PC21 Draft Determination
NI Water Response

Annex 4.2 - Frontier Shift (Economic Insight)

Version 1.0

Economic Insight

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Economic Insight Ltd

FRONTIER SHIFT AT PC21

Report for Northern Ireland Water

Frontier Shift at PC21

This report for Northern Ireland Water (NI Water) sets out our analysis of the Utility Regulator's (UR's) approach to frontier shift at PC21. Overall, we recommend that point estimates for productivity growth place equal weight on the periods before and after the 2007 financial crisis (i.e. 1998 to 2016) and that capex productivity growth is estimated based on the construction industry. This implies adjusted opex and capex productivity growth of 0.52% and 0.27% respectively, and average annual frontier shift of RPI-0.47% for opex and RPI-0.39% for capex.

We first set out the frontier shift proposals in NI Water's business plan, followed by an explanation of the estimates and approach in the UR's draft determination. We then provide an evaluation of the UR's methodology, and, based on analysis of the existing data alongside arguments drawn from external evidence, set out our views as to the appropriate level of frontier shift.

1.1 NI Water's business plan

Economic Insight provided analysis and recommendations for NI Water's submitted frontier shift for PC21, which averaged 0.43% for opex and 0.12% for capex. These figures account for both the efficiency savings from additional productivity gains, and the increase in costs arising from input price growth over and above inflation.

These estimates were derived using the UR's PC15 methodology, updated for more recent data. Where appropriate, we also used alternative data to reflect more accurate forecasts – for example putting emphasis on an alternative index or taking averages across a selection. For both opex and capex, the data indicated that there would be relatively limited real price effects (RPEs), i.e. the projected rate of input price growth was generally similar to the rate of inflation. Consequently, the net frontier shift figures were primarily driven by the forecast rate of productivity growth.

To measure productivity growth, we analysed data from the EU KLEMS dataset (2017 release). For opex, this involved taking a weighted average across the following five industries, in line with the PC15 approach:

- total manufacturing (20%)
- electricity, gas & water supply, and transportation & storage (together 20%) and
- finance & insurance, and professional, scientific, technical, administrative & support services (together 45%).[1]

Weighted average growth between 1999-2015 (the full period covered by the data) implied a productivity growth rate of 0.44%. Capex productivity growth was based on the EU KLEMS construction industry productivity, which had an average growth rate between 1999 and 2015 of 0.08%. Combined with estimated RPEs, this implied average annual frontier shift of 0.43% and 0.12% for opex and capex respectively, as shown in the table below.

Table 1: NI Water frontier shift submission (%)

Opex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	3.07	3.10	3.15	3.06	3.06	3.06
RPI	3.05	3.07	3.07	3.07	3.07	3.07
Productivity	0.44	0.44	0.44	0.44	0.44	0.44
Frontier shift	RPI-0.43	RPI-0.41	RPI-0.36	RPI-0.45	RPI-0.45	RPI-0.45
Capex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	3.01	3.03	3.07	3.00	3.00	3.00
RPI	3.05	3.07	3.07	3.07	3.07	3.07
Productivity	0.08	0.08	0.08	0.08	0.08	0.08
Frontier shift	RPI-0.12	RPI-0.12	RPI-0.08	RPI-0.14	RPI-0.14	RPI-0.14

Source: PC21 Annex 5.2.3: Economic Insight NI Water Frontier Shift Report.

[1] *The remaining 15% of inputs consist of EA charges, bad debts, and other costs, which are not deemed to be affected by productivity growth.*

1.2 The UR's Draft Determination

The UR's draft determination found average frontier shift of 0.7% for both opex and capex. Similar to our own results, the UR concluded there to be close to zero RPEs, meaning that the rate of frontier shift rests predominantly on productivity growth. For both capex and opex the regulator obtained higher forecasts of productivity growth than our own analysis: 0.79% for opex and 0.61% for capex.

Since the publishing of the draft determinations, it has emerged that an error in the UR's spreadsheet means that the rates of opex frontier shift quoted in the documents are slightly overstated. Specifically, the level of opex input price growth for rates, bad debt, EA charges and other costs (which should have been equal to RPI inflation) were incorrect. The resulting, corrected annual rates of frontier shift proposed by the UR are shown in the table below. In the remainder of this section, we will use these figures when referring to the UR's frontier shift proposal, rather than those in Annex K of the draft determination.

Table 2: Utility Regulator frontier shift draft determination (%)

Opex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	3.02	3.19	2.97	3.03	3.03	3.03
RPI	3.00	3.00	3.00	3.00	3.00	3.00
Productivity	0.79	0.79	0.79	0.79	0.79	0.79
Frontier shift	RPI-0.77	RPI-0.61	RPI-0.82	RPI-0.76	RPI-0.76	RPI-0.76
Capex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	2.85	3.01	2.80	2.86	2.86	2.86
RPI	3.00	3.00	3.00	3.00	3.00	3.00
Productivity	0.61	0.61	0.61	0.61	0.61	0.61
Frontier shift	RPI-0.76	RPI-0.60	RPI-0.80	RPI-0.75	RPI-0.75	RPI-0.75

Source: 2020-10-21 PC21 frontier shift calculations - final draft for NIW.xlsx.

1.3 Reconciliation between NI Water's submission and the UR's estimates

Although NI Water's submission and the UR's determination followed similar methods in broad terms, materially different figures for productivity growth were obtained. There are three reasons for these differences.

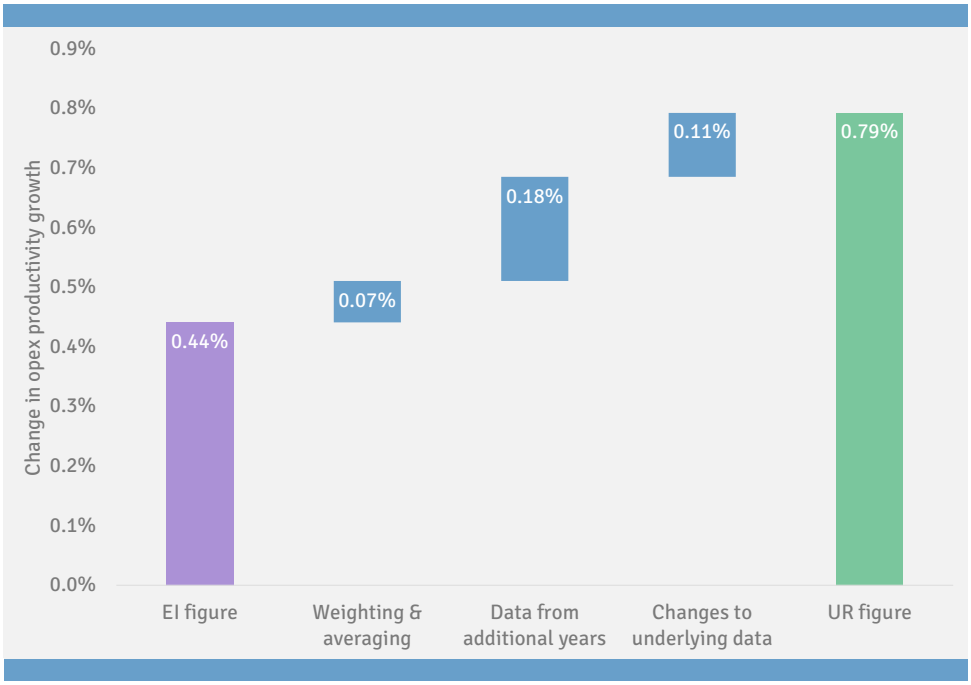
- **Weighting and averaging.** For opex productivity, the UR applied the same weights as those used at PC15 and in calculating productivity growth for NI Water's business plan. For capex productivity, however, the UR changed its approach and reduced the weight it attached to construction productivity growth from 100% to 75%, while also attaching weight to total manufacturing (12.5%) and machinery and equipment (12.5%). There are also minor differences relating to how average figures have been calculated. Together the impact of weight and averaging account for +0.07% of the difference in estimated opex productivity and +0.35% of the difference in capex productivity.

- **Additional years of data.** The EU KLEMS datasets are updated every few years. NI Water's business plan estimates used the 2017 release, which spans 1998-2015. Shortly after this was completed, an updated dataset was published (the 2019 release), covering 1995-2016. The UR's analysis therefore includes three additional years at the beginning of the period (1995-1997) and one at the end of the period (2016). The additional years of data account for +0.18% for the difference in estimated opex productivity and -0.06% of the difference in estimated capex productivity.

- **Changes to underlying data.** In addition to adding more years of data, the 2019 release includes material revisions to estimates of productivity growth for the industries used to estimate opex and capex productivity growth. To illustrate this, the charts overleaf shows the annual figures in the construction index from the 2017 and 2019 data releases. There are clear differences between the two, particularly in later years. These changes to underlying data account for +0.11% of the difference in estimated opex productivity and +0.24% of the difference in estimated capex productivity.

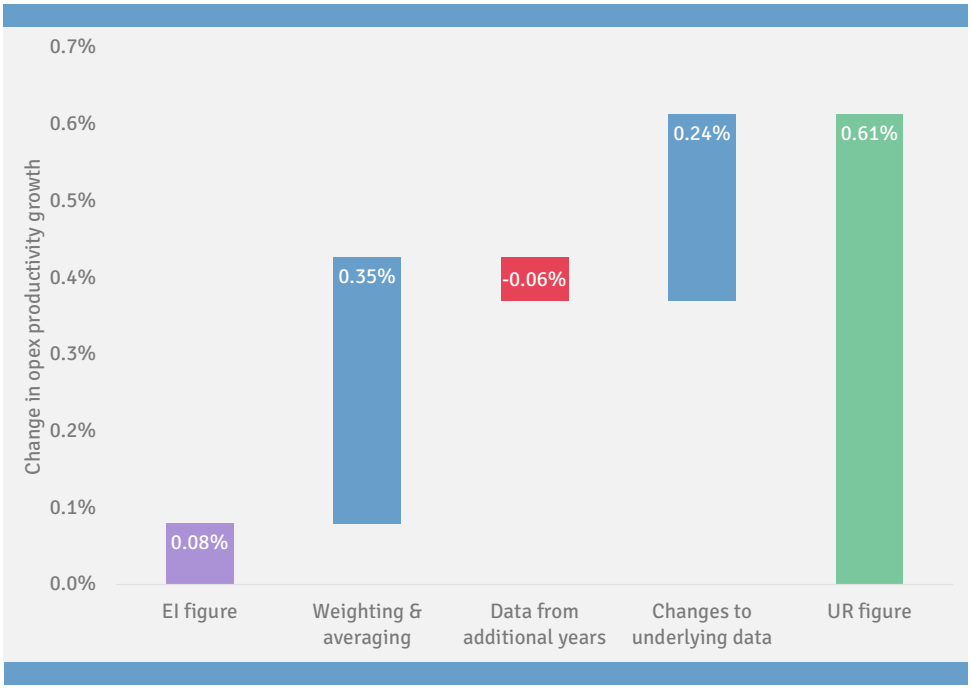
The figures overleaf summarise our reconciliation between Economic Insight's and the UR's opex and capex productivity figures.

Figure 1: Differences between Economic Insight's and the UR's opex productivity estimates



Source: Economic Insight analysis of EU KLEMS 2017 and 2019 releases.

Figure 2: Differences between Economic Insight's and the UR's capex productivity estimates



Source: Economic Insight analysis of EU KLEMS 2017 and 2019 releases.

1.4 Economic Insight analysis

1.4.1 Headline conclusions

As outlined in the previous section, there is little difference between the UR's forecast RPEs and our own, whereas there are material differences in the rates of productivity growth. We therefore focus our analysis and response to the regulator on productivity alone.

We acknowledge that there is a significant degree of uncertainty over both the appropriate timeframe and comparator industries used to estimate productivity growth. However, we consider that the following revisions would lead to an improved approach.

- Attaching **equal weight to pre- and post-financial crisis periods** by calculating productivity growth over a timeframe that includes an equal number of years from each. Relative to the UR's approach, this attaches greater weight to recent evidence of subdued productivity growth. Making greatest use of the available data, this covers the period 1998 to 2016.

- Retaining the UR's PC15 approach of **basing capex productivity growth estimates on the construction industry**. The UR's decision to attach weight to total manufacturing and machinery production appears to arise from a misunderstanding over the weight attached to these industries at PC15. In fact, these industries were considered as potential comparators alongside construction, but were assessed to have fewer similarities with water industry capex, and sole weight was instead attached to construction.

Together, these changes imply opex productivity growth of 0.52% and capex productivity growth of 0.27%. The table below compares the UR's productivity growth estimates with those implied by our revised methodology.

Table 3: Comparison of productivity growth estimates

	Opex	Capex
Utility Regulator	0.79%	0.61%
Revised methodology	0.52%	0.27%

Source: Economic Insight analysis

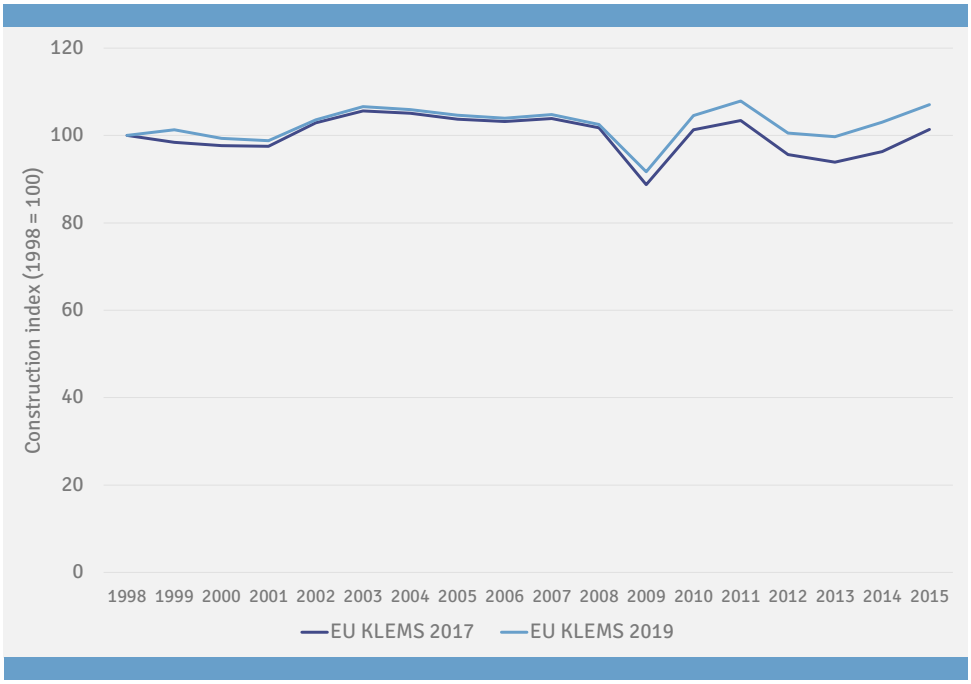
In the following sections we set out our supporting analysis in more detail on: (i) the choice of dataset; (ii) the timeframe for the analysis; and (iii) the comparators used for capex productivity growth.

1.4.2 Choice of dataset

Our analysis to support NI Water's business plan submission used 2017 KLEMS release, which was at the most up to date version available at the time. For this analysis, we have used the same approach as the UR and based our analysis on the 2019 release. This is because the 2019 release contains an additional year of recent data and includes updates and methodological changes, which we understand are intended to improve its reliability.

We note that the 2019 release includes material revisions to estimated productivity growth for some sectors. As set out above, such revisions were responsible for 0.11% of the difference between NI Water's and the UR's opex productivity growth estimates and 0.24% of the difference between capex productivity growth estimates. To illustrate this point, the figure below shows the construction industry indices in the 2017 and 2019 KLEMS datasets, with a material divergence in productivity arising from 2008 onwards.

Figure 3: Construction index in 2017 and 2019 EU KLEMS datasets



Source: Economic Insight analysis of EU KLEMS 2017 and 2019 releases

1.4.3 Timeframe

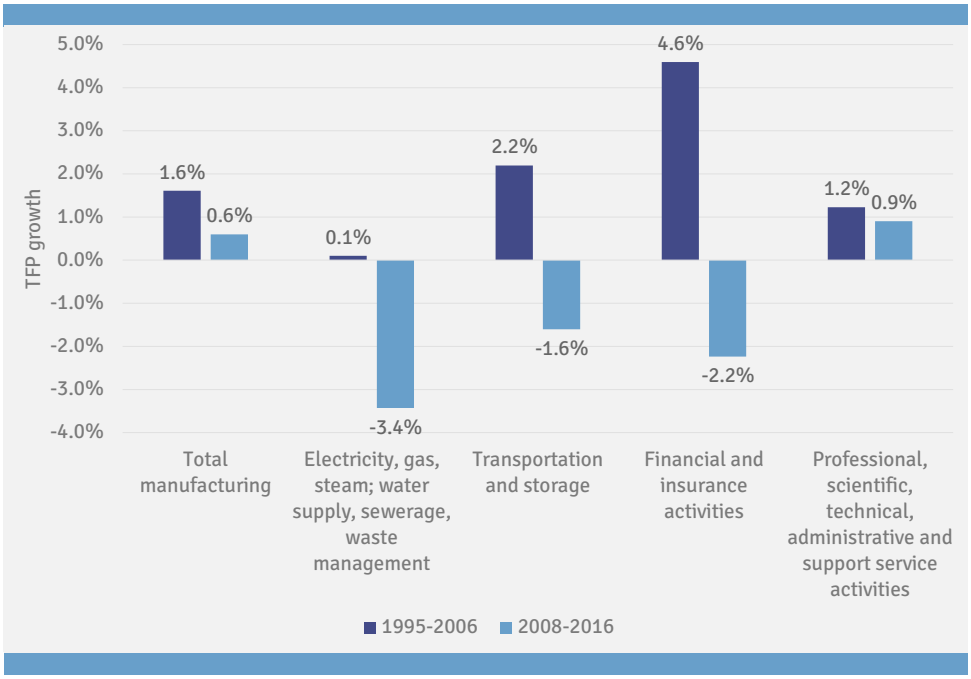
As set out above, a material part (0.18%) of the difference between NI Water's and the UR's estimates for opex productivity arise because the UR's analysis includes three additional years prior to the financial crisis (1995-1997) and one year after it (2016). In adopting this approach, the UR understandably sought to make use of all of the data available to it. We have concerns with this approach, however, on the grounds that: (i) basing the timeframe on the number of years included in the 2019 KLEMS dataset is somewhat arbitrary and implicitly attaches greater weight to the period of high productivity growth prior to the financial crisis; and (ii) in practice, this leads to the UR's higher estimates being driven by high productivity growth in particular industries in individual years. We set out each of these concerns in turn, before setting out a revised approach.

The UR's timeframe attaches greater weight to pre-crisis productivity growth

The productivity growth estimates in NI Water's business plan were based on a timeframe that included a similar number of years pre- and post-financial crisis: nine years from 1999 to 2007 and eight years from 2008 to 2015. By adding three years to the beginning of this period and one to the end, the UR's estimates of productivity growth include 13 years before the financial crisis, compared to nine years afterwards. As a consequence, the UR's estimates place greater weight on the higher productivity growth that occurred before the financial crisis.

In practice, productivity growth was markedly higher before the 2007 financial crisis. We illustrate this point in the figure below, which compares TFP growth in 1995-2006 with growth in 2008-2016 for the sectors used in the estimation of opex productivity growth. In each of the five, productivity growth was higher in the period 1995-2006 than in 2008-2016, and in three of the five sectors, productivity growth was negative in 2008-2016.

Figure 4: Comparison of pre- and post-financial crisis TFP growth



Source: Economic Insight analysis of EU KLEMS 2019 release

We acknowledge that there is uncertainty as to whether productivity growth will remain subdued or return to pre-crisis levels. On balance, we do not consider that there is a strong rationale for placing more weight on the latter possibility. This is for the following reasons.

- While some forecasts suggest an eventual return to higher productivity growth,[2] this is inherently uncertain. Further, the timing of any return to higher productivity growth will be affected to a large extent by the impact of and the economy's recovery from the COVID-19 pandemic. This is also inherently uncertain and raises the possibility that any return to growth may be pushed further into the future and therefore be less likely to materialise over the course of the PC21 price control period. In this context, we note that the immediate impact of the pandemic has been a sharp fall in productivity. This particularly applies to labour productivity, as public policy has provided incentives for firms to retain employees despite a sharp fall in output. For example, output per worker fell by 21% between Q4 2019 and Q2 2020.[3]

- The argument that water sector frontier shift in England and Wales enjoys a degree of insulation from subdued productivity growth in the wider economy due to certainty provided by the regulatory regime and an investment boost from Ofwat's innovation fund are not applicable to Northern Ireland Water.

In view of the above, we therefore propose a more balanced approach, that attaches equal weight to pre- and post-crisis periods. Making greatest use of available data, this implies an 18-year timeframe from 1998 to 2016, comprising nine years pre-crisis (1998 to 2006) and nine years post-crisis (2008 to 2016). We note that this method takes account of recent evidence of subdued productivity growth, while allowing for a degree of improvement in future productivity performance towards the longer-term average.[4]

The UR's estimates are driven by high growth in a limited number of years and sectors

A further consequence of the UR's choice of timeframe is that its higher productivity growth estimates are driven to a large extent by productivity growth in a small number of industries during the very early years of the period under consideration. We consider it problematic that productivity growth estimates are, to a large degree, driven by such outliers. We illustrate this in Figure 5 overleaf, which shows year-on-year productivity growth for the sectors underlying the opex productivity growth estimates. This shows that the three additional years that the UR includes at the start of the dataset (1995-1998) include one year of extremely high growth (1997 to 1998) in financial and insurance activities of 17.5%.

We show the impact of this on estimated productivity growth in Figure 6 overleaf. This shows estimated opex growth based on the UR's sector weights for various timeframes. For example, the first bar shows that estimated opex productivity growth based on a timeframe of 1999 to 2016 is 0.49%, whereas the final bar shows that an estimate based on a timeframe of 1995 to 2016 is 0.79%. This demonstrates that the

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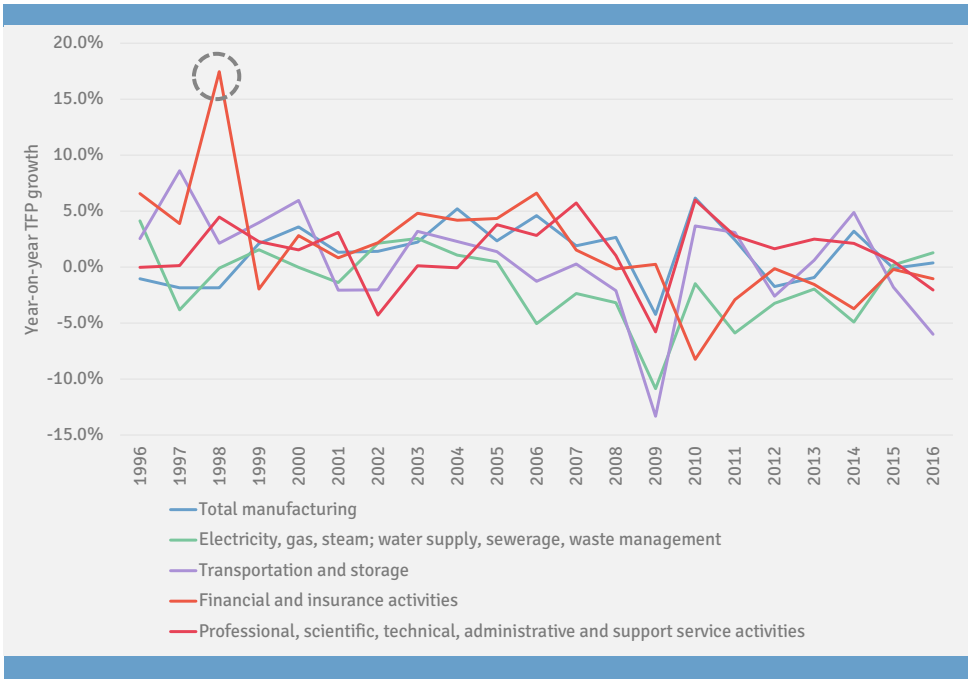
2 *'Anglian Water Services Limited, Bristol Water plc, Northumbrian Water Limited and Yorkshire Water Services Limited price determinations: Provisional findings.' Competition and Markets Authority (September 2020); para. 4.328.*

3 *Output per worker: whole economy SA. Office for National Statistics (November 2020).*

4 *As argued in 'Appendix 8.1.A – Economic Insight report on input cost and frontier shift assumptions.' Wessex Water (2018).*

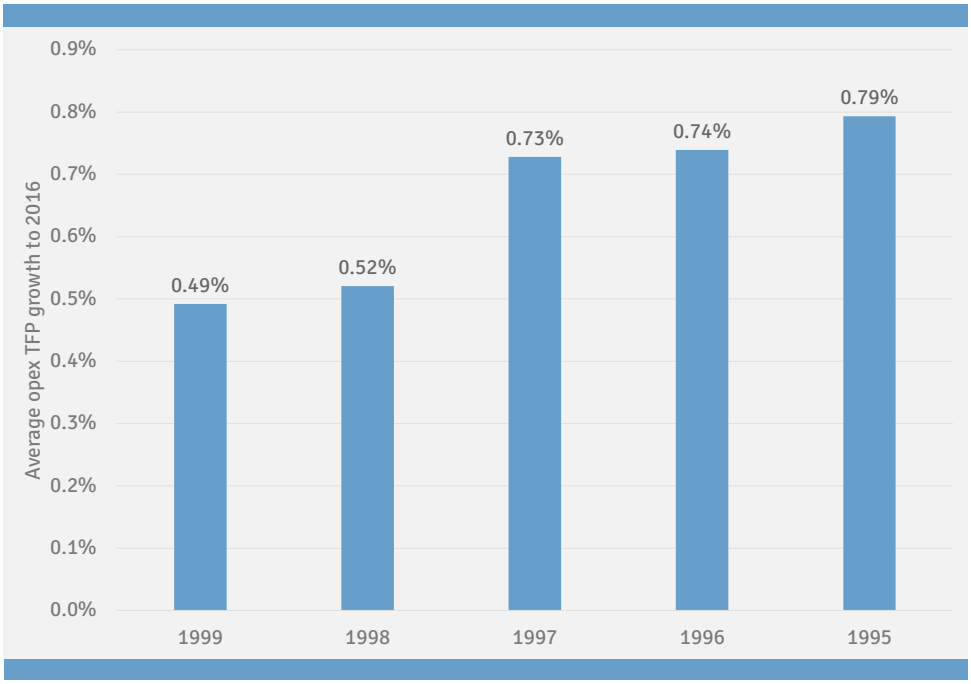
inclusion of years from 1997 and earlier leads to a marked jump in estimated productivity growth. If 1999 or 1998 is used as the starting year for estimating opex productivity growth, the average rate is around 0.5%; if any of the 3 years before this are used, this rises significantly to 0.7%-0.8%.

Figure 5: Year-on-year productivity growth of component industries



Source: Economic Insight analysis of EU KLEMS 2017 and 2019 releases

Figure 6: Impact of starting year on implied opex TFP growth



Source: Economic Insight analysis of EU KLEMS 2019 release.

1.4.4 Comparators for capex productivity

While the UR has maintained the approach used at PC15 to the comparators used to estimate opex productivity growth, it has changed its approach to capex comparator industries, moving from placing 100% weight on construction, to placing 75% weight on this industry, with 12.5% weight on each of total manufacturing and machinery and equipment. We are concerned that the UR's choice of these weightings is based on a misunderstanding of the approach used at PC15.

The regulator opted to apply weights of 12.5% to total manufacturing and machinery and equipment on the basis that the PC15 report by First Economics does not explicitly state the weights it used. In doing so, the UR appears to have misunderstood First Economics' position. While it is true that total manufacturing and machinery and equipment were identified as *possible* comparators, First Economics assessed that they had fewer similarities to water industry capex than construction, to which sole weight was attached. Although First Economics does not state explicitly that it puts 100% weight on the construction sector, this is apparent as First Economics' capex productivity growth estimate of 0.6% is equal to the 0.6% productivity growth rate it reports for construction between 1990 and 2007.

First Economics stated that *"[w]e have been able to identify three competitive sectors of the economy – construction, manufacturing and machinery production – which constitute potential comparators to the activities that make up a typical water industry investment project".* It went on to say that *"it is appropriate to put most weight on data for the construction sector"*, on the grounds that *"[w]ater industry capex shares a number of characteristics with construction – including the way in which activity is carried out at site-specific locations, the broad mix of labour, materials and equipment, and even the identity of some of the contractor firms involved"*. First Economics then went on to downplay the similarity of total manufacturing and machinery and equipment to water industry capex, stating that *"there are fewer similarities with the processes and final products in the other sectors"*.[5]

In this context, we note that, in practice, construction industry productivity growth shows a greater degree of similarity to measured water industry productivity growth than is the case for the other two sectors. For example, we calculated the correlation between year-on-year TFP growth for the KLEMS index for water supply, sewage and waste management and remediation activities and the indices for construction, total manufacturing, and machinery production. The correlation between growth in the water and construction indices was higher (at 0.41) than either the total manufacturing (0.25) or machinery and equipment (0.11) indices.

We acknowledge that the choice of industry comparator(s) is inherently uncertain. However, the UR's application of 100% weight to construction at PC15 was based on a clear rationale that involved the identification of potential comparators and a comparison of their characteristics with water industry capex. In contrast, the decision to attach weight to total manufacturing and machinery production at draft determination appears to be driven by a misunderstanding over the conclusions of this analysis at PC15, rather than a revised assessment of the appropriate

[5] *'Water and Sewerage Service Price Control 2015-2021. PC15 Annex O. The Rate of Frontier Shift Affecting Water Industry Capital Costs: A report prepared for the Utility Regulator. First Economics (April 2014); pages 14-15.*

comparators. We therefore suggest that it would be more appropriate to retain the PC15 approach and attach 100% weight to the construction industry index.

1.4.5 Frontier shift implications

We therefore set out frontier shift estimates based on two adjustments to the UR's approach.

- First, to estimate both opex and capex productivity growth, we have used the period 1998-2016, rather than 1995-2016. This strikes a balance between the higher growth observed before the financial crisis and more recent evidence of subdued productivity growth.

- Second, for capex productivity growth, we have retained the UR's PC15 approach of attaching sole weight to the construction industry, on the grounds that the UR's decision to attach weight to other sectors appears to have been driven by a misunderstanding of the approach at PC15, rather than new evidence over the appropriate comparators for capex.

Taken in combination, these adjustments imply annual productivity growth of 0.52% for opex and 0.27% for capex. Together, these adjustments imply average annual frontier shift of RPI-0.47% for opex and RPI-0.39% for capex. This represents reductions in the rate of frontier shift of 0.27% and 0.34%, respectively. The underlying calculations, alongside annual frontier shift figures. are set out in the table below.

Table 4: Revised frontier shift calculations

Opex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	3.02	3.19	2.97	3.03	3.03	3.03
RPI	3.00	3.00	3.00	3.00	3.00	3.00
Productivity	0.52	0.52	0.52	0.52	0.52	0.52
Frontier shift	RPI-0.50	RPI-0.33	RPI-0.55	RPI-0.49	RPI-0.49	RPI-0.49
Capex						
	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27
Weighted input prices	2.85	3.01	2.80	2.86	2.86	2.86
RPI	3.00	3.00	3.00	3.00	3.00	3.00
Productivity	0.27	0.27	0.27	0.27	0.27	0.27
Frontier shift	RPI-0.41	RPI-0.26	RPI-0.46	RPI-0.41	RPI-0.41	RPI-0.41

Source: Economic Insight calculations

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