenges</td></tr>
<tr><td colspan="4">Bespoke review of enhancement expenditure (Quality, Enhanced Service, Supply/Demand)</td><td>Un-modelled enh. adjustment</td><td>Un-modelled enh. adjustment?</td></tr>
<tr><td>Incentives</td><td>Out-performance retained in period</td><td colspan="2">Rolling outperformance incentive</td><td>Opex roller
CIS menu</td><td>Menu incentive</td><td>Cost sharing incentive</td></tr>
<tr><td>Approx. coverage of econometrics</td><td>Informing approx. 50% of expenditure requirement</td><td>Informing approx. 70%</td><td>Informing approx. 70%</td><td>Informing approx. 50%</td><td>Explicitly setting approx.90%</td><td>Explicitly setting approx. 80%?</td></tr>
</table>

EARLY APPROACHES SAW THE MOST INEFFICIENT COMPANIES CATCHING UP

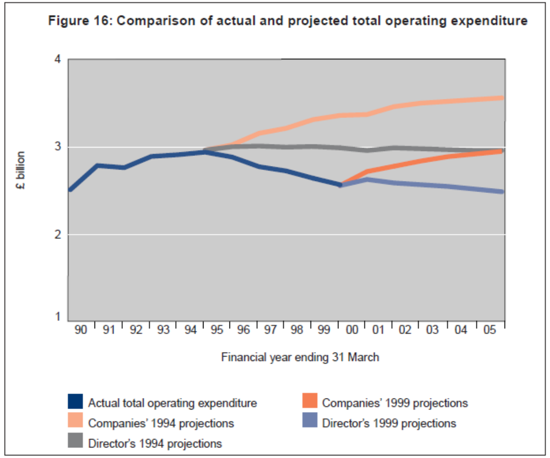
The ability of the sector to out-perform the regulatory assumption (with the greatest outperformance by those considered the least efficient) suggests that models and associated adjustments were able to identify genuine opportunity for efficiency.

AMP2: 1% to 3.5% water opex catch-up efficiency assumed in PR94 FD

- PR99 FD – "Some companies have made more savings than others, with those set the greater challenges outperforming the most."

AMP3: 0% to 3.5% water opex catch-up efficiency assumed in PR99 FD

- PR04 FD - "There have been major improvements in efficiency in recent years, with all of the companies now in the top three relative efficiency bands compared with only half in 1999."



Ofwat: PR99 FD

PR14 SAW A STEP CHANGE IN THE SIGNIFICANCE OF ECONOMETRICS

A move from a complimentary regulatory tool to the fundamental component of cost assessment:

Independent assessment of all expenditure - Company plans compared to an independent benchmark rather than specifically scrutinised	Fundamental response to **Information asymmetry**
Opex and Capex not differentiated - Introduction of totex	Fundamental response to perceived **Capex bias**
Limited allowance of: **- Policy items** (Rates, 3rd party costs and pension deficit recovery); and **- Adjustments** (high evidence bar)	Fundamental assumption that **Simple models can predict most expenditure**

At a high level, the PR14 approach appears to have been fit for purpose with sensible levels of out performance and underperformance being delivered.

COMPETITION AND MARKETS AUTHORITY (CMA) SCRUTINISED OFWAT'S USE OF ECONOMETRICS

CMA scrutiny fundamentally challenged:

Robustness of models –

- Need for underpinning engineering logic
- Importance of coherent model coefficients

It also considered:

Applicability of totex modelling –

- Modelling inherently lumpy enhancement expenditure using historic expenditure is challenging

The need for simplicity –

- Necessary given the small modelling data set

(econometric modelling is best suited to 1000's of independent observations)

OFWAT'S PR19 MODELLING APPROACH SHOULD ENCOURAGE IMPROVED MODELS

Ofwat's PR19 cost modelling consultation set out its approach to develop and test potential models:

Primacy of engineering, operational and economic logic
To specify models and generate cost driver expectations.

→

Testing of model coefficients
Expected sign and of plausible magnitude.
Stable, consistent and significant across different specifications.

→

Consideration of unintended consequences
Using cost drivers under management control
Risk of perverse incentives.

→

Confirmation of wider model validity
Against statistical tests and diagnostics
Though appropriateness of estimation method.

We support Ofwat's overall approach. However, we believe there is a need when specifying models to include at least one scale driver and other primary cost drivers reflecting engineering, operational and economic logic. Therefore, it is useful to consider:

- For each model - the adequacy of primary cost driver coverage
- For each primary cost driver - the case of using alternative explanatory variables

OFWAT HAS RESPONDED TO THE CMA CRITIQUE IN DEVELOPING PR19 MODELS

Improved model specification (and potential risks)

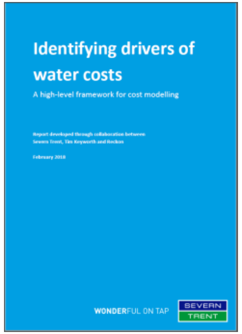
- Review of modelling from 1st principles (requiring identification and coverage of primary cost drivers)
- Move away from Totex modelling (but uncertainty of Botex+)
- Simpler model forms (but at the cost of engineering logic?)
- More price control controls and exploration of multiple levels of aggregation (but primary cost drivers are less clear or easy to isolate in some price controls)

Stronger method

- Good engagement through CAWG and consultation
- Acknowledging difference – simple models cannot perfectly replicate complex and varied business operations

We stress the need for engineering and economic logic to be the primary criteria on which models are specified. It should not be sacrificed in the drive for simplicity.

THERE ARE OPPORTUNITIES TO IMPROVE THE OFWAT MODELS AT PR19



Framework published on WaterUK market place for ideas (2018)

There is a need for greater emphasis on engineering and operational factors. Primary cost drivers need to be understood and clearly accounted for

We have engaged with internal technical experts, Reckon, Arup and Tim Keyworth and developed a cost assessment framework. This identifies primary cost drivers against which the coverage of models can be assessed

Considering water models, there are five areas where we believe improvements can be made:

- Distance water is transported
- Congestion and Rurality
- Economies of scale at WTWs
- Treatment complexity
- Network complexity

I will discuss these briefly in turn

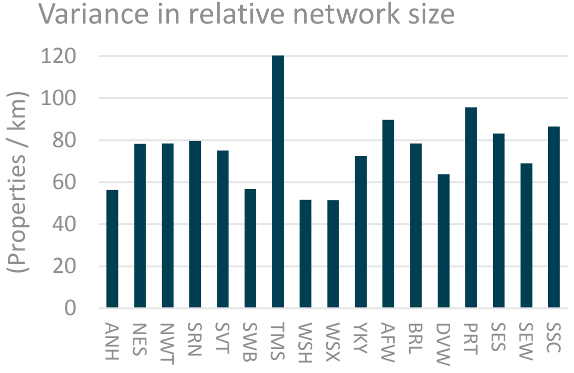
WE HAVE A FEW SUGGESTED CHANGES (NETWORK SIZE AND DISPERSION)

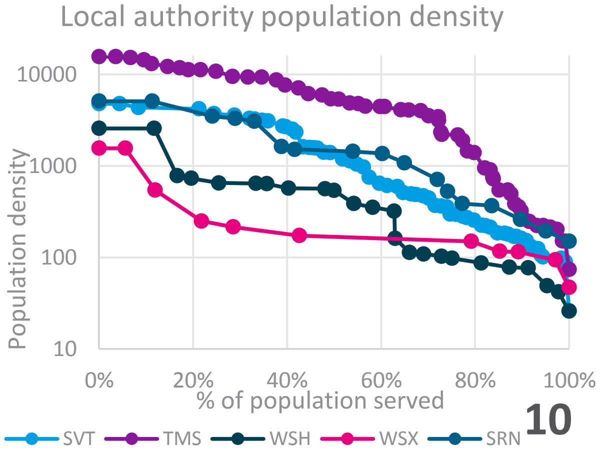
Distance water is transported (network size)

- Primary cost driver as cost to operate and maintain a network increases with length (rather than quantity treated or customers served)
- Half of Ofwat's consultation models don't explicitly capture network size
- Include network length, or account for though interaction of a quantity cost driver with inclusion of population density

Congestion and rurality (dispersion)

- Primary cost drivers of network cost. Highly urban areas increase cost due to below and above ground congestion. Rural areas also increase cost by increased network assets / reduced opportunity for economies of scale
- Half of Ofwat's consultation models did not account for congestion (population density proxy excluded). No models explicitly considered rurality drivers
- Include population density as a proxy for congestion. Consider separate sparsity driver or squared terms (may also be partially covered by WTW economies of scale).



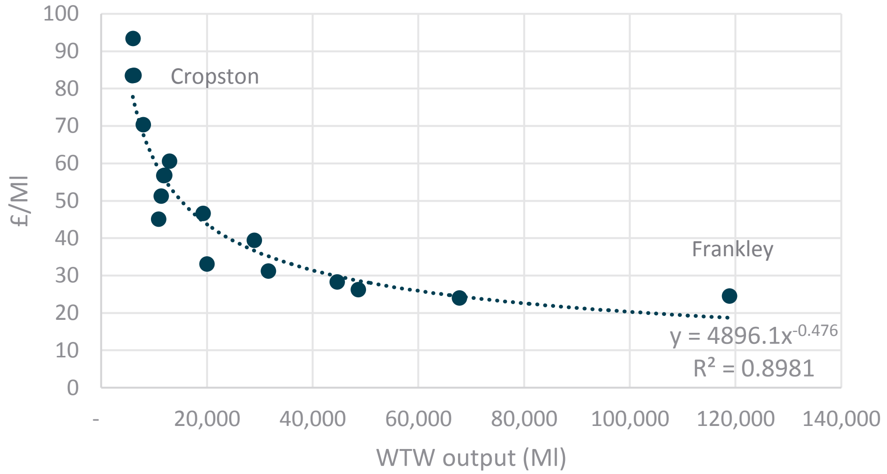


WE HAVE A FEW SUGGESTED CHANGES (TREATMENT ECONOMIES OF SCALE)

Economies of scale at WTWs

- Primary cost driver because larger treatment assets reduce unit costs through reduction in fixed expenditure and opportunities for process optimisation. WTW size is driven by population density *and* regional geography *and* historic constraints
- Very few models make explicit consideration. Some consider through population density, however, this is a an incomplete descriptor due to geographical and historical drivers
- Include number of WTWs to allow interaction with scale drivers and account for average size of treatment assets

Severn Trent surface WTW unit costs

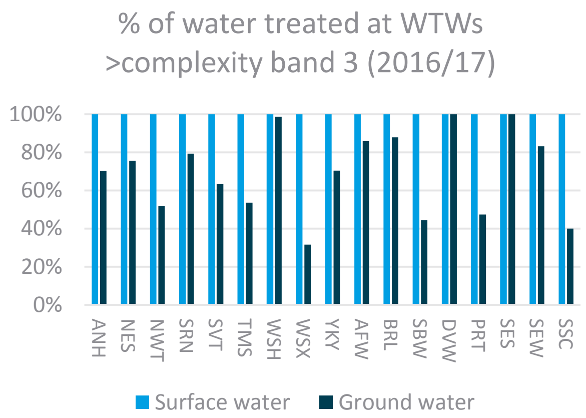


Includes: Manpower, chemical analysis, materials/consumables, operational maintenance, hired and contracted costs, GAC regen
Excludes: Power and chemicals (driven by water quality) and abstraction fees
Strong relationship with size (power curve fit – costs halve if WTW output increases fourfold)

WE HAVE A FEW SUGGESTED CHANGES (COMPLEXITY)

Treatment complexity

- Primary cost driver because costs rise where raw water quality necessitates complex treatment processes (typically through power and chemicals consumption and maintenance complexity)
- Whilst most Ofwat models include an explanatory variable, their explanatory power is very limited (complex processes are not sufficiently identified. All surface water WTWs in the industry as categorised in bands 3-6)
- Set threshold of complex processes as 4-6, in line with cat 4 definition: "…treatment with significantly higher operating costs than in [cat 2&3]"



Network complexity (primarily topography)

- Primary cost driver because material operating and maintenance costs are incurred where gravity cannot be used to transport water
- A third of Ofwat's wholesale models did not explicitly include a variable. Remainder sensibly use density of booster stations and service reservoirs as proxies
- Include an appropriate network complexity driver in all models

THERE IS ALSO A NEED TO AVOID PERVERSE INCENTIVES

Reviewing the consultation models we have identified the potential for several perverse incentives:

Dis-incentivising companies to maintain their networks

- Network age variables have a negative coefficient. Therefore, models will predict reduced expenditure for companies that have proactively renewed their network in the past

Dis-incentivising bulk supplies (water trading)

- Bulk supplies will appear more expensive relative to an equivalent owned resource due to the implicit inclusion of financing costs within in the bulk cost. Conversely, financing costs are accounted for after cost assessment for all company owned assets

Dis-incentivising water efficiency and sustainable urban drainage

- Volume is a poor cost driver of wastewater treatment. It is in part driven by HH PCC, sewer infiltration and amount of surface water in the sewer
- Therefore, the natural incentive is to reduce water efficiency, reduce infra maintenance and reduce implementation of SUDs / separation of the network

SOME FINAL REFLECTIONS

There are always questions over the use of econometrics to estimate costs.

Therefore, if econometrics are used, models need to:

- be as good a possible to reflect engineering and operational characteristics (accounting for all primary cost drivers);
- deliver 'credible' results e.g. consistency over time; and
- avoid perverse incentives e.g. to maintain the network.