NERA

ECONOMIC CONSULTING

Memo

To: **WPD**

Date: 11 June 2013

From: NERA

Subject: **Risk Modelling Assumptions**

This memo describes the assumptions used to assess WPD's risk exposure under the RIIO-ED1 regulatory framework. We describe the statistical distributions of the risk factors we have simulated and how they feed through into each DNO's EBITDA and operating cash flows. The base case forecasts of the risk factors were provided by WPD in its "unified" model. For this analysis, which considers the sensitivity of modeled outcomes to changes in input assumptions, we make the following assumptions regarding key regulatory parameters, which we agreed with WPD:

- 65% gearing;

- 6.7% CoE;

- 80% capitalization rate; and

- 45 yrs depreciation (phased-in).

The following sections of this memo present the statistical distributions assumed for a range of key inputs, alongside the impact of this assumed uncertainty on the DNOs' modeled EBITDA and operating cash flows[1] over the RIIO-ED1 period. By analysing the effect at the level of EBITDA, we account for the effect of any Ofgem mitigation schemes on revenues that are triggered following changes in costs. All the numbers presented in this memo are expressed in real terms in 2011/2012 prices.

1.   Business Risk

For each cost category, we apply a random deviation to the base case forecast for the entire RIIO ED1 period, using assumptions provided by WPD. For each draw, we then spread this deviation over the individual years of RIIO ED1. For example, if we simulate a deviation of 1% from the base case (assuming this translates to an additional cost of £28 mln over RIIO ED1), the

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[1]   Operating cash flows correspond to the cash flow statement line labelled "cash generated from operations" and measure the cash flows to each DNO after opex, capex, interest, tax and changes in working capital.

additional cost incurred by the DNO will be spread over the RIIO ED1 years as shown in Table 1.1

Table 1.1
Example of Business Risk Simulation

Year ending	2016	2017	2018	2019	2020	2021	2022	2023	Total
Additional cost incurred (£ mln)	0	1	2	3	4	5	6	7	28

By simulating business risks in this way, we model the impact of increasing uncertainty around cost forecasts over the RIIO ED1 period.

1.1. Controllable Opex

- **Network Opex**

The increase (or decrease) away from the base case network operating expenditure (opex) over the RIIO-ED1 period follows a triangular distribution with **mode 0%**[2], **minimum 0% and maximum 2% for all DNOs.** WPD therefore forecasts that network opex will be equal or greater than its base case forecast. Table 1.2 presents key distribution percentiles of simulated network opex for each DNO and how they feed through into EBITDA and operating cash-flows, holding all other risk factors constant.

In the first four rows of the table, we show:

1. The base case forecast for network opex over the ED1 period (e.g. £362.8 mln for West Midlands);

2. The percentiles of simulated network opex in money-terms for each of the DNO (1%, 5%, 25%, 50%, 75%, 95% and 99%). The x% percentile value means that x% of the simulated network opex is below this value;

3. A snapshot of the simulated distribution, the interquartile range, which is calculated as the difference between the 75th and the 25th percentile.

The table then shows:

1. The base case forecasts of EBITDA ;

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[2]   The mode of a statistical distribution is the outcome of the distribution that appears most often

2. The simulated percentile values of EBITDA when randomising network opex, holding all other factors constant throughout the simulation. The simulated EBITDA is variation in EBITDA we obtain when we run the simulation holding all other inputs static at their base case values, but varying network opex stochastically. For instance, simulating uncertainty on network opex of West Midlands gives a range of EBITDA between £362.8 mln and £369.4mln.

3. Similarly as for network opex, we show the interquartile range of the simulated EBITDA.

Finally, we show the base case forecasts, percentiles and interquartile range of the operating cash flows of each DNO. We include operating cash-flows to capture the effects of variability in actual interest, tax and capex, which do not feed into EBITDA.

Comparing interquartile ranges of the network opex, EBITDA and operating cash-flows documents how much of the uncertainty on network opex feeds through into the bottom line and cash flows.

Table 1.2
Network opex

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
Network OPEX	W Mids	362.8	362.8	363.0	363.8	365.0	366.4	368.3	369.4	2.6
	E Mids	377.5	377.5	377.7	378.5	379.8	381.3	383.4	384.1	2.8
	S. Wales	215.2	215.2	215.3	215.7	216.4	217.4	218.4	218.8	1.7
	S. West	317.3	317.4	317.5	318.2	319.2	320.5	322.3	323.1	2.4
EBITDA	W Mids	2223.7	2,223.7	2,223.6	2,223.0	2,222.2	2,221.2	2,219.9	2,219.1	1.8
	E Mids	2086.4	2,086.4	2,086.3	2,085.7	2,084.9	2,084.0	2,082.6	2,082.2	1.8
	S. Wales	957.9	957.9	957.9	957.6	957.1	956.4	955.7	955.5	1.2
	S. West	1404.2	1,404.2	1,404.1	1,403.7	1,403.0	1,402.0	1,400.8	1,400.3	1.6
Operating Cash-Flow	W Mids	(209.7)	(209.7)	(209.9)	(210.6)	(211.7)	(213.0)	(214.7)	(215.8)	2.4
	E Mids	(200.7)	(200.8)	(200.9)	(201.7)	(202.9)	(204.3)	(206.2)	(206.9)	2.6
	S. Wales	(236.8)	(236.8)	(236.9)	(237.3)	(237.9)	(238.8)	(239.8)	(240.1)	1.6
	S. West	(344.6)	(344.6)	(344.7)	(345.4)	(346.3)	(347.5)	(349.2)	(349.9)	2.2

Simulated network opex is always greater than the base case forecast, which is consistent with the assumed distribution parameters. Table 1.2 above shows the effect of uncertainty on network opex on EBITDA and cash flows for all DNOs. For example, for West Midlands, the interquartile range assumed for network opex is £2.6 mln, whereas the modelled interquartile range at the EBITDA level is lower, at £1.8 mln. The reduced effect on EBITDA of uncertainty on network opex is due to the mitigation effect provided by the IQI scheme, which only requires that the DNO bears 70% of the deviation from forecast network opex. The effect on EBITDA is further reduced by the actual split of network opex between opex and capex components, as only the opex component impacts (negatively) the EBITDA. The effect of the capex component is reflected in operating cash-flows, since capex is a cash expenditure.

- **Closely associated indirects**

The increase (or decrease) away from the base case closely associated indirects over ED1 follows a triangular distribution with **mode 0%, minimum 0%** and **maximum 5% for all DNOs**. WPD therefore forecasts that closely associated indirects will be equal or greater than the base case forecast. Table 1.3 presents key distribution percentiles of the simulated closely associated indirects for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.3
Closely Associated Indirects

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
CAI	W Mids	412.3	412.5	412.8	415.2	418.4	422.4	428.1	430.5	7.2
	E Mids	413.3	413.4	413.9	416.4	419.6	423.9	429.5	431.7	7.5
	S. Wales	273.5	273.6	274.0	275.5	277.6	280.4	284.0	285.6	4.9
	S. West	423.2	423.3	423.8	425.9	429.7	433.8	440.3	443.0	7.9
EBITDA	W Mids	2223.7	2,223.7	2,223.5	2,222.7	2,221.5	2,220.1	2,218.1	2,217.3	2.6
	E Mids	2086.4	2,086.4	2,086.2	2,085.3	2,084.2	2,082.6	2,080.6	2,079.8	2.7
	S. Wales	957.9	957.9	957.8	957.2	956.4	955.4	954.0	953.4	1.8
	S. West	1404.2	1,404.2	1,404.0	1,403.3	1,401.8	1,400.3	1,397.9	1,396.9	2.9
Operating Cash-Flow	W Mids	(209.7)	(209.9)	(210.2)	(212.4)	(215.4)	(219.1)	(224.5)	(226.7)	6.7
	E Mids	(200.7)	(200.8)	(201.3)	(203.6)	(206.6)	(210.6)	(215.8)	(217.9)	7.0
	S. Wales	(236.8)	(236.9)	(237.2)	(238.6)	(240.6)	(243.2)	(246.5)	(248.0)	4.6
	S. West	(344.6)	(344.7)	(345.1)	(347.1)	(350.6)	(354.4)	(360.5)	(363.0)	7.3

Similarly as for network opex, uncertainty on closely associated indirects has a reduced effect on EBITDA due to mitigation provided by the IQI scheme and the actual split between opex and capex components for this cost item. For East Midlands for instance, the interquartile range assumed for closely associated indirects is £7.5 mln, whereas the modelled interquartile range at the EBITDA level is lower, at £2.7 mln. The effect of the capex component is reflected in operating cash-flows, with modelled interquartile range at £7 mln.

▪ **Business support costs**

WPD expects no uncertainty on business support costs over RIIO ED1 for all DNOs.

1.2. Load Related Expenditure (LRE)

▪ **Net connections capex**

The increase (or decrease) away from the base case net connections capex over the RIIO-ED1 period follows a triangular distribution with

- **mode 0%, minimum -10% and maximum 20% for the Midlands DNOs**

- **mode 0%, minimum -30% and maximum 10% for the South Wales/South West DNOs**

WPD forecasts that net connections capex of the Midlands DNOs is more likely to be greater than the base case than lower, and when greater, it is likely to deviate by a larger amount than when lower. WPD forecasts the opposite for the South Wales/South West DNOs. Net connections capex for these DNOs is more likely to be lower than the base case than greater, and when lower, it is likely to deviate by a larger amount than when greater.

Table 1.4 presents the key distribution percentiles of net connections capex for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.4
Net Connections Capex

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
Net Connections Capex	W Mids	33.4	30.6	31.4	32.9	34.2	35.8	38.1	39.2	2.9
	E Mids	35.4	32.4	33.2	34.9	36.5	38.1	40.6	41.7	3.2
	S. Wales	18.0	13.2	13.9	15.8	17.1	18.1	19.0	19.4	2.3
	S. West	18.4	13.6	14.3	16.0	17.4	18.4	19.5	19.9	2.4
EBITDA	W Mids	2223.7	2,223.9	2,223.9	2,223.8	2,223.7	2,223.7	2,223.7	2,223.6	0.1
	E Mids	2086.4	2,086.6	2,086.6	2,086.5	2,086.4	2,086.4	2,086.3	2,086.3	0.1
	S. Wales	957.9	958.0	958.0	957.9	957.9	957.9	957.8	957.8	0.1
	S. West	1404.2	1,404.3	1,404.3	1,404.2	1,404.2	1,404.2	1,404.1	1,404.1	0.1
Operating Cash-Flow	W Mids	(209.7)	(207.1)	(207.9)	(209.3)	(210.5)	(212.0)	(214.2)	(215.3)	2.8
	E Mids	(200.7)	(197.9)	(198.6)	(200.3)	(201.8)	(203.3)	(205.7)	(206.7)	3.1
	S. Wales	(236.8)	(232.3)	(233.0)	(234.7)	(236.0)	(236.9)	(237.7)	(238.1)	2.1
	S. West	(344.6)	(340.0)	(340.7)	(342.3)	(343.6)	(344.6)	(345.6)	(345.9)	2.3

There is almost no effect of uncertainty on net connections capex on EBITDA as capex does not feed through into the EBITDA on the costs side[3]. Capex has a negative impact on operating cash-flows since it is a cash expenditure. For instance, for West Midlands, the interquartile range assumed for net connections capex is £2.9 mln, and the modelled interquartile range at the operating cash-flow level is similar, at £2.8 mln.[4]

- **General reinforcement capex**

The increase (or decrease) away from the base case general reinforcement capex over the RIIO-ED1 period follows a triangular distribution with

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[3] A small effect is observed due to the change in revenue allowances due to the IQI sharing mechanism for totex over/underspend.

[4] The effect on cash-flows is slightly mitigated due to the increased revenue allowance caused by the capex.

- **mode 0%, minimum -10% and maximum 5% for the Midlands DNOs**

- **mode 0%, minimum -10% and maximum 20% for the South Wales/South West DNOs**

WPD forecasts that general reinforcement capex of the Midlands DNOs is more likely to be lower than the base case than greater, and when lower, it is likely to deviate from the base case by a larger amount than when greater. WPD forecasts the opposite for the South Wales/South West DNOs. General reinforcement capex of the South Wales/South West DNOs is more likely to be greater than the base case than lower, and when greater, it is likely to deviate from the base case by a larger amount than when lower.

Table 1.5 presents the key distribution percentiles of general reinforcement capex over ED1 for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.5
General Reinforcement Expenditure

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
GRE	W Mids	215.4	196.4	200.3	207.0	212.4	216.7	221.8	223.6	9.7
	E Mids	268.6	245.7	249.7	258.8	265.6	270.3	276.7	279.3	11.5
	S. Wales	60.7	55.4	57.0	59.9	62.1	65.2	69.5	71.3	5.3
	S. West	116.9	107.5	109.9	115.1	120.0	125.8	133.9	138.1	10.6
EBITDA	W Mids	2223.7	2,224.0	2,223.9	2,223.8	2,223.6	2,223.4	2,223.2	2,223.1	0.3
	E Mids	2086.4	2,086.8	2,086.7	2,086.4	2,086.3	2,086.1	2,085.8	2,085.6	0.4
	S. Wales	957.9	958.3	958.2	958.1	958.0	957.9	957.8	957.8	0.2
	S. West	1404.2	1,404.9	1,404.8	1,404.5	1,404.3	1,404.2	1,404.0	1,403.9	0.3
Operating Cash-Flow	W Mids	(209.7)	(191.7)	(195.4)	(201.8)	(206.9)	(210.9)	(215.8)	(217.5)	9.1
	E Mids	(200.7)	(179.1)	(182.8)	(191.5)	(197.9)	(202.3)	(208.4)	(210.9)	10.9
	S. Wales	(236.8)	(231.7)	(233.3)	(236.1)	(238.2)	(241.1)	(245.2)	(246.9)	5.0
	S. West	(344.6)	(335.7)	(338.0)	(343.0)	(347.6)	(353.0)	(360.7)	(364.7)	10.1

For the Midlands DNOs, simulations of general reinforcement capex are typically lower than the base case forecasts,[5] whereas for the South Wales/South West DNOs simulations are typically greater than the base case forecasts. This reflects the assumed asymmetric distribution of the inputs. Similarly as for net connections capex, uncertainty on general reinforcement capex has limited impact on EBITDA but almost fully feeds through into the operating cash-flows.

1.3. Non Load Related Expenditure (NLRE)

- **Asset replacement expenditure**

The increase (or decrease) away from the base case asset replacement expenditure over the RIIO-ED1 period follows a triangular distribution with **mode 0%, minimum -5% and maximum 5% for all DNOs**. WPD therefore considers that asset replacement expenditure is as likely to be greater as lower than their base case forecasts. Table 1.6 presents the key distribution percentiles of the asset replacement expenditure for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

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[5]   As shown by the median (equal to the 50%- percentile) being lower than the base case forecast.

Table 1.6
Asset Replacement Expenditure

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
NLRE Replace ment CAPEX	W Mids	744.6	713.7	719.0	733.3	744.1	753.9	770.2	774.4	20.5
	E Mids	601.4	574.5	580.0	593.1	602.0	610.1	622.3	627.6	17.0
	S. Wales	354.1	339.3	342.1	348.8	354.3	359.5	366.5	368.9	10.6
	S. West	561.1	537.0	542.6	552.2	560.3	568.7	580.4	585.5	16.4
EBITDA	W Mids	2223.7	2,225.0	2,224.8	2,224.1	2,223.7	2,223.2	2,222.6	2,222.4	0.9
	E Mids	2086.4	2,087.6	2,087.3	2,086.8	2,086.4	2,086.0	2,085.4	2,085.2	0.8
	S. Wales	957.9	958.6	958.5	958.2	957.9	957.7	957.4	957.3	0.5
	S. West	1404.2	1,405.3	1,405.1	1,404.6	1,404.2	1,403.8	1,403.4	1,403.2	0.7
Operatin g Cash-Flow	W Mids	(209.7)	(180.2)	(185.3)	(198.9)	(209.2)	(218.5)	(234.1)	(238.1)	19.6
	E Mids	(200.7)	(175.0)	(180.3)	(192.8)	(201.3)	(209.0)	(220.6)	(225.7)	16.2
	S. Wales	(236.8)	(222.7)	(225.3)	(231.7)	(236.9)	(241.9)	(248.6)	(250.9)	10.1
	S. West	(344.6)	(321.6)	(326.9)	(336.1)	(343.9)	(351.8)	(363.0)	(367.9)	15.7

Simulated asset replacement expenditure is as often higher than the base case than lower for all DNOs,[6] which is consistent with the assumed symmetry of the distribution parameters. Similarly as above, uncertainty on asset replacement expenditure has a very limited effect on EBITDA but feeds through into the operating cash flows.

- **NLRE capex – ex ante**

The increase (or decrease) away from the base case NLRE capex (ex ante) over the RIIO-ED1 period follows a triangular distribution with **mode 0%, minimum -10% and maximum 10%**. Similarly as for the asset replacement expenditure, WPD sees the same upside and downside risk around the base case forecasts. Table 1.7 presents the key distribution percentiles of NLRE capex

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[6] As shown by the median (equal to the 50%-percentile) being close to the base case forecasts.

(ex ante) for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.7
NLRE capex (ex ante)

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
NLRE capex (Ex Ante)	W Mids	13.9	12.6	12.9	13.4	13.9	14.2	14.7	15.0	0.8
	E Mids	18.4	16.9	17.2	17.9	18.4	19.0	19.7	19.9	1.1
	S. Wales	12.1	11.1	11.3	11.8	12.1	12.5	13.0	13.2	0.7
	S. West	4.2	3.8	3.9	4.1	4.2	4.3	4.5	4.6	0.2
EBITDA	W Mids	2223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	0.0
	E Mids	2086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	0.0
	S. Wales	957.9	958.0	958.0	958.0	957.9	957.9	957.9	957.9	0.0
	S. West	1404.2	1,404.2	1,404.2	1,404.2	1,404.2	1,404.2	1,404.2	1,404.2	0.0
Operating Cash-Flow	W Mids	(209.7)	(208.6)	(208.8)	(209.3)	(209.7)	(210.0)	(210.5)	(210.8)	0.7
	E Mids	(200.7)	(199.3)	(199.6)	(200.2)	(200.7)	(201.2)	(201.9)	(202.2)	1.0
	S. Wales	(236.8)	(235.8)	(236.0)	(236.5)	(236.8)	(237.1)	(237.6)	(237.8)	0.7
	S. West	(344.6)	(344.2)	(344.3)	(344.5)	(344.6)	(344.7)	(344.9)	(344.9)	0.2

Similarly as above simulated NLRE capex (ex ante) is symmetrically distributed, in line with the assumed distribution parameters. Similarly as above, uncertainty on NLRE capex (ex ante) has a limited effect on EBITDA but feeds through into the operating cash flows.

▪ **NLRE capex – other**

The increase (or decrease) away from the base case NLRE capex (other) over the ED1 period follows a triangular distribution with **mode 0%, minimum -10% and maximum 10%**. Similarly as for the two previous categories, WPD sees the event of NLRE capex (other) being greater than the base case forecasts equally likely as it being lower. Table 1.8 presents the key distribution percentiles of NLRE capex (other) for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.8
NLRE capex (Other)

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
NLRE CAPEX (Other)	W Mids	31.4	28.7	29.2	30.4	31.4	32.2	33.6	34.1	1.8
	E Mids	34.5	31.5	32.0	33.4	34.4	35.4	36.8	37.5	2.0
	S. Wales	29.2	26.6	27.1	28.2	29.2	30.2	31.3	31.7	2.0
	S. West	32.3	29.5	30.1	31.3	32.3	33.2	34.6	35.1	1.9
EBITDA	W Mids	2223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	2,223.7	0.0
	E Mids	2086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.4	0.0
	S. Wales	957.9	958.0	958.0	958.0	957.9	957.9	957.9	957.9	0.0
	S. West	1404.2	1,404.3	1,404.3	1,404.2	1,404.2	1,404.2	1,404.2	1,404.2	0.0
Operating Cash-Flow	W Mids	(209.7)	(207.2)	(207.7)	(208.8)	(209.7)	(210.5)	(211.8)	(212.2)	1.7
	E Mids	(200.7)	(198.0)	(198.4)	(199.7)	(200.7)	(201.6)	(202.9)	(203.5)	1.9
	S. Wales	(236.8)	(234.4)	(234.9)	(235.8)	(236.8)	(237.7)	(238.7)	(239.1)	1.8
	S. West	(344.6)	(342.0)	(342.5)	(343.7)	(344.6)	(345.4)	(346.7)	(347.3)	1.8

Similarly as above simulated NLRE capex (other) is symmetrically distributed, in line with the distribution parameters. Similarly as above, uncertainty on NLRE capex (other) has a limited effect on EBITDA but feeds through into the operating cash flows.

- **NLRE capex – legal**

The increase (or decrease) away from the base case NLRE capex (legal) over the RIIO-ED1 period follows a triangular distribution with

- **mode 0%, minimum -10% and maximum 5% for the Midlands DNOs**

- **mode 0%, minimum -10% and maximum 20% for the Wales/South West DNOs**.

WPD has different expectations concerning NLRE capex (legal) incurred by the Midlands DNOs and the Wales/South West DNOs during RIIO-ED1. WPD forecasts that NLRE capex (legal) of the Midlands DNOs has a greater chance to be smaller than the base case forecasts than larger.

However, WPD sees a greater risk for the SouthWales/South West DNOs NLRE capex (legal) to be greater than the base case forecasts than lower.

Table 1.9 presents the key distribution percentiles of NLRE capex (legal) for each DNO and how they feed through into their EBITDA and operating cash-flows, holding all other risk factors constant.

Table 1.9
NLRE CAPEX (Legal)

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
NLRE CAPEX (Legal)	W Mids	32.3	29.4	30.0	31.0	31.8	32.5	33.2	33.6	1.4
	E Mids	31.9	29.3	29.7	30.7	31.5	32.2	32.9	33.2	1.5
	S. Wales	13.4	12.3	12.6	13.2	13.7	14.5	15.4	15.7	1.2
	S. West	22.8	20.8	21.5	22.5	23.5	24.6	26.0	26.8	2.1
EBITDA	W Mids	2223.7	2,223.8	2,223.8	2,223.7	2,223.7	2,223.7	2,223.6	2,223.6	0.1
	E Mids	2086.4	2,086.4	2,086.4	2,086.4	2,086.4	2,086.3	2,086.3	2,086.3	0.1
	S. Wales	957.9	958.0	958.0	958.0	958.0	957.9	957.9	957.9	0.0
	S. West	1404.2	1,404.4	1,404.4	1,404.3	1,404.3	1,404.2	1,404.2	1,404.2	0.1
Operating Cash-Flow	W Mids	(209.7)	(207.0)	(207.5)	(208.5)	(209.3)	(209.9)	(210.6)	(211.0)	1.4
	E Mids	(200.7)	(198.2)	(198.6)	(199.6)	(200.4)	(201.0)	(201.7)	(202.0)	1.4
	S. Wales	(236.8)	(235.7)	(236.0)	(236.6)	(237.1)	(237.7)	(238.7)	(239.0)	1.2
	S. West	(344.6)	(342.7)	(343.3)	(344.3)	(345.2)	(346.3)	(347.7)	(348.4)	2.0

The simulated NLRE capex (legal) is asymmetrically distributed for all DNOs, in line with the respective distribution parameters. Similarly as for other capex categories, NLRE capex (legal) does not affect EBITDA but feeds through into the operating cash-flows.

2.   Incentive Schemes

To simulate the risk of reward/penalty due to the RIIO-ED1 incentives schemes, we have simulated uncertainty in a different way than business risks. For each of the incentive schemes, we pick two independent draws of reward/penalty for the first and the last year of the RIIO

period. We then interpolate the penalty/reward from the two boundary values to calculate exposure for each year within RIIO ED1. For instance, if we draw a penalty equal to -0.3% in the first year and a reward equal to 0.4% in the last year, the annual reward/penalty (in % of allowed revenues) during RIIO-ED1 will be as shown in Table 2.1

Table 2.1
Example of Reward/Penalty Simulation

Year	2016	2017	2018	2019	2020	2021	2022	2023
Reward/penalty (+/-)	-0.3%	-0.2%	-0.1%	0%	0.1%	0.2%	0.3%	0.4%

By simulating the incentive reward/penalty in this way, we acknowledge the existence of some inertia in the way a company performs against the incentives schemes. If a company performs in a certain way in a given year, it is unlikely that it will perform radically differently in the following year.

2.1. Broad Measure of Customer Satisfaction (BMCS)

We group the individual components of the BMCS scheme to show their impact on EBITDA and operating cash flows. We present the distribution parameters separately for each of the sub-categories but then present the aggregated effect on EBITDA and operating cash-flows. The distribution parameters are expressed in percentage of the Ofgem Final Proposals revenue allowances calculated by the model. WPD forecasts exposure in line with Ofgem's maximum exposure for the BMCS scheme.

▪ **Minor connections**

The reward/penalty (in percentage of allowed revenues) related to minor connection follows a triangular distribution with **mode 0%, minimum -0.5% and maximum 0.5%**.

▪ **Interruptions**

The reward/penalty on interruptions follows a triangular distribution with **mode 0%, minimum -0.3% and maximum 0.3%**.

▪ **General inquiry**

The annual reward/penalty on general inquiry follows a triangular distribution with **mode 0%, minimum -0.2% and maximum 0.2%**.

▪ **Complaints metrics**

The annual reward/penalty (in percentage of allowed revenues) on the complaints metric follows a triangular distribution with **mode 0%, minimum -0.5% and maximum 0%**.

▪ **Stakeholder engagement**

The annual reward/penalty (in percentage of allowed revenues) on stakeholder engagement follows a triangular distribution with **mode 0%, minimum 0% and maximum 0.5%**.

Table 2.2 presents the distribution percentiles of the simulated reward/penalty on BMCS during the RIIO-ED1 period for each of the DNO and how this feeds through their EBITDA and operating cash flows.

Table 2.2
BMCS

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
BMCS - Reward/ Penalty	W Mids	0	(14.5)	(10.5)	(4.0)	0.1	4.7	10.8	16.3	8.6
	E Mids	0	(16.3)	(10.9)	(4.4)	0.1	4.8	10.9	15.4	9.3
	S. Wales	0	(8.3)	(6.2)	(2.5)	0.1	2.4	5.7	7.5	4.9
	S. West	0	(11.6)	(8.4)	(3.3)	0.3	3.5	8.0	10.8	6.7
EBITDA	W Mids	2223.7	2,208.0	2,212.7	2,219.2	2,223.9	2,228.8	2,235.7	2,240.5	9.6
	E Mids	2086.4	2,070.0	2,074.3	2,081.5	2,086.4	2,091.4	2,098.3	2,102.2	9.8
	S. Wales	957.9	949.6	951.7	955.4	958.0	960.6	963.8	966.1	5.2
	S. West	1404.2	1,391.7	1,395.5	1,400.9	1,404.6	1,408.0	1,413.0	1,416.1	7.0
Operating Cash-Flow	W Mids	(209.7)	(222.6)	(218.7)	(213.4)	(209.5)	(205.6)	(200.0)	(196.1)	7.8
	E Mids	(200.7)	(214.2)	(210.6)	(204.7)	(200.7)	(196.7)	(191.0)	(187.8)	8.0
	S. Wales	(236.8)	(243.6)	(241.8)	(238.9)	(236.7)	(234.6)	(232.0)	(230.1)	4.3
	S. West	(344.6)	(354.7)	(351.7)	(347.3)	(344.3)	(341.6)	(337.4)	(334.9)	5.8

Uncertainty on performance against the BMSC incentive scheme fully feeds through into the EBITDA and operating cash flows, as shown by the similar size of the interquartile ranges of the assumed reward/penalty and the modelled EBITDA and operating cash-flows.

2.2. Interruption Incentive Scheme

▪ **IIS**

The annual reward/penalty (in £ mln) related to the Interruption Incentive Scheme (IIS) follows a triangular distribution with **mode £ 0 mln, minimum -£ 10 mln and maximum £ 16 mln** over the entire RIIO ED1 period for each DNO**.** The parameters selected imply that WPD see both being rewarded and penalised as possible events but considers that the potential for reward is greater. Table 2.3 presents the distribution percentiles of the simulated reward/penalty in money-terms during the RIIO-ED1 period for each of the DNO and how this feeds through their EBITDA.

Table 2.3
IIS

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
IIS - Reward/ Penalty	W Mids	0	(6.2)	(4.3)	(0.9)	1.8	4.6	8.4	10.7	5.5
	E Mids	0	(5.8)	(3.9)	(1.0)	2.0	4.7	8.0	10.3	5.7
	S. Wales	0	(5.5)	(3.8)	(0.6)	1.8	4.5	8.4	10.9	5.1
	S. West	0	(6.1)	(3.9)	(0.5)	2.0	4.7	8.9	11.3	5.3
EBITDA	W Mids	2223.7	2,217.4	2,219.2	2,222.7	2,225.5	2,228.5	2,232.3	2,234.9	5.8
	E Mids	2086.4	2,080.5	2,082.0	2,085.2	2,088.4	2,091.3	2,094.7	2,097.4	6.1
	S. Wales	957.9	952.0	953.9	957.1	959.7	962.7	966.7	969.0	5.6
	S. West	1404.2	1,398.1	1,400.0	1,403.5	1,406.2	1,409.3	1,413.4	1,416.1	5.8
Operating Cash-Flow	W Mids	(209.7)	(214.9)	(213.4)	(210.5)	(208.3)	(205.8)	(202.7)	(200.6)	4.7
	E Mids	(200.7)	(205.6)	(204.3)	(201.7)	(199.1)	(196.8)	(193.9)	(191.8)	5.0
	S. Wales	(236.8)	(241.6)	(240.1)	(237.4)	(235.3)	(232.9)	(229.6)	(227.7)	4.5
	S. West	(344.6)	(349.6)	(348.1)	(345.2)	(343.0)	(340.5)	(337.1)	(334.9)	4.7

In line with its assumed distribution parameters, the IIS produces more often rewards than penalties. As above, uncertainty on performance against the IIS fully feeds through into the

EBITDA and operating cash flows, as shown by the similar size of the interquartile range of the assumed reward/penalty and the modelled EBITDA and operating cash-flows.

2.2.1.　　　Time to Connect (minor connections)

- **Time to connect (minor connections)**

The annual reward/penalty (in % of allowed revenues) related to the time to connect for minor connection customers follows a triangular distribution with **mode 0%, minimum 0% and maximum 0.4%.** WPD forecasts exposure in line with Ofgem's maximum exposure for this scheme. Table 2.4 presents the distribution percentiles of the simulated reward/penalty in money-terms during the RIIO-ED1 period for each of the DNO and how this feeds through their EBITDA.

Table 2.4
Time to Connect (Minor Connections)

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
Time to Connect Reward/ Penalty	W Mids	0	0.6	1.1	2.8	4.3	5.9	8.4	10.0	3.2
	E Mids	0	0.5	1.2	2.7	4.0	5.7	8.2	9.4	3.1
	S. Wales	0	0.2	0.6	1.4	2.2	3.0	4.2	5.0	1.6
	S. West	0	0.4	0.8	1.9	3.1	4.2	6.0	6.9	2.3
EBITDA	W Mids	2223.7	2,224.4	2,224.9	2,226.5	2,228.0	2,229.9	2,232.4	2,234.3	3.4
	E Mids	2086.4	2,086.9	2,087.5	2,089.0	2,090.5	2,092.3	2,094.9	2,096.3	3.3
	S. Wales	957.9	958.2	958.5	959.3	960.0	961.0	962.3	963.2	1.7
	S. West	1404.2	1,404.6	1,405.1	1,406.2	1,407.3	1,408.6	1,410.3	1,411.4	2.3
Operating Cash-Flow	W Mids	(209.7)	(209.2)	(208.8)	(207.5)	(206.2)	(204.7)	(202.6)	(201.1)	2.8
	E Mids	(200.7)	(200.3)	(199.9)	(198.6)	(197.4)	(195.9)	(193.8)	(192.7)	2.7
	S. Wales	(236.8)	(236.6)	(236.3)	(235.7)	(235.1)	(234.3)	(233.3)	(232.5)	1.4
	S. West	(344.6)	(344.3)	(343.9)	(343.0)	(342.1)	(341.1)	(339.6)	(338.7)	1.9

WPD always gets rewarded under this incentive scheme, consistent with the assumed distribution parameters. As above, performance against this scheme fully feeds through into the EBITDA and operating cash flows.

2.2.2. Incentive Connections Engagement (major connections)

▪ **Incentive Connections Engagement (major connections)**

WPD does not expect any exposure to this incentive scheme for all the DNOs over the RIIO ED1 period.

2.3. Cost of Debt

▪ **Methodology**

The model accounts for uncertainty on:

▪ allowed cost of debt;

▪ actual cost of new debt issued and

▪ volume of new debt issued over the ED1 period.

The cost of WPD's embedded debt is based on each DNO's existing debt portfolio and therefore is fixed in the model.

The amount of new debt issued is determined by modelled costs and allowed revenues, which are random variables in the model, and is set such that gearing is kept constant at the notional level for all years of the RIIO ED1 period.   New short-term debt is issued up to a maximum of £200mln for each DNO. The cost of short-term debt is calculated as the prevailing LIBOR rate plus a fixed margin in line with the original WPD model. Once the £200mln threshold gets breached, long-term bond with nominal value of £250mln is issued at the prevailing spot rate for A/BBB-rated corporate bonds.

To simulate the market price of short-term floating debt and long-term bonds, we simulate future real risk-free rates as future interest rates on a 10-year maturity UK government bond by randomly shocking the current Bank of England's real forward curve.[7] Figure 1 illustrates the simulation of a future path of the real risk free rate. In the picture t_0 is the current year and t_1, t_2,

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[7] The Bank of England forward curve is the UK "instantaneous implied" real forward curve based on yields on UK government bonds and on yields in the collateral repo market.

etc. are future (simulated) years. Current 1-year maturity forward rates are randomly shocked with normally distributed variables.[8] Shocked 1-year forward rates are then re-combined appropriately using the Fisher equation to obtain simulated 10-year forward rates.

Figure 1
Simulation of Future Risk-Free Rates

	1Y	2Y	3Y	4Y	...	10Y	11Y	12Y	...
t0	f1,0	f2,0	f3,0	f4,0	...	f10,0	f11,0	f12,0	...
t1	f1,1	f2,1	f3,1	f4,1	...	f10,1	f11,1	f12,1	...
t2	f1,2	f2,2	f3,2	f4,2	...	f10,2	f11,2	f12,2	...
t3	...								
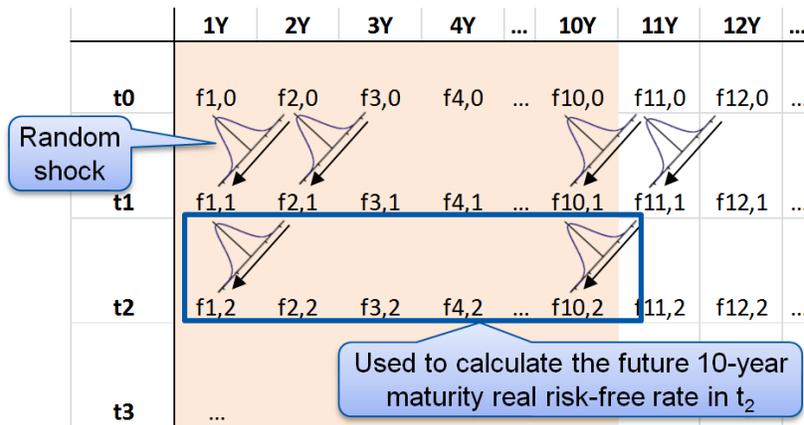
Source: NERA analysis

Using this method, we simulate 4000 future paths for the risk-free rate, from which one is randomly picked at each draw. Each path has an equal chance to be picked within the model. Figure 2 illustrates the distribution of the simulated risk-free rates (we show here the average risk free rate over RIIO ED1). 90% of the real RFR simulations are between -2.2% and 3.0%, which gives a range of plausible RFR.

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[8] Using "white noise" random variables , i.e. normally distributed with an expected value of zero and a strictly positive standard deviation, calibrated on historical data over the past 5 years

Figure 2
Simulated Risk-Free Rates (90% confidence interval)
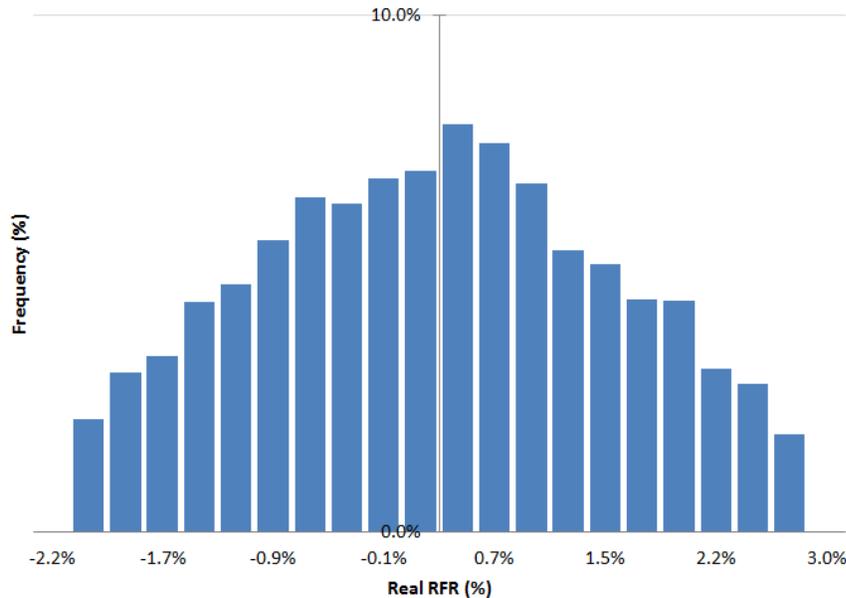
Source: NERA analysis

The real cost of future *long-term* bonds issued by the model is calculated by adding to the simulated real risk free rate a debt premium spread. The *spread* for long-term bonds corresponds to the expected debt premium paid by a A/BBB-rated non-financial company on top of the risk-free rate for a bond with a maturity of 10+ years. The estimated spread is calibrated on historic debt cost indices published by iBoxx for the relevant rating and maturity. The level of the future spread in each year is inversely correlated to the level of the simulated real risk free rate, so that the actual (real) cost of new debt is less volatile than the simulated risk free rate. This is consistent with market evidence on the volatility of utilities' long-term bond costs.

LIBOR, which is used to calculate the price of future *short-term* floating debt, is calculated similarly by adding a spread to the simulated real risk-free rate. The estimated spread is calibrated on historical LIBOR data.

Ofgem's future allowed cost of debt in each year of the RIIO-ED1 period is updated with the simulated costs of new debt for an A/BBB-rated non-financials corporate bond with 10+ years maturity.

▪ **Simulation results**

Table 2.5 shows the impact of randomising cost of debt on the distribution of actual interest payments, EBITDA and operating cash-flows.

Table 2.5
Cost of Debt

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
Actual Interest Payments	W Mids	624.1	534.8	563.3	598.9	626.5	655.7	711.1	747.5	56.8
	E Mids	564.2	487.5	508.4	539.5	566.6	592.5	644.7	688.0	53.0
	S. Wales	282.7	239.2	250.9	269.9	285.1	298.6	330.3	353.5	28.7
	S. West	404.0	342.8	360.2	385.2	405.5	427.7	468.4	498.8	42.5
EBITDA	W Mids	2223.7	2,134.8	2,160.8	2,199.1	2,226.8	2,251.4	2,296.2	2,323.1	52.3
	E Mids	2086.4	2,002.8	2,027.2	2,063.2	2,089.2	2,112.5	2,154.6	2,179.9	49.2
	S. Wales	957.9	917.5	929.4	946.7	959.4	970.6	991.0	1,003.1	23.8
	S. West	1404.2	1,342.9	1,360.8	1,387.2	1,406.4	1,423.4	1,454.4	1,472.9	36.2
Operating Cash-Flow	W Mids	(209.7)	(238.4)	(229.2)	(217.9)	(211.6)	(205.3)	(196.5)	(191.0)	12.6
	E Mids	(200.7)	(234.7)	(224.0)	(211.2)	(202.9)	(195.4)	(185.2)	(177.1)	15.8
	S. Wales	(236.8)	(269.1)	(256.6)	(245.4)	(238.3)	(232.0)	(222.8)	(215.5)	13.3
	S. West	(344.6)	(375.0)	(363.5)	(353.3)	(346.4)	(339.6)	(331.4)	(324.4)	13.6

Deviations from the base case allowed cost of debt[9] (both positive and negative) feed through into EBITDA due to increases/decreases in the revenue allowances (via the cost of debt allowance). Deviations in actual interest paid resulting from deviations in the actual cost of debt, do not feed through the EBITDA, since this is calculated before interest. The combined effect of deviations from base case for both the allowed and actual cost of debt is reflected in the operating cash flows.

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[9] Base case cost of debt is set equal to the average of the 4000 simulations.

2.4. RPI

Costs in the model are indexed each year based on a forecast of RPI inflation[10]. We have developed the following approach for the assessment of simulated RPI risk. In each simulation run the model selects an inflation forecast from a range of different independent forecasts for RPI during the RIIO-period. We use inflation forecasts reported in the HM Treasury Publication "Forecasts for the UK economy: a comparison of independent forecasts" from May 2013.[11] The forecasts are drawn from reputable sources; hence they are assumed to occur with equal probability.

Figure 3 shows the independent RPI forecasts that we have used for our simulation.

Figure 3
RPI Forecasts

18 independent RPI forecasts

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Barclays Capital	3.4%	3.4%	3.8%	3.7%	3.8%	3.6%	3.6%	3.6%	3.6%	3.6%
Capital Economics	3.2%	2.6%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
Citigroup	3.3%	2.9%	3.3%	3.3%	3.8%	3.3%	3.3%	3.3%	3.3%	3.3%
Commerzbank	3.5%	2.8%	3.3%	4.2%	4.2%	3.6%	3.6%	3.6%	3.6%	3.6%
Credit Suisse	3.2%	2.7%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Goldman Sachs	3.4%	3.3%	3.1%	2.9%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%
Nomura	3.3%	2.9%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%	3.1%
RBS Global Banking & Market	3.3%	3.1%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%	3.2%
Schroders	3.3%	3.4%	3.4%	3.6%	3.7%	3.5%	3.5%	3.5%	3.5%	3.5%
Beacon Economic Forecasting	3.2%	2.2%	3.3%	3.6%	3.6%	3.2%	3.2%	3.2%	3.2%	3.2%
Cambridge Econometrics	2.4%	2.9%	2.9%	3.1%	2.8%	2.8%	2.8%	2.8%	2.8%	2.8%
CEBR	3.2%	3.0%	3.2%	3.4%	3.7%	3.3%	3.3%	3.3%	3.3%	3.3%
EIU	3.4%	3.0%	2.7%	2.3%	2.9%	2.9%	2.9%	2.9%	2.9%	2.9%
Experian	3.6%	3.3%	3.6%	4.1%	4.2%	3.8%	3.8%	3.8%	3.8%	3.8%
ITEM Club	3.2%	3.0%	3.8%	4.3%	3.6%	3.6%	3.6%	3.6%	3.6%	3.6%
Liverpool Macro Research	3.3%	3.1%	2.8%	2.5%	2.5%	2.8%	2.8%	2.8%	2.8%	2.8%
NIESR	3.3%	3.1%	3.0%	2.9%	3.0%	3.1%	3.1%	3.1%	3.1%	3.1%
Oxford Economics	3.3%	2.9%	2.6%	2.7%	3.5%	3.0%	3.0%	3.0%	3.0%	3.0%
Mean	**3.3%**	**3.0%**	**3.2%**	**3.3%**	**3.4%**	**3.2%**	**3.2%**	**3.2%**	**3.2%**	**3.2%**

Source: HM Treasury Publication "Forecasts for the UK economy: a comparison of independent forecasts" May 2013

Table 2.6 shows the impact on EBITDA and operating cash flows of randomising RPI.

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[10]   Unless provided in nominal terms, such as pensions.

[11]   We assemble the medium term forecasts available. If the forecast is not complete for the entire ED1 period we substitute the average value of forecasted RPI growth for years where it is not available.

Table 2.6
RPI

(£ mln)	DNO	Base Case	Simulated Percentiles							Inter-quartile range
			1%	5%	25%	50%	75%	95%	99%	
EBITDA	W Mids	2223.7	2,222.7	2,222.7	2,223.4	2,223.8	2,224.0	2,224.7	2,224.7	0.5
	E Mids	2086.4	2,085.4	2,085.4	2,086.1	2,086.5	2,086.7	2,087.4	2,087.4	0.6
	S. Wales	957.9	955.6	955.6	956.8	957.7	958.9	960.1	960.1	2.1
	S. West	1404.2	1,400.4	1,400.4	1,402.3	1,403.9	1,405.9	1,408.1	1,408.1	3.6
Operating Cash-Flow	W Mids	(209.7)	(230.3)	(230.3)	(221.6)	(208.8)	(201.7)	(199.4)	(199.4)	19.9
	E Mids	(200.7)	(215.9)	(215.9)	(205.7)	(200.1)	(195.3)	(187.5)	(187.5)	10.4
	S. Wales	(236.8)	(239.0)	(239.0)	(237.3)	(236.8)	(236.1)	(234.8)	(234.8)	1.2
	S. West	(344.6)	(350.2)	(350.2)	(347.1)	(344.8)	(343.4)	(341.6)	(340.5)	3.7

The EBITDA effect of randomising RPI is quite limited. [12] The effect on operating cash flows is larger, due to costs of embedded debt being fixed in nominal terms whereas allowances vary with each RPI draw.

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[12]   Randomizing inflation has a larger impact on EBITDA of the South Wales and South West DNOs than the Midlands because of their larger proportion of costs fixed in nominal terms in the model.