Europe Economics

Comments on NERA/NERL critiques of Europe Economics' WACC analysis

6 June 2019

Contents

1   Introduction

This Annex provides our analysis, to this point, of certain issues the CAA has asked that we consider arising from the responses provided by NERL and its consultants NERA to the CAA's consultation on its proposals for RP3. The specific tasks were as follows.

Debt beta:
- *Review new analysis on debt betas and provide view on any changes to debt beta for NERL: (i) Report from Prof. Zalewska on empirical estimates; (ii) NERA's comments on apparent errors in Europe Economics' approach*

Asset beta:
- *Review new information on ENAV's asset beta and provide view on any changes to asset and equity beta for NERL: (i) changes in ENAV's and other comparators' asset betas since CAA's draft proposals; (ii) NERA's proposed adjustment for terminal services*

Cost of new debt:
- *Review new market information on NERL's bond, iBoxx indices and gilt yields and provide view on any changes to NERL's cost of new debt*
- *Set out a sensitivity for how cost of new debt changes if assumed a 15-year maturity*

This document is structured as follows.

- Section 2 provides our updated estimates of NERL's cost of debt, including sensitivity analysis
- Section 3 summarises NERA's comments on apparent errors in Europe Economics' approach to debt beta.
- Section 4 provides our review of the Zalewska report
- Section 5 provides our updated view of NERL's debt beta
- Section 6 gives our updated estimates for the asset and equity betas

2 Updated Estimates of NERL's Cost of Debt

Data has moved on since our previous report. In the following table we present yield estimates for the NERL bond and for the ENAV bond. We see that they are extremely similar. Of particular interest is that there has been a non-trivial drop in yields over recent months.

Figure 2.1 Yield estimates for ENAV and NERL bonds
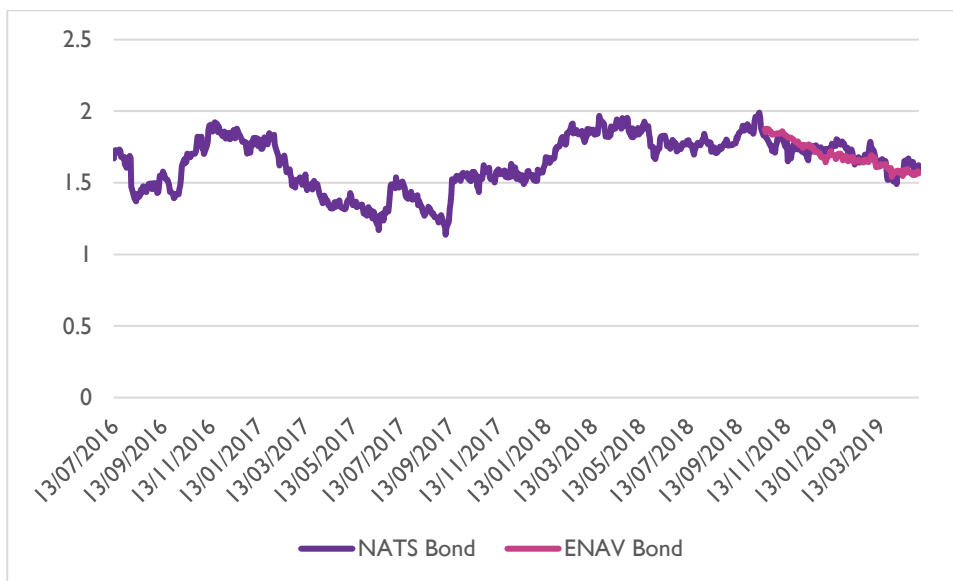
In the previous report we also made use of iBoxx indices, reported in the next graph. Again we see a fall in recent months.

Figure 2.2 iBoxx yields
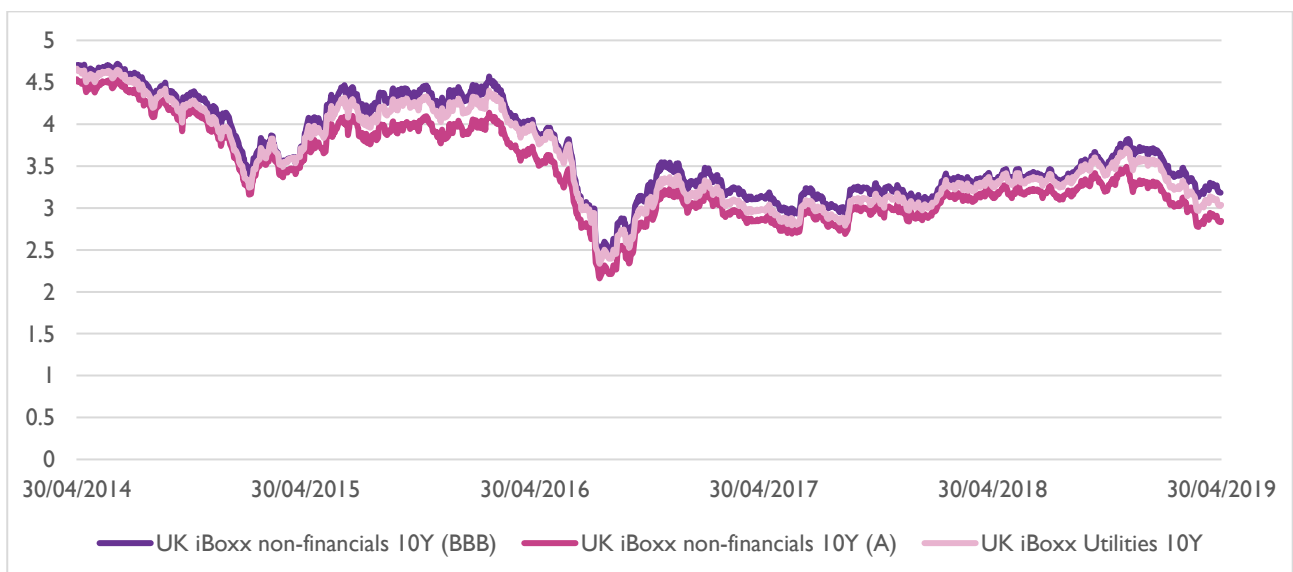
We shall now present the latest spot estimates and their implications for Europe Economics' upper and lower bound estimates on the same methodology used in our previous report.[1]

2.1   Lower Bound

Since the NATS bond has an effective 5 years to maturity[2] we need to convert its yield to reflect differences between those on a 5 year bond and a 10 year bond, given that the latter forms our benchmark timescale. At our cut-off date of 30 April 2019, according to Bank of England Yield Curve data[3], the yield on a government bond with 5 years to maturity was 0.85 per cent whilst the yield on a 10 year bond was 1.19, a difference of 34bps. We add this to our NATS bond yield of 1.62 per cent (as of 30 April 2019) to obtain a 10 year equivalent, giving a point estimate of 1.96 per cent.

In order to determine how bond rates are expected to develop over the period to mid-RP3 (i.e. over the next approximately four years from the time of our data cut-off), we make use of the yields on different maturity gilts in order to estimate the forward rates for relevant length gilts, to estimate how risk-free yields are expected to evolve in the future. Using the formula discussed in the main NERL report we get the expected yield between 4 and 14 years of 1.73 per cent. As at that same date the yield on a 10 year bond was 1.19 per cent. So the premium was 0.54bps. We then deduct 10bps of liquidity premium.[4] This takes our premium down to 44bps. When we add this to our point estimate, it shifts from 1.96 to 2.40 per cent.

Furthermore, future NATS bond issues might be affected by the change in the licence termination notice period, potentially raising the cost of debt for longer-term debts by some 50 basis points.[5] Adding this to our 2.40 per cent produces a final lower bound estimate, for the middle of RP3, of **2.90** per cent (on a nominal basis).

2.2   Upper Bound

As a regulated entity with a high credit rating, we would expect NERL to be more similar to utilities than to non-financials in general. However, NERL is A rated whilst the iBoxx Utilities series is for all utilities bonds (i.e. BBB and above). Since the iBoxx data does not include an index for A rated utilities, we therefore constructed our own approximate "A-and-above Utilities index", as follows. First we constructed an effective "Average A and BBB" series from these data and compared that to the Utilities series. This gave a "wedge", i.e. an amount by which the utilities series is above the average of the constructed "Average" series, which we then applied to the non-financials A series. For example, for 30 April 2019 the iBoxx non-financials BBB 10+ index had a yield of 3.196 per cent and the A 10+ index had a yield of 2.846, so the average was 3.021 per cent. The iBoxx Utilities 10+ series has a yield of 3.038, so the wedge versus the constructed average non-financials index was 0.017. When we average such wedges over the year to 30 April 2019 we obtain an average wedge of 0.044 per cent. If we add 0.044 to the iBoxx A 10+ non-financials index value of 3.038 we obtain 3.08 per cent. That constitutes our estimate of an A-and-above Utilities values.

If we then add the 44 basis points for expected interest rate rises, and then deduct 20 basis points for the effects of term associated with the 10+ iBoxx series including bonds longer in maturity than 10 years, we obtain an overall figure of **3.32** per cent.

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[1]   Note that this includes the adjustment for the effects of changing license notice periods and an adjustment for issuance costs.
[2]   NATS' bond maturity is around 7 years, however since it is a sinking fund bond the effective maturity is shorter and closer to 5 years.
[3]   https://www.bankofengland.co.uk/statistics/yield-curves GLC Nominal Daily Data, UK Nominal Spot Curve.
[4]   The rationale for this is explained in the main report.
[5]   See "Implications for debt-raising and the cost of debt of changing the minimum termination notice period for NERL's licence", Europe Economics, September 2015.

We note that the iBoxx Utilities index will contain regulated entities with a mix of license periods — some longer and some shorter than NERL's. Hence we do not need to include an additional adjustment for that here.

2.3   Cost of Debt Estimate

We then add 7bps to both the lower bound and the upper bound.[6]   We conclude for an overall range of **2.97** to **3.39** for the cost of new debt. We find no strong reason to favour any part of this range, and hence recommend a point estimate of **3.18** per cent, the mid point of this range. Table 2.3 summarizes our results.

For reference, we contrast them with the previous estimates. We can see that there has been a fall of some 14bps in the central estimate. This arises from a combination of a fall in benchmark yields and a fall in debt premiums.

Table 2.1: Updated cost of debt estimates

	Figures for Cost of Debt	
	New	*Old*
Nats bond	1.62	*1.71*
ENAV bond	1.56	*1.93*
UK iBoxx non-financials 10Y (BBB)	3.20	*3.43*
UK iBoxx non-financials 10Y (A)	2.85	*3.22*
UK iBoxx Utilities 10Y	3.04	*3.37*
GB 10Y BMK	1.19	*1.33*
EU 10Y BMK	0.01	*0.44*
Lower Bound	2.97	*3.10*
Upper Bound	3.39	*3.53*
Cost of debt	3.18	*3.32*

As a sensitivity check, we also report what the cost of debt would be if we had changed the benchmark timescale from 10 years to 15 years.[7]

Table 2.2 Sensitivity Analysis using a 15 year benchmark timescale

	Figures for Cost of Debt (15 year benchmark)
Nats bond	1.62%
ENAV bond	1.56%
UK iBoxx non-financials 10Y (BBB)	3.20%
UK iBoxx non-financials 10Y (A)	2.85%
UK iBoxx Utilities 10Y	3.04%

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[6]   This is done to compensate for issuance and liquidity costs.

[7]   Note: We convert the NATS bound to a 15 year equivalent bond for the lower bound and we do not deduct the 20 basis points in the calculation for the upper bound. The iBoxx 10+ series have average years to maturity of greater than 10 years. The 20 bps adjustment applied in the case of the 10 year series is a rough allowance for some of that effect, based on the general utilities bonds yield curve data from Thomson Reuters. It is perhaps worth noting that this is not a full adjustment and that at 20 bps the implied maturity of debt at the upper bound would still be in excess of 10 years.

	Figures for Cost of Debt (15 year benchmark)
GB 15Y BMK	1.51%
Lower Bound	3.15%
Upper Bound	3.45%
Cost of debt	3.30%

There is a difference of 12 bps in the cost of debt. Most of this difference arises from the increase in the lower bound estimate. We note that whilst the yield on 15 year bonds is higher than that on 10 year bonds, yields on 15 year bonds are expected to rise by less, over the horizon, than are yields on 10 year bonds (i.e. although the level is higher, the change in that level is less).

3   Our Responses to NERA's Comments

NERA's headline claim is that "EE's beta estimates for ENAV are based on a flawed estimation methodology" and that this leads to a substantial understatement of ENAV's beta. We summarise their arguments in Appendix A and our responses in this section.

Criticism: *Asset betas are based on a Local Italian market index (FTSE MIB) with only 40 companies.*

We note that the criticism here is really one of degree or weight. The Europe Economics approach placed some weight on both domestic and European indices. NERA urges that domestic indices should be ignored. We are not convinced by this, especially given that the equity beta ultimately to be derived from this exercise will be applied to a domestic (UK) index and the ERP used will be a domestic UK ERP (which is likely to be higher than a European ERP).

The criticism that the market index does not include the firms under consideration seems an odd and irrelevant one. A market index never need include the firms against which a beta is to be calculated. The issue is whether the index can reasonably be considered to span risks sufficiently that all systematic risks available for exposure by any portfolio of assets in the economy can be obtained by a portfolio combination of the stocks in the index. Italy is a developed economy with an extremely long history of financial markets. We do not consider that an extravagant assumption. As to whether 40 firms is sufficient, we note that the benchmark index for the UK market was for many years the FT 30 index which covered the stocks of 30 firms.

Nonetheless, we do believe it is more appropriate to give some weight to the European index betas than to use purely domestic betas.

Criticism: *The Europe Economics approach assumes that ENAV's terminal services are higher risk compared to ENAV's en-route*

Comparisons between NERL's position and Europe Economics' are complicated by the fact that NERA has used more up-to-date data for its estimates and had access to reports that have been published by ENAV (and others) since our report.

Beyond a repeat of criticisms elsewhere, such as that the lower bound on the en route beta is below the water companies' betas or that betas are estimated with some weight placed on an Italian index rather than European indices, other criticisms are less focused. Europe Economics did not directly assume that terminal services had a lower beta than en route, as NERA claims, although that is a consequence of its approach. Instead the Europe Economics approach was to look at market data for ENAV and assume that UK airports and terminal services would have a similar beta. There are three areas where it might be worth elaborating.

- Is it self-evident that en route services face less systematic risk than terminal services, such that any methodology that finds to the contrary must be flawed?
- How reasonable is it to assume that airports and terminal services should have a similar asset beta?
- Are the various judgements on WACC components that NERA makes in approach to deriving ENAV en route and terminal asset betas superior to the values Europe Economics used or derived from pwc?

We have considered new evidence from the most recent Eurocontrol Performance Review, which allows for some limited comparison of the operational leverage of terminal and en route services.   The report presents aggregate data for 38 European ANSPs on costs.   While it does not report capital expenditure or the size of the asset base, it does provide data on operating costs and depreciation. The latter might be used as a proxy for capex, an assumption that is arguably more reasonable when looking at data from a large number

of firms, since the importance of where one particular firm is in the "investment cycle" becomes relatively less important. We see below that by the depreciation to opex ratio measure, terminal services appear to be a little less operationally leveraged than en route services. This lower cost risk reinforces the effect (if it is correct) of lower demand risk. But, as we can see in the following table, the effect is rather small, especially given how imperfect the measures of operational leverage here are.

Table 3: Opex to Capex ratios

	Terminal	En Route	ANSP
PRM 2017, page 65			
Depreciation: Opex	*10%*	*15%*	*14%*

Source: page 65, https://www.eurocontrol.int/sites/default/files/publication/files/draft-performance-review-report-prr-2018.pdf

To understand how small, we can contrast this difference with the difference we report in the table below, replicating the result set out in our 2018 report[8], namely that operational leverage for NERL is higher than that for ENAV. That difference between 40 per cent and 16 per cent induced an increase in the NERL asset beta of 9 per cent.[9] A difference between 10 per cent and 15 per cent would be nugatory in impact. Moreover, the Eurocontrol data suggest that the ENAV capex: opex ratio is broadly in line with what we would expect for a European ANSP, whereas the capex: opex ratio for NERL is much higher than the depreciation: opex estimate when looking at Eurocontrol data for European ANSPs. In other words, the driver of difference is not that ENAV is in some way atypical. It is that NERL's current capex is high. It is possible that the higher capex: opex ratio for NERL reflects an investment cycle rather than a long-term business model difference. For example, NERL's opex: RAB ratio was in line with ENAV's. That may mean that the adjustment we have applied (which we discuss further below) exaggerates the impact.

Table 4: Opex to Capex ratios

	NERL (mainly En Route)	ENAV (ANSP)
Capex: Opex	40%	16%

Source: page 65, https://www.eurocontrol.int/sites/default/files/publication/files/draft-performance-review-report-prr-2018.pdf

Overall, given the ambiguity of the evidence, the likely nugatory scale of the effect under some measures, and the fact that even the strongest evidence in favour of an operational gearing adjustment appears to invite an interpretation as a cyclical not structural effect, we do not consider this evidence from operational gearing sufficiently decisive to justify changing our central recommendation. However, for reference we shall set out, later, a "no adjustment" version of our range — in which we drop both the en route versus terminal services adjustment and also the operational leverage adjustment. We report the impact of that in Section 0.

Criticism: *Europe Economics' operational leverage assumptions lie at the bottom end of the plausible range*

Given that NERA accepts Europe Economics' estimate as lying within the plausible range, it is unclear that there is much for us to respond to on this point.

Criticism: *Utilities are not plausible comparators for air traffic services*

Europe Economics estimate a "constraint range" for NERL's asset beta of 0.46 to 0.54, with the lower bound based on betas for UK utilities and upper bound based on betas for UK airports, consistent with Europe Economics' argument than NERL's asset beta should be higher than that of UK utilities and lower than that of UK airports.

Europe Economics' reasons for considering utilities as relevant were set out in our previous report, and we believe are consistent with previous work for the European Commission. We note that the utilities "lower

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8   Section 4.3.1
9   Section 8.1

bound" was binding, so our specification of a utilities lower bound *raised* our beta conclusion rather than lowering it.

Criticism: *Airport betas should not be regarded as providing an "upper bound"*

Again the Europe Economics position reflected previous European Commission analysis. We note that in this case the "upper bound" was not binding — 0.54 would have been our maximum value even had we relied upon the value obtained from more direct beta estimates based on ENAV (the "Comparator Range").

Criticism: *Europe Economics gives insufficient weight to other Airport comparators*

Europe Economics' position was that UK airports were most relevant to NERL (more relevant, per se, than international airports) and that international airports were relevant to the estimation of UK airport betas. We stand by that position.

Criticism: *The "indirect" method proposed by EE for the estimation of debt betas omits a key component and is not calculated with the correct parameters*

We do not agree with the use of a liquidity premium as it involves an ad hoc departure from the CAPM, but for references we shall later present estimates with and without a liquidity premium. We discuss direct beta estimates in the next section.

4 Direct Econometric Estimates of Debt Beta

4.1 The regression approach

Debt betas can be estimated using a "decomposition approach", as is the preferred method adopted by Europe Economics in its previous report, based on decomposing the debt premium using the mathematics of the CAPM formula, or a "regression approach", which is based on regressing bond returns against market returns indices.

The regression approach has been subject to a range of criticisms. The most important include concerns about the high level of volatility of results (betas estimated under this approach exhibit a wide range of values, and are often negative), or the inability to statistically differentiate the estimates from zero (confidence intervals tend to be wide enough to encompass zero).[10] Some previous research has also noted the limitations of such an approach, especially in contrast to researchers' prior expectations given the fairly stable nature of utilities' bonds.

In addition to poor statistical properties, the Competition Commission, when it considered debt betas in its key judgement of 2007[11], added some issues related to:

- Data quality: in particular, "the relatively poor quality of the data that we have on returns to debt holders",
- Thin trading: which "affect[s] debt beta estimates more seriously than equity beta estimates even for large firms",
- Differences in gearing levels used: "the difference between historical and assumed [regulatory period] gearing levels".

For these reasons, the Competition Commission stated "These factors have led us to favour the indirect, decomposition method, where we can be much more confident that we are correctly observing how much compensation lenders are asking for in exchange for bearing systematic risk."

4.1.1 Review of NERL's consultation response

In its response to the consultation, NERL (Appendix G[12]) submitted a research paper which provides new analysis of debt betas and suggests what it claims is a new view on the calculation of debt beta for NERL.

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[10] The importance of this criticism is easy to overstate. If we observed 100 point estimates, independently observed, each of which had a 95 per cent confidence interval of -0.1 to +0.2, and each has a point estimate of +0.05, the probability of the true value being zero or below would be less than 10^{-18} per cent. Of course, the first criticism tells us that it is not true that we always obtain a positive regression debt beta — so thus far we have merely repeated the point about volatility of observations in a more technical form. But by itself, all this criticism really adds is that one should be circumspect in placing high weight simply the latest point estimate.

[11] See p F24, paragraph 92, of https://webarchive.nationalarchives.gov.uk/20140402235745/http://www.competition-commission.org.uk/assets/competitioncommission/docs/pdf/non-inquiry/rep_pub/reports/2007/fulltext/532af.pdf

[12] Professor Ania Zalewska (April 2019) "Estimation of the debt beta of the bond issued by Nats (En-Route) plc".

Paper summary

The aim of the paper is to estimate the market risk of the bond issued by Nats (En-Route) plc (referred to as the NATS-bond), and assess whether it is greater than 0.1. The analysis is performed within the CAPM framework using three different methods: OLS, ML-GARCH(1,1) and the Kalman Filter.

The evidence uses individual bonds and bond indices:

- **Individual bonds:** include the NATS-bond (issued on 18 August 2003, ticker ED1004032 Corp) and six other comparable bonds issued by Heathrow Funding Ltd (tickers: EH5179385 Corp, EI0650552 Corp, EI0682746 Corp, EH5179583 Corp, EH5177660 Corp, EH5177629 Corp).
- **Three iBoxx indices:** "iBoxx non-financials A rated", "iBoxx non-financials" and "iBoxx financials".

The analysis uses different definitions as proxies for the market portfolio (which we have labelled as E, EB and TEB, below):

- **[E] - Equity-only portfolio index.** Three indices are used: the FTSE All Share to represent the domestic equity market portfolio, and the FTSE All Europe and Euro Stoxx 600 indices (converted into pound sterling returns), as proxies of foreign equity market portfolios.
- **[EB] - Equity-bond market index.** Constructed as the capitalisation-weighted averages of equity and bond indices minus the risk-free rate of return. The indices in [E] are used as equity indices, and two different indices are used for the bond index (iBoxx-UK, constructed as capitalisation-weighted returns on the iBoxx Sterling Non-Financials and iBoxx Sterling Financials; and iBoxx-Europe calculated as the capitalisation-weighted returns on the iBoxx Euro Financials and the iBoxx Euro Non-Financials). Risk-free rates are proxied by a 5-year government bond.
- **[EBT] - Tax-corrected equity-bond market index.** The same indices used in [EB] are here used after applying adjustments for the effects of tax (adjusted capitalisation weighted index constructed of the stock market indices and the bond indices). The corporation tax rate was assumed to be 20 per cent.

According to the paper, the results strongly support the thesis that the NATS-bond's beta is negative (and statistically significant) and not different from zero in recent years. The results are said to be robust across various specifications and methods of estimation. The conclusions are that the insignificance of the betas (i.e. their being statistically not different from zero) indicate that the returns on the NATS-bond are determined by the risk free-rate and the idiosyncratic risk of the bond (e.g. default risk) but not the performance of (returns on) the market portfolio.

Detailed results

Throughout the different analyses and estimation methods, the paper reports a consistent finding of:

- Negative betas for the period 2010-2019.
- Non positive beta (or not statistically different from zero) in the more recent period of 2016-2019.

This is supported with evidence from different models[13]:

- **iBoxx Beta estimates – daily data.** OLS and ML betas estimates for iBoxx indices show very similar estimates (Table 9 and Table 10). The absolute estimates for Non-financial indices (A-rated and all bonds) are statistically significant and negative. The estimates appear as less negative using a more recent period (2016-2019). Estimates using the Kalman Filter show a time evolution of the estimated betas and a similar pattern for the three analysed indices (Figure 4): beta estimates tend to be negative although some of these are positive for recent years. Using a 95 per cent confidence interval for the iBoxx non-financials, applying Kalman filter estimates (Figure 5) shows how "in the most recent years, there are short periods of time over which the beta estimates are positive". These positive estimates are "not statistically significant" according to the paper.

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[13] All the tables and figures below our referring to tables and figures in "*Estimation of the debt beta of the bond issued by Nats (En-Route) plc*" (2019) by Professor Ania Zalewska.

- **Individual bonds betas: NATS-bond and HTHRW - daily data.** OLS estimates (Table 11) show consistency in the estimates across the different market portfolio indices used. The betas are also comparable across the bonds, showing statistically significant negative betas. The results are very similar when using equity-bond market indices (Table 12) and tax-corrected equity-bond market index (Table 13). ML GARCH models also show very similar results for the 2010 –2019 period (Table 14). Betas are smaller (in absolute terms) when estimated for more recent years (2016-2019, Table 15). The Kalman Filter estimates (for NATS-bond and HTHRW-bonds, Figure 6) also show great similarity in the estimates obtained for the three different indices. Again the paper reports recent betas much closer to zero than the estimates obtained for the longer period (2008-2014). Also, with an exception of a "few short-lived 'spikes'" betas are non-positive and within the range of -0.2 to 0. The 95 per cent confidence intervals for NATS-bond for the betas obtained from the regressions using the FTSE All Share index (Figure 7) also show recent estimates as statistically insignificant. Finally, betas estimated for HTHRW-bonds using the FTSE All Share index show great similarity across the six bonds' time paths (Figures 8) and comparable to the NATS-bond (Figure 9). Again, the paper reports betas with a considerable time-variation, with more recent values smaller than those obtained for the 2008 Financial Crisis period.
- **Individual bonds Beta estimates – Weekly.** The paper undertakes a similar analysis using weekly returns in the different specifications. Estimates using the Kalman filter for the NATS-bond (Figure 10) confirms the non-positiveness of the beta (observed previously using daily data) and show estimates which are robust to different market portfolio specifications. The 95 per cent confidence intervals for NATS-bond (Figure 11) show again statistically significantly and negative betas during the 2008-2010 period, whilst they became statistically insignificant in more recent years. Comparing the time-paths for the NATS-bond and HTHRW-bonds average (Figure 12) shows considerable similarity between the two series, again with lower values observed in 2008-2014, and higher values (but still close to zero) in the more recent years. The beta for the NATS-bond is nevertheless more stable than the HTHRW-bonds' average.
- **iBoxx Beta estimates – Weekly.** The Kalman filter estimates showing the time-path of the betas for the main iBoxx indices (Figure 13) and with the 95 per cent confidence intervals for the iBoxx non-financials index' (Figure 14) confirms the trends observed for the individual bonds (weekly and daily data). Betas have increased in recent years but remain statistically not different from zero and 0.1 (they are statistically different from 0.2). In this part of the paper the analysis takes a slight different approach, using a dummy variable to test any statistical differences in the 2016-2019 period. OLS regressions (Table 16) show again betas significantly negative in 2010-2019. Significant dummy variables indicate again that in most recent years betas increased and that betas for 2016-2019 period are statistically not different from zero. The ML approach with dummy variables (Table 17) shows the same results (albeit coefficients are smaller than OLS): betas 2010-2016 significant and negative and 2016-2019 betas not different from zero. Betas are significantly smaller than 0.1.
- **Individual bond Beta estimates – Monthly data.** Using monthly data the paper claims that monthly data can result in unreliable outcomes. This is demonstrated by showing contradictory results for NATS-bond when using OLS and a mid-month average (Table 18) or end-of-month average return (Table 19): insignificant, significant negative or significant positive beta in the first case and not significant when using end-of-month returns.

Discussion of the detailed results

The paper displays a large number of results, analyses and regressions (we have counted 285) in addition to several correlation tables and figures. The differences pieces of analysis are all pointing towards the same finding and seek to paint a picture according to which the posted original hypothesis (negative or non-positive betas) is true.

Apart from issues that reflect the general criticisms of the regression approach, it is important to grasp that, at a high level, this paper "proves too much". Its overall finding is that investment-grade corporate debt as a whole (not simply NERL's debt or Heathrow's debt — *all* investment-grade corporate debt) has a non-positive debt beta (zero or negative). That should be seen less as a radical comprehensive finding about UK debt markets and more as a *reductio ad absurdum* of the methodology. To restate the point: the paper does

not simply conclude that NERL has a zero or negative debt beta. It concludes that *all* investment-grade corporates do.

The author explicitly invites us to interpret all debt premiums as arising from idiosyncratic risk of default — i.e. driven by the wedge between expected returns and promised returns. Even for half of typical debt premiums to be attributable to this effect would imply that each year over 80 per cent of investment-grade corporate debt was expected to default.[14] That compares with credit ratings agency estimated defaults risks for utilities of around 0.2 per cent per year.

Beyond the general and overarching criticisms, and moving to the more detailed and specific level, despite the extensive work undertaken, the research has a number of further limitations, the most important being a lack of sensitivity of the different analyses (there is some impression — fairly or not — of cherry-picking of results that demonstrate the main hypothesis). The important questions that any reader can formulate when looking at the paper remain unanswered.

- **Repeated re-statement of the same finding.** The paper correctly identifies correlation between many of the variables. Most noticeably, the high correlation between returns in the equity market indices [E] and the equity market indices and bond indices [EB] are shown in Table 7. The yearly trends of the individual bonds and iBoxx indices is also evident from Figures 1, 2, and 3. Therefore, findings using one market index will be similar if this is replaced for another highly correlated index. Consistency found for models using the different individual bonds should also not come as a surprise as these are also shown to have high correlations between them. Hence, instead of providing additional layers of evidence, the findings are a simple re-stating of one finding (this is simply because the instruments used are correlated with each other). That is to say, this should be seen as sensitivity analysis rather than a separate new finding.
- **Repeated estimation.** The paper shows insignificant differences between OLS and ML GARCH. Some authors have recently advocated for the use of GARCH models given that high-frequency financial data display heteroscedasticity. The similarity of both estimates would seem to indicate that such heteroscedastic data might not be a problem. Hence, GARCH-correction methods would seem not to be needed (again, it is not really an additional piece of evidence).
- **Spurious regression:** All models provided show very low goodness-of-fit (as provided by the Adj-R2). This would be an indication that any of the proposed models are not being reflected properly with the current specifications. The impression is confirmed in Figure 3 of the paper, which shows the daily movement of FTSE ALL Share index and the three iBoxx Sterling indices. The large changes observed in any of the three iBoxx indices are not reflected in the general market index (FTSE All Share index). In fact, the relationship the betas might be picking up might be simply due to the fact that, over the observed period, all series appear to be with a drift (increasing in time).

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[14] We see that mathematically as follows.
Debt beta = ((1 – probability of default) x Debt Premium - probability of default (risk-free rate + loss given default)/ERP
This can be decomposed into two components:
probability of default (risk-free rate + loss given default)/ERP, which is the deduction effect because of the wedge between the promised and expected return
(1 – probability of default) x Debt Premium/ERP, which is the debt beta-driving effect
So if more than half the debt premium is attributable to the deduction effect, we have
(1 – probability of default) x Debt Premium > probability of default (risk-free rate + loss given default)
If we assume the Debt Premium is 100 bps and the sum of the risk-free rate and loss given default are 20 per cent (typical bankruptcy losses given default are near 20 per cent and the risk-free rate is currently near zero), then we have
(1 – probability of default) x 1 > probability of default (0.2)
$\Rightarrow$ probability of default > 1/1.2 = 83.3%.

Figure 4.1 Daily movement of the FTSE All Share index and three iBoxx Sterling indices
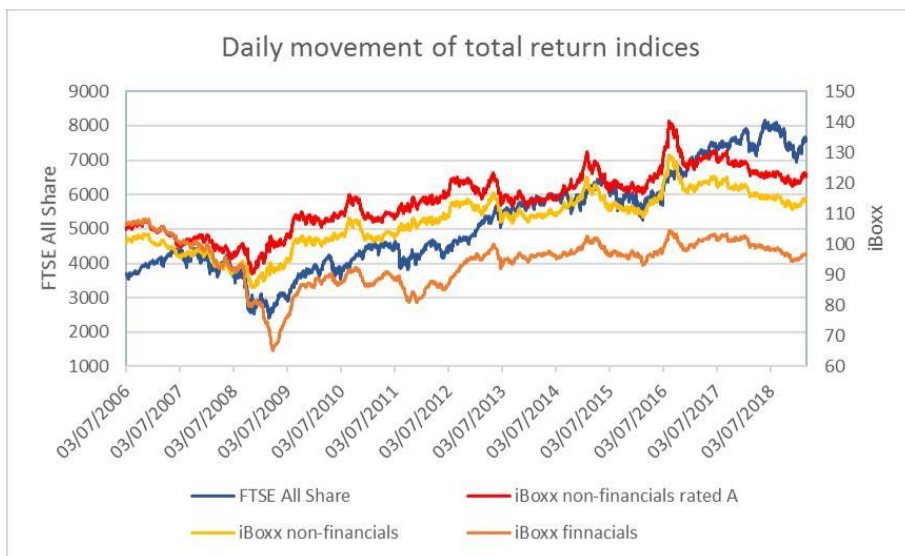
- **Volatility in the estimates:** Beta estimates show a huge disparity across time (as reflected by the time-paths estimated using the Kalman filter). Although the change in time of beta estimates is something already acknowledged and recognised (when reporting time differences in equity betas across time), the level of volatility observed in the paper is rather exceptional. Some of the beta estimates for NATS-bond change in magnitude in a matter of days, moving from negative to positive values. The patterns is consistent across the sample period (similar swings are also observed for Kalman Filter estimates of the iBoxx indices).

Figure 4.2 Daily estimates of the beta for NATS-bond when the market portfolio is as the legend specifies.
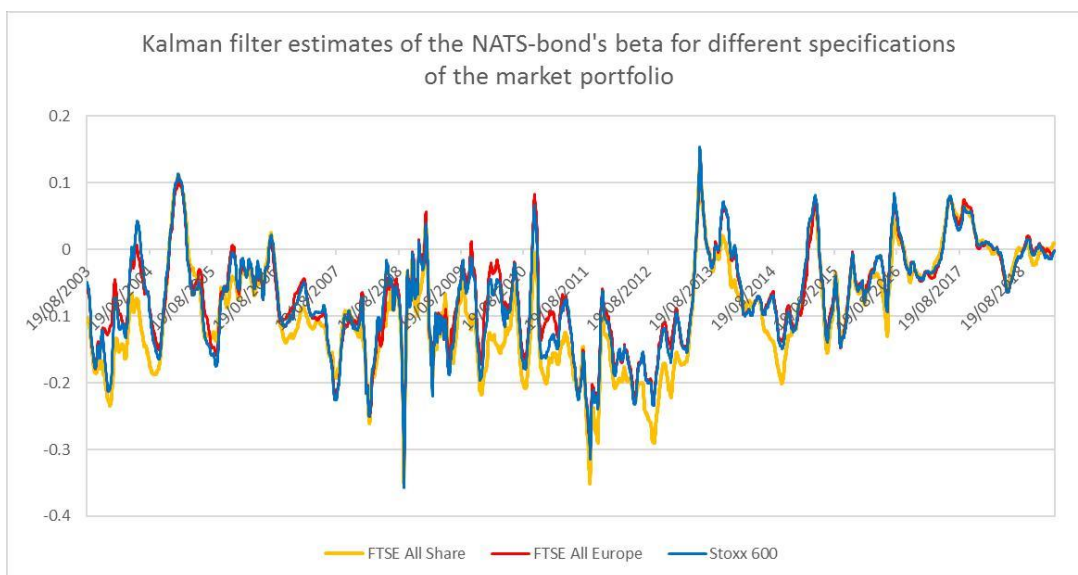
"Partial" hypothesis testing: The paper correctly identified two periods in the sample: 2010-2019 and 2016-2019. It then argues that (a) betas are negative during 2010-2019 and (b) not statistically different from zero in 2016-2019. The first period is justified "to provide the assessment after the 2008 Financial Crisis" and the second "to give an overview of the most recent developments". The periods

chosen could be criticised as being subjective (if after-2008 is to be analysed it would seem logical to use that year as a cut-off point). But even using such periods one thing seems clearly missing from the analysis and this is the analysis for observations for 2003-2010. For example, the iBoxx non-financials betas and confidence interval Figure 5 shows a repeated inclusion of zero in the confidence interval. This happens throughout the period, but more persistently during the period 2006-2010 (earlier data are not shown). The independent reader looking at that graph will automatically ask why are the results and subsequent tests not undertaken using pre-2010 data too. In fact, just by looking at the graph it might seem plausible to conclude that any change in the betas does not happen after 2016. Instead, it might seem reasonable to conclude that what are unusual are the estimates obtained during the 2010-2013 window, which would appear as "abnormally" low. Following this line of argumentation it could then be argued that the betas found for the whole period (2006-2019) are uncertain, despite the fact that some negative values have been obtained during the 2010-2013 period.

Figure 4.3 The Kalman Filter estimates of the daily betas of the iBoxx non-financials index with the FTSE All Share index used as the proxy for the market portfolio.
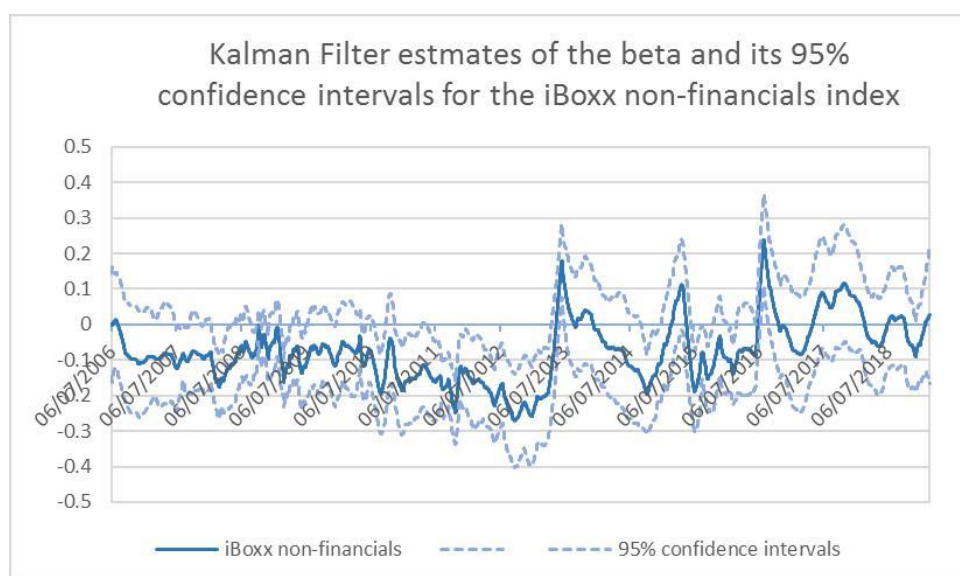
4.1.2   Conclusion

In conclusion we have seen that the regression approach has suffered from a range of problems.

Some criticisms have been derived from the high level of volatility of results or the inability to statistically differentiate the estimates from zero. Other problems are not new and have been previously highlighted by the Competition Commission in 2007 when noting the poor quality of the data, the thin trading of debt data and the differences in gearing levels used.

A further problem is that the methodology, when applied to corporates in general, provides a very radical conclusion: UK investment-grade corporates as a whole (not simply NERL or Heathrow) have a zero or negative debt beta. We submit that this should be seen less as a radical comprehensive finding and more as a *reductio* test of the methodology (which it fails).

Our analysis of NERL's response to the consultation has also identified a number of further issues. The most relevant ones relate to the low goodness-of-fit of the presented models (which, together with the visual representation of the series, seem to indicate a problem of spurious regression), the high volatility in the beta estimates obtained (with some of the estimates changing in magnitude and sign in a matter of days), and the fact that some of the results seem to be based on periods of analysis chosen subjectively (which would seem

to hide the low positive values of betas observed for the whole period and the negative betas found for the 2010-2013 period).

5 Updated view of NERL's debt beta

5.1 Calculating debt beta

For most utilities, the cost of new debt is higher than the risk-free rate — there is a "debt premium" that means, by definition, that market participants (rightly or wrongly) believe there is some probability of utility companies defaulting on their debts.[15] Such defaults create a wedge between the risk-free rate and the cost of new debt in two ways. First, a default probability creates a wedge between the promised return on debt and the expected return on debt: because the amount promised might sometimes not be paid, the expected return of debt[16] must (by definition) be lower than the promised return of debt.

$$Expected\ return\ on\ debt$$
$$= prob(default) \cdot \%\ loss\ given\ default + \big(1 - prob(default)\big)$$
$$\cdot\ promised\ return\ on\ debt.$$

Secondly, if there is a correlation between when defaults are most likely to occur, or the losses on default when defaults occur, and the broader returns cycle, there will be a yield cost reflecting the systematic risk borne — i.e. a debt beta.

The CAPM applies to any asset — an electricity grid, a plastics bottle-making machine, an equity claim on a telecoms firm or a debt claim on a water network. So the expected cost of debt can be expressed, in the CAPM, as[17]

$$Expected\ return\ on\ debt\ =\ RFR + \beta_D \cdot ERP,$$

It is worth observing the relationship between the probability of default, the loss given default and the debt beta. In an accounting sense, the debt beta arises from the residual debt premium that is not explained by the probability of default and loss given default, so for any given debt premium, the lower the probability of default and loss given default, the higher the debt beta must be. Conversely, the lower the debt beta, the higher the probability of default and loss given default must be. The assumption of a zero debt beta is equivalent to the assumption that all of the debt premium is to be accounted for by the probability of default and loss given default and that no default risk has a systematic component. That will not typically be correct.

When adjusting for small differences in gearing, it is often mathematically convenient to assume a debt beta of zero because even with a debt beta of 0.1 or 0.2, the mathematical impact would only arise at the second or third significant figure. However, if the enterprise value gearing of listed comparator company differs materially from the notional gearing, then unlevered betas must be re-levered at a materially different gearing. In such a situation it is inappropriate to assume a zero debt beta in order to determine the asset beta unless one really believes the debt beta is zero.

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[15] We note that defaults have been very rare in developed economy utilities sectors. Nonetheless, the market data indicates that market participants do perceive some risk of default. As we shall explain later, we calibrate from market data what the market-implied rate of default is.

[16] The "expected return on debt" here is not the same as the cost of debt. The expected return on debt is the (promised) cost of debt adjusted for the probability of default and loss given default.

[17] Note that this means the debt beta is equal to the ratio of the difference between the expected return on debt and the risk-free rate. Insofar as we can ignore the risk of default, that means the debt beta is roughly equal to the ratio of the spread to the ERP. In what follows we shall derive a formula that is simply a more precise variant of this basic insight, with a small adjustment for the risk of default.

In practical terms, it can be shown that the debt beta can be calculated according to the following mathematical formula (we refer to the Appendix for the technical details of how the formula is derived).[18]

$$\beta_D = \frac{(1 - prob(default)) \cdot debt\ premium - prob(default) \cdot (RFR + \%\ loss\ given\ default)}{ERP}$$

A debt beta estimation approach based on the formula above is known as a decomposition approach. An alternative method to estimate debt beta is a regression approach where the returns on a company bonds, (or an appropriate bond index) are regressed against the returns of a broad market index.

5.2   Calculation results

In this section we report our updated estimates, based on our preferred methodology, for NERL's debt beta. These reflect the latest cost of debt figures and the CAA's RP3 draft proposal values for the risk-free rate and the ERP.[19]

Table 5.1: Debt beta under preferred methodology

	Low	High	Mid-point
Cost of debt	2.97%	3.39%	3.18%
Probability of default	0.20%	0.20%	0.20%
Debt premium	1.41%	1.83%	1.62%
Liquidity premium	0	0	0
Nominal risk-free rate	1.56%	1.56%	1.56%
Percentage loss given default	20%	20%	20%
Nominal ERP*	7.0%	7.0%	7.0%
Debt beta	0.19	0.25	0.22

Notes: * The nominal ERP = the real ERP x (1 + the inflation rate). Here the RPI-deflated ERP is 6.8% and RPI inflation is 3%.

5.2.1   Liquidity premium

Some regulators (and in particular the Competition Commission in its key 2007 debt beta analysis[20]) propose that, in addition to the adjustment for the difference between expected and promised returns, and the effect of debt beta, a third component of the debt premium is a (non-CAPM) "liquidity premium". NERA argues[21] that such a liquidity premium adjustment should be used for NERL.

As a sensitivity check, we also report what the debt premium would be if we had used a liquidity premium adjustment, as per the methodology preferred by the Competition Commission in 2007. Estimates of the

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[18]
   https://www.caa.co.uk/uploadedFiles/CAA/Content/Standard_Content/Commercial_industry/Airports/Economic_regulation/Files/Europe%20Economics%20beta%20and%20cost%20of%20new%20debt%20report.pdf

[19]   Risk-free rate of -1.4% in RPI-deflated terms. ERP of 6.8% in RPI-deflated terms (based on 5.4 per cent Total Market Return less -1.4% Risk-free rate).

[20]   See   https://webarchive.nationalarchives.gov.uk/20140402235745/http:/www.competition-commission.org.uk/assets/competitioncommission/docs/pdf/non-inquiry/rep_pub/reports/2007/fulltext/532af.pdf
   This judgement was particularly influential since it was the first time the CC had considered the question of whether it was appropriate to use a non-zero debt beta and the first full debate about whether the debt beta should be non-zero in UK regulation. It is also key in that all subsequent UK regulatory analyses of debt beta have appealed to it as an authority.

[21]   NERA report, section 3.3.2.

liquidity premium vary.[22] We adopt the Bank of England's 2014 estimate of 30 bps for illustrative purposes. That would have the following implications for the debt beta.

Table 5.2: Debt beta under Competition Commission (2007) methodology with 30bps liquidity premium

	Low	High	Mid-point
Cost of debt	2.97%	3.39%	3.18%
Probability of default	0.20%	0.20%	0.20%
Debt premium	1.41%	1.83%	1.62%
Liquidity premium	0.30%	0.30%	0.30%
Nominal risk-free rate	1.56%	1.56%	1.56%
Percentage loss given default	20%	20%	20%
Nominal ERP	7.0%	7.0%	7.0%
Debt beta	0.15	0.21	0.18

The natural interpretation here is that the CAA's preferred value of 0.13 is more consistent with a decomposition approach that includes a liquidity premium adjustment than Europe Economics' preferred decomposition approach is.

5.2.2 Alternative probability of default and loss given default estimates

We note that NERA had certain detailed criticisms of the decomposition approach.[23] The most important of these is that NERA proposes alternative assumptions about the probability of default and loss given default. Whereas we assume a probability of default of around 0.2 per cent and a loss given default of around 20 per cent, NERA assumes much higher values. It claims that the probability of default should be considered over the whole lifetime of the bond, not on an annual basis, and that the loss given default should be 55 per cent not 20 per cent.

We believe it should be clear from the mathematics of the formula that the relevant probability of default is the default in any one year, since the calculation is to capture the expected return in any one year, and accordingly that NERA's proposal of using a cumulative probability over the lifetime of a bond (and hence a probability of default perhaps times as high) is flawed. For completeness, we note that with a loss given default of 20 per cent, if the probability of default were 2 per cent (per year) the debt beta range from Table 5.1 would become 0.14 to 0.19.

NERA's proposal of a loss given default of 55 per cent (as opposed to the 20 per cent we assume) is possibly more arguable. Default on utilities is so rare that it is highly unclear what the correct assumption is. The 20 per cent figure we used was simply a costs-in-bankruptcy "rule of thumb" often used in scenarios analysis.

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[22] See, for example:
https://www.bankofengland.co.uk/-/media/boe/files/quarterly-bulletin/2007/decomposing-corporate-bond-spreads
https://www.bankofengland.co.uk/-/media/boe/files/financial-stability-report/2014/june-2014.pdf?la=en&hash=D3691C1DC4980B3F5E530E24F97C787CA3C3AB7B (Chart A in Box 1)
https://www.bankofengland.co.uk/-/media/boe/files/financial-stability-report/2016/november-2016
https://www.bankofengland.co.uk/-/media/boe/files/financial-stability-report/2018/june-2018.pdf?la=en&hash=9D057C7302B80EF57D634020F50C6F46D782904C
https://www.pwc.se/sv/pdf-reports/global-financial-markets-liquidity-study.pdf

[23] Certain of these flow from disputes about pwc's risk-free rate and TMR estimates, and as such fall beyond our scope here. Others include new analysis of the debt premium — we have set out our view of the cost of debt in Section 2 and the debt premium simply flows mathematically from our cost of debt estimate and the risk-free rate assumption. NERA also notes that we erroneously used a TMR instead of an ERP estimate in one calculation.

There have certainly been defaults at much higher rates. For example, in 2012 some Eircom bondholders received a payout of 100 per cent on their CDS insurance — i.e. default was deemed to have been total. In our view it is very unlikely that NATS assets would not be re-used in some way after bankruptcy and a 20 per cent loss was a reasonable working assumption, but we do not dispute it is reasonable to consider other scenarios, also. So, for example, if we assume a 55 per cent loss given default, but all other parameters were unchanged (including the probability of default at 0.2 per cent), the range for the debt beta from Table 5.1 would become 0.18 to 0.24 — a drop of 1 bps.

For completeness, we note that if we combined the two alternative assumptions, and so had a 2 per cent annual probability of default and 55 per cent loss given default, the debt beta would become 0.04 to 0.09, as NERA indicates. Thus the material point of dispute here is the (annual) probability of default. At a 2 per cent annual probability of default, over a ten year period NERL would be expected to default nearly 20 per cent of the time. We consider this highly implausible.
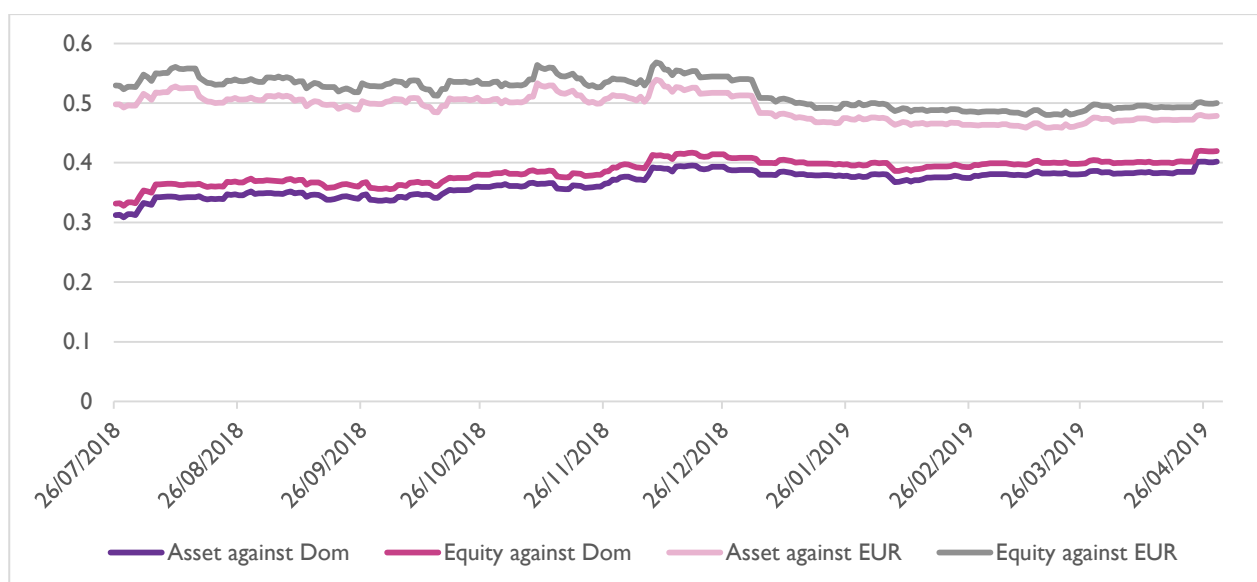
6 Updated view of ENAV's Asset and Equity Betas

In this section we report the updated data on ENAV.

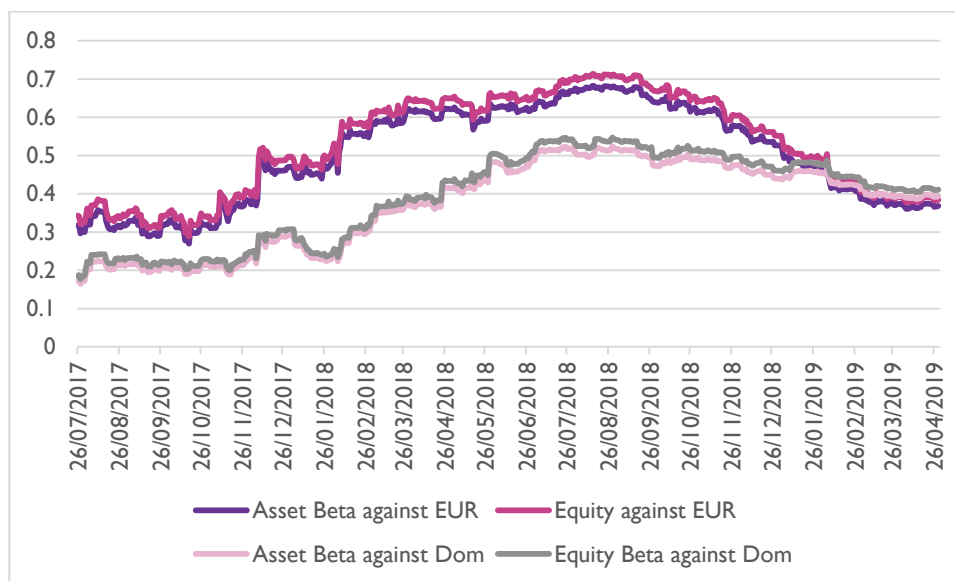## 6.1 New unlevered beta data for comparator range

At the time of the previous report the available dataset was very short. That has now been much extended, as we see in the figure below.

Table 6.1: ENAV 2 year asset and equity betas

Table 6.2: ENAV 1 year asset and equity betas

The key observation from these graphs is that since July 2018 (the previous data window), domestic asset betas have risen and European asset betas have fallen. (This illustrates one of the merits of the previous decision to place weight upon both.) At 0.40 the 2 year asset beta for the domestic index still lies slightly below the previous lower bound estimate (from utilities), before applying any adjustment for en route versus domestic services. (That could be seen as vindicating the previous use of the utilities index as a lower bound.)[24]

The table below summarises the beta estimates for ENAV. To construct our ENAV range, we use the 2-year domestic unlevered beta of 0.40 as our floor and the 2-year European unlevered beta of 0.48 as our ceiling. Assigning ENAV a debt beta of 0 (reflecting its extremely low levels of debt, with ENAV's enterprise value gearing being 7 per cent our asset beta range corresponds to our unlevered beta range of 0.40-0.48).

Table 6.3 Summary table of beta estimates for ENAV

Index	2-years unlevered beta (29/04/2019)	1-year unlevered beta (29/04/2019)
Domestic	0.40	0.39
European	0.48	0.37

6.2 New utilities lower bound data

Using the same dataset as in our 2018 report, below we report how the data has evolved since the data period used in that report. We see that there has been a modest drop in unlevered betas, from 0.38 last year to 0.36 more recently.

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[24] We note that there was an error in the previous version of the table that most affected the European 1 year unlevered beta, which we reported as 0.71 but should actually have been 0.65, but also would have made the European 2 year figure 0.50 not 0.54 (though as it happened that would not have affected our overall number because of the interplay between the constrained and comparator ranges).

Table 4: Updated UK utilities lower bound data

Comparators	2-years unlevered beta (17/08/2018)	2-year unlevered beta (30/04/2019)
Centrica	0.48	0.50
National Grid	0.43	0.36
Pennon	0.36	0.32
SSE	0.42	0.42
Severn Trent	0.32	0.29
United Utilities	0.30	0.27
Average	**0.38**	**0.36**

Source: Europe Economics calculations based on Thomson Reuters data

If we continue to use 0.125 for the utilities debt beta, as per our 2018 report, we obtain a value for the asset beta of 0.44.

6.3 New range

The new range (continuing to use 0.55 for the UK airports), equivalent to the previous 0.29-0.54, would be 0.36-0.46. The mid-point is 0.41. Raising that by 9 per cent (applying the same operational gearing adjustment as was set out in Section 8.1 of our 2018 report) would take that to an implied point estimate of 0.45 marginally above the new lower end of our constraint range value of 0.44 (thus still consistent with it).

On a "no adjustment basis" (in which we drop the adjustment for terminal services having a higher beta), the range would be 0.4-0.48 with a point estimate of 0.44. That is right at the 0.44 lower bound of our constraint range.

Overall, we continue to believe that a value towards the bottom end of the constraint range is the consistent message of the analysis.

7 Appendix A: Summary of NERA Comments on Beta

Criticism: *Asset betas are based on a Local Italian market index (FTSE MIB) with only 40 companies.*

This criticism is supported by the following considerations.

- *Local indices do not reflect the investment universe of the marginal investor:*

  - investor base is highly international with a number of large international investment funds holding stakes.
  - Italian or other local indices are not a representative benchmark for these investors when calculating beta.
  - local indices used by EE contain only very large cap stocks and do not include ENAV, AdP or Fraport themselves and hence cannot represent the investment universe for investors in these stocks.

- *Wider European benchmark is more similar to UK FTSE than local indices:*

  - Given that the overall purpose is to estimate a beta for NERL, the reference market for comparator companies should be similar to the UK stock market.
  - Europe Stoxx 600 index is similar to the FTSE All Share index in terms of size and sector composition, further supporting the use of a Europe wide index as the market benchmark.

Criticism: *The Europe Economics approach assumes that ENAV's terminal services are higher risk compared to ENAV's en-route*

Applying a downward adjustment to ENAV overall beta to derive an en-route beta.

- NERA says that its review of risk for ENAV's different services suggests ENAV's terminal services are actually *lower risk* compared to ENAV's en-route services, given the regulatory regime shields terminal services from volume (and in some cases cost) risks.
- NERA claims its findings are consistent with the allowed asset betas for ENAV en-route vs. terminal services in RP2, as reported in the ENAV IPO prospectus.
- NERA claims that correcting for this "error" supports an 8 per cent uplift to ENAV's total beta to derive a beta for ENAV's en-route services only.

NERA seeks to demonstrate that terminal services (at least for ENAV) are subject to less demand risk than en route services because of the regulatory regimes. It is silent on operational leverage during this discussion (although it supports the principle and argues elsewhere that the original report applied too modest an adjustment to the NERL beta).

Criticism: *Europe Economics' operational leverage assumptions lie at the bottom end of the plausible range*

NERA concedes that Europe Economics correctly identifies that NERL is exposed to greater operational leverage risks compared to ENAV and correctly concludes that NERL's en-route beta should lie above ENAV's en-route beta.

However, NERA contends that Europe Economics' proposed 9 per cent uplift to the ENAV asset beta for NERL's greater operational leverage lies at the bottom end of plausible adjustments applied by the CMA and should therefore be considered as a lower bound on the necessary adjustment.

Criticism: *Utilities are not plausible comparators for air traffic services*

NERA disagrees with Europe Economics that UK utility betas are relevant comparators for NERL, even as a lower bound, given UK utilities are regulated under a revenue cap framework which protects them from volume risk and also have lower operating leverage compared to NERL, which (NERA claims) implies NERL asset beta should be well above utilities, consistent with established UK regulatory precedent.

Criticism: *Airport betas should not be regarded as providing an "upper bound"*

NERA similarly disagrees with Europe Economics' position that UK airport betas represent an upper bound on NERL risk, given NERL is exposed to more internationally diversified traffic from overflights and is also subject to risk sharing.

- NERA's review of peak-to-trough traffic volatility concludes that NERL has experienced greater not lower underlying traffic volatility compared to UK airports.
- Moreover, NERA argues that despite traffic risk sharing, NERL is exposed to greater *cash-flow* volatility for a given demand shock compared to Heathrow and Gatwick, due to NERL's greater operating leverage.

Criticism: *Europe Economics gives insufficient weight to other Airport comparators*

NERA repeats its previous position that NERL's beta should be estimated directly using available listed airport comparators.

- As per its March 2018 report, NERA concludes that the closest comparator for NERL is AdP, given similar traffic composition and noting that AdP is also subject to a volume risk sharing mechanism.
- NERA also repeats its position that it would expect NERL to face greater systematic risk than AdP because of NERL's higher operating leverage. Updated evidence supports an asset beta for AdP of 0.58 (at 0.05 debt beta), which is also consistent with the average beta for the wider airport comparator set.

Criticism: *The "indirect" method proposed by EE for the estimation of debt betas omits a key component and is not calculated with the correct parameters*

NERA argues against a debt beta of 0.19 as estimated by EE.

- EE's formula omits a key component of the debt premium – liquidity premium – as considered by the CMA in its calculation of debt betas in 2007.
- NERA disputes several of the key parameters used in the decomposition, including: i) the default premium (understated); ii) the debt spread (overstated) and iii) the ERP (understated).
- Applying its own parameter estimates and using the CMA's liquidity adjustment, NERA calculates lower debt betas of 0.05 to 0.1, which it claims are closer to the empirical beta estimates.