NZCC comments on asset beta estimates for airports

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COMPETITION ECONOMISTS GROUP

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1 Introduction

1. I, Tom Hird of 14 Glen Eira Rd, Ripponlea, Victoria, have been engaged by NZ Airports Association ("NZ Airports") to provide advice on asset beta estimation for airports in the context of the 2023 IM update by the New Zealand Commerce Commission ("NZCC").

2. I hold the following qualifications:

   - Bachelor of Economics (Honours First Class), Monash University (1989); and
   - PhD in Economics, Monash University.

3. From 1990 to 2000 (both prior to, during and after the completion of my PhD in economics) I was employed by the Commonwealth Treasury. Since 2001 I have worked as a consulting adviser specialising in economics: first with Arthur Andersen, then NERA Australia and, since 2007, for my own firm, Competition Economists Group ("CEG"). I have advised private clients, regulators, and other Government agencies on a large number of cases specialising in finance theory.

4. I have more than 30 years of experience in the economic analysis of markets and in the provision of expert advice in regulatory, litigation and policy contexts. I have provided expert testimony before courts and tribunals and in numerous regulatory forums in Australia but also in the United Kingdom and New Zealand.

5. In completing this report, I have received assistance from my colleagues at CEG, Ker Zhang and Samuel Lam. Notwithstanding this assistance, all of the opinions expressed in this report are my own.

6. In preparing this report I have had regard to the materials specifically identified throughout the report, in the form of footnotes or in the text.

1.1 Report scope

7. This report covers the following issues:

   a. An empirical assessment of the reasonableness of the NZCC's 5 BP downwards asset beta adjustment to the sample average asset beta on the basis that aeronautical operations are lower risk than non-aeronautical operations;

   b. Provides a critique of the NZCC's recent comments[1] as they relate to:

[1] In its recent covering letter to a CEPA report dated 8 December 2022 and entitled "CEPA report on aspects of the cost of capital Input Methodologies for the 2023 review".

i. extending the estimation period from 10 to 15-years in response to the impact of COVID-19 on estimated asset betas;

ii. excluding airports based on:

- being located in countries with different MRPs; and
- having large variance in estimates based on daily, weekly, and four-weekly data.

c. Whether airport specific changes in asset beta measurement are appropriate.

1.2 Key conclusions

8. My key conclusions are:

a. There is no conceptual basis for presuming aeronautical operations are lower risk than non-aeronautical operations and the available empirical evidence strongly supports the opposite conclusion.

b. The key criterion for setting the estimation window is that the average asset beta applied across all past and future price setting events ("PSEs") reflect the average realised asset beta risks in equity markets for airports across time.

c. With this key criterion, the NZCC should not alter the estimation window for asset beta from 10-years in response to the COVID-19 shock. Airports have applied this methodology since outset of the IMs and any change implemented with the express purpose of lowering the estimated asset beta would create bias and present value under-recovery of risks/costs actually borne by airports.

d. Should the NZCC look to change its estimation window the only possibly reasonable approach would be to:

i. extend the estimation window to 14/15-years for the purpose of estimating IM/PSE asset betas (with IM changes applied across sectors); and

ii. retain that extended estimation window for all future IMs/PSEs.

e. The key criterion for deriving a sample of asset beta comparators is to have as large and diversified a sample as possible.

i. Consistent with this, the NZCC should not seek to arbitrarily shrink the size of the sample established using the 2016 IM methodology.

ii. However, if the NZCC ignored this advice, and sought to define a sample that is “most similar” to NZ Airports', then it is difficult to understand why such a change in methodology would not result in primary weight being given to AIAL’s estimated asset beta.

f. The statements by the NZCC addressed in this report have the potential to create a perception of selective change in methodology driven by an increase in the

measured asset beta of the airport sector. If so, this could be expected to have adverse outcomes associated with an unpredictable regulatory environment and may impact investor confidence and the regulated entities' confidence to make critical infrastructure investments.

1.3 Report structure

9. The remainder of this report is structured as follows:

- **Section 2** provides a conceptual and empirical examination of the relative risk of aeronautical and non-aeronautical revenues.
- **Section 3** responds to the NZCC's statements regarding the estimation period used to estimate asset beta.
- **Section 4** responds to the NZCC's statements regarding the exclusion of airports based on country risk and/or variance of asset beta estimates.
- **Section 5** addresses concerns about the possible perception of selective changes in methodology driven by an increase in the measured asset beta of the airport sector.
- **Appendix A** provides detailed description of our sourcing of aeronautical and non-aeronautical revenue and profits.
- **Appendix B** provides detailed analysis in support of the conclusions reached in section 3.
- **Appendix C** provides charts indexed to 2019 vs 2018.
- **Appendix D** is my curriculum vitae.

2 Empirical analysis of aeronautical versus non-aeronautical risk

2.1 Conceptual framework

10. In section 4 of my previous report for NZ Airports[2], I set out a conceptual framework for assessing whether regulated aeronautical operations could be expected to have a higher or lower asset beta than unregulated non-aeronautical operations.

11. I do not repeat the entirety of that analysis here. In summary, I concluded that:

- In relation to exposure to **temporary shocks** to the economy and passenger numbers, aeronautical cash-flows are **riskier** than non-aeronautical (and, therefore, the average of airport wide) cash-flows. This is because airport-wide cash-flows are more stable due to the stability of cash-flow from services that have contractually fixed payments and/or are not sensitive to passenger volumes.
- In relation to exposure to **permanent shocks** to the economy and passenger numbers, aeronautical cash-flows can be expected to be:
  - **lower risk than some non-aeronautical services** (e.g., car parking) where a shock to passenger numbers gives rise to the same or similar immediate impacts on cash-flows but where the shock might have higher impact on long run non-aeronautical cash-flows;[3] but
  - **higher risk than some services** where revenues are unrelated or less sensitive to passenger numbers in both the short and long term (e.g., some land/building leases);[4] and

2 Tom Hird, Asset beta update for the 2023 IMs, August 2022

3 However, it is worthwhile noting that this assumes that the service (e.g., car parking) has unlimited spare capacity that can accommodate sales at low marginal cost. In reality, permanently higher demand is likely to bring-forward the time at which costly capacity expansions (e.g., a new car park) are required (such that the net impact on profits is lower than if capacity was unlimited). Thus, a realistic analysis is likely to be more complicated than the stylised analysis I perform here.

4 For example, tenants whose next best alternative is leasing land/buildings at another location (which may or may not be near the airport) will be unlikely to be willing to pay more at renewal just because passenger numbers at the airport are higher. For example, tenants in a business park are unlikely to be willing to pay more because passenger numbers at the airport are higher.

- **uncertain relative risk for other services** where contractual cash-flows mean there is no short term impact but where there may be a long term impact when contracts are renegotiated.[5] [6]

12. My conclusions were summarised in Table 4-1 of my earlier report which I reproduce below.

Table 2-1: Relative risk of aeronautical vs airport wide cash-flows

Service	Transient shock to GDP and passengers	Permanent shock to GDP and passengers
Aeronautical (cash-flows are immediately impacted by changes in the number of passengers but may be less so in the long term)	Highest risk	Middle risk
Services where cash-flows are impacted immediately and in the long term by the level of passengers	Highest risk	Highest risk
Services where cash-flows are not impacted immediately but are impacted in the long term by the level of passengers	Lowest risk	Middle risk
Services where cash-flows are not impacted (either immediately or in the long term) by the level of passengers	Lowest risk	Lowest risk
Is aeronautical cash flow higher or lower risk than airport average?	**Aero is highest risk**	**Aero is middle risk**

13. I concluded that

> *it is not possible to know a priori whether aeronautical cash-flows are higher or lower risk than airport wide cash-flows. It is possible that aeronautical risk is lower but it is also possible that it is higher (or the same). A more accurate answer depends on an empirical analysis of both the relative importance of transient (booms and bust) versus permanent*

5 For example, permanently higher passenger throughout may lead to a higher rental on a fixed price lease (e.g., for retail space) at some future date when it is renegotiated. Thus, the shock has zero impact on cash-flows for a period and a positive impact from some future date (the opposite of the profile of impact on aeronautical services cash flow). Here, an important issue will be the discount rate used to value future cash-flow improvements. The higher this discount rate is, the smaller will be the impact on the present value of cash flows of a permanent shocks that has a delayed impact. In addition, permanently higher passenger numbers will bring forward the need for costly expansions to terminal infrastructure.

6 The longer the period over which a set of payments is fixed the smaller will be the discounted value of any change to the cash-flows beyond that period. For example, imagine a contract has 10 years of contractual payment after which it can be renegotiated. Now, let a shock occur today that raises the expected cash-flows from year 11 on by 5%. At a 10% discount rate this 5% increase in future revenues only raises the present value of revenues by less than 2%. This is a smaller impact on present value than if revenues were temporarily raised by 5% for 10 years and then returned to their previously expected levels.

(e.g., due to unexpected technological developments good and bad) shocks to economic activity and also on the nature of the contracts at the airport in question.

2.2 NZCC past analysis

14. The NZCC made a downward 0.05 adjustment to asset beta based on a presumption that aeronautical cash-flows are slightly lower risk than airport wide cash flows. In its draft decision, the NZCC originally justified this 0.05 decrement by relying on statistical analysis of the relationship between aeronautical revenues and asset beta. However, in its final decision, the NZCC accepted that there was an error in that analysis:[7]

> *We agree with NZ Airports and UniServices that there was an error in Figure 8 of the draft decision, and that when corrected, the revised graph does not support making a downwards adjustment to the sample average.*

15. However, the NZCC went on to apply the same adjustment in its final decision. The NZCC's subsequent basis for this adjustment was a presumption that:[8]

> *Unregulated services (such as retail shopping) are generally considered more risky than regulated services (such as provision of airfields), for example there is greater demand uncertainty.*

16. The NZCC provided no empirical analysis to support this conclusion and did not grapple with the conceptual issues that I discuss in section 2.1 above.

2.3 Empirical analysis

2.3.1 CEG data collection

17. In order to perform my own empirical analysis, I have undertaken an exhaustive process of collection of aeronautical and non-aeronautical revenues from 2018 to 2021 and, where available, EBIT for aeronautical and non-aeronautical operations over the same time period. I have done this for every airport in the NZCC sample except AERO SG (Belgrade) which earns its revenues from a concession fee from the operator Vinci Airports, and it is unclear how that concession fee varies with underlying aeronautical and non-aeronautical revenues.

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7 NZCC, Input methodologies review decisions, Topic paper 4: Cost of capital issues, December 2016, p. 124 at paragraph [482].

8 NZCC, Input methodologies review decisions, Topic paper 4: Cost of capital issues, December 2016,p. 122, at paragraph [478].

18. The exact basis for each calculation is reported in Appendix A however, as a rule, airports' financial statements are generally fairly clear about distinguishing aeronautical versus non-aeronautical revenues in their segment analysis.

19. One exception to this rule is airport companies, such as AdP that report aeronautical and non-aeronautical revenues only for their domestic operations and then report "international revenues" as its own segment; where "international revenues" captures both aeronautical and non-aeronautical revenues derived from international operations. In this situation we have relied only on the domestic segment. For example, AdP's 2021 percentage of revenues that are aeronautical (50.1%) is calculated as revenues from the Aviation segment that relates only to Paris airports (€ 1.028bn) divided by total 2021 revenues (€ 2.777bn) less revenues from "international and airports developments" in 2021 (€ 0.726bn).

20. I note that airports are on different reporting schedules. This means that, for example, "2020" revenues might relate to the 12 months ending March, June, September, or December 2020. This should be kept in mind especially when attempting to interpret the impact of COVID-19 on any measures.

2.3.2 Regression analysis of asset beta against % non-aero revenues

21. In its 2016 draft decision, the NZCC relied on a positive estimated linear regression slope between the percentage of non-aeronautical revenues and the estimated asset beta for an airport. However, this analysis was subsequently found to have errors and was not relied on in the final decision.

22. We have repeated this analysis with the full set of airports in the airport sample identified in my previous report for NZ Airports. To do so we have used estimates of asset beta for the five years to 30 June 2022 and compared these to estimates of the percentage of non-aeronautical revenue. We have repeated this process four times using non-aeronautical revenues in 2018, 2019, 2020 and 2021.

23. We focus on the last 5-year asset beta because this is a period when all airports were affected by a large negative shock to passenger numbers which helps isolate the relative riskiness of aeronautical and non-aeronautical operations. Having a large shock to passenger numbers affecting all airports in the estimation windowreduces the impact of noise in asset beta estimates. In other periods, some airports (and their local economies) might or might not experience shocks that have a material impact on passenger numbers. In which case, the relative level of asset betas across airports will be more affected by "noise" (what shocks hit what countries/airports). This makes it (statistically) harder to accurately assess factors that might affect the risk of one airport relative to another. In this case, the share of non-aeronautical versus aeronautical operations.

24. In all cases the relationship between estimated asset beta and non-aeronautical revenues is negative. That is, the higher the percentage of non-aeronautical revenues

the lower the asset beta. The slope coefficient is statistically significant at the 10% level irrespective of the year in which the non-aeronautical revenue percentage is calculated and is significant at the 5% level if the percentage of aeronautical revenues in 2020 is used (and at the 5.3% level if using the percentage of aeronautical revenues in 2021).

Table 2-2: Asset beta vs % non-aero revenue

	Coeff	p value	R^2
Full sample			
2018 % non-aero	-0.51	0.09	0.112
2019 % non-aero	-0.50	0.09	0.113
2020 % non-aero	-0.66	0.04	0.169
2021 % non-aero	-0.58	0.05	0.148
Ex JAT			
2018 % non-aero	-0.66	0.04	0.165
2019 % non-aero	-0.62	0.05	0.157
2020	-0.71	0.03	0.19
2021	-0.62	0.04	0.17

Asset beta is measured for the 5-years to 30 June 2022 using the NZCC method (the average of: a) the average of 5 weekly estimates; and b) the average of 20 four weekly estimates).

25. Table 2-2 also includes the results if Japan Airport Terminals ("JAT") is excluded. CEPA has proposed the exclusion of JAT, but this is not why I have excluded JAT. The reason I have excluded JAT is that its non-aeronautical revenues are not comparable to those for other airports. This is because JAT owns its own retail outlets and, unlike other airports, this leads to its gross revenues including cost of goods sold. Cost of goods sold for JAT's Merchandise segment was around two thirds of revenue in 2018 and 2019.[9] Cost of goods sold for Food and Beverage was around 50% of revenue in the same period.[10] This means that non-aero revenue is inflated by a factor of at least 2 to three times[11] for JAT compared to other airline companies. This means that using revenue as a measure of the importance of non-aeronautical operations materially overstates the importance of JAT's non-aeronautical operations as a percentage of profits (relative to other airports).

26. Consistent with this, JAT segment profits (EBITDA and EBIT) can also be compared with the four other firms in the sample (Frankfurt, AENA, AIAL and AdP) that report EBITDA and/or EBIT on aeronautical vs non-aeronautical segment basis. In 2018,

9 2018 (2019) merchandise cost of sales was 121 (104) bn yen while revenue was 171 (148) bn yen.

10 2018 (2019) food and beverage cost of sales was 11 (10) bn yen while revenue was 20 (19) bn yen.

11 For the Merchandise (Food and Beverage) segment revenue net of cost of goods sold is one third (half) of gross revenue reported.

JAT had a materially higher non-aeronautical revenue share than Frankfurt, AENA, AIAL and AdP. However, on a profit basis, JAT had the smallest or second smallest share of non-aeronautical profits (depending on whether EBIT or EBITDA is used).

Table 2-3: Non-aero revenue share vs profit share where available

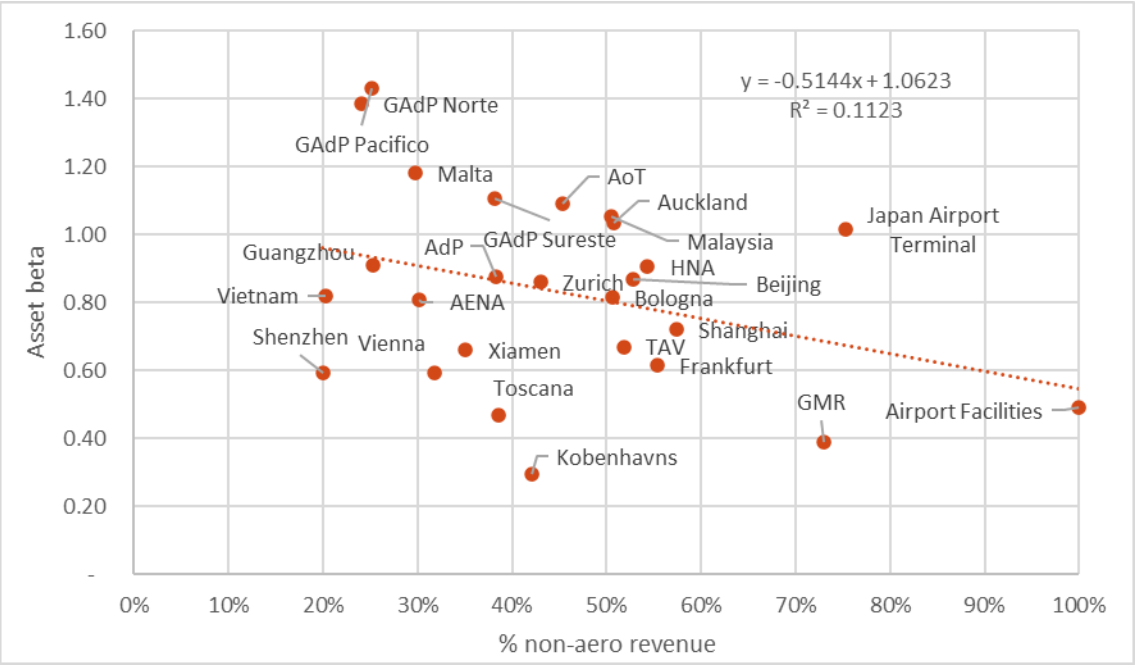
	JAT	Frankfurt	AENA	AIAL	AdP
Non-aero revenue	75%	55%	30%	51%	38%
Non- aero EBITDA	36%	33%	38%	55%	55%
Non-aero EBIT	55%	68%	NA	NA	65%

Source: Annual reports and CEG analysis. JAT reports for three segments. I estimate aeronautical revenues as Facilities Management segment revenue less Rental revenue. I estimate non-aeronautical revenues as the sum of Merchandise and Food and Beverage Segments plus Rental revenue. Similarly, I remove/add Rental revenue net of Rental expenses from/to aeronautical/non-aeronautical profits (EBIT and EBITDA).

27. Moreover, when moving from revenue share to profit share, the share of non-aeronautical operations tends to increase at all non JAT airports. But at JAT the share of non-aeronautical operations falls when profits are used as the relevant metric.

28. The importance of this for the regression analysis can be seen by examining the scatter plot that underpins the first row of Table 2-2 above.

Figure 2-1: Asset betas vs 2018 non-aeronautical revenue share

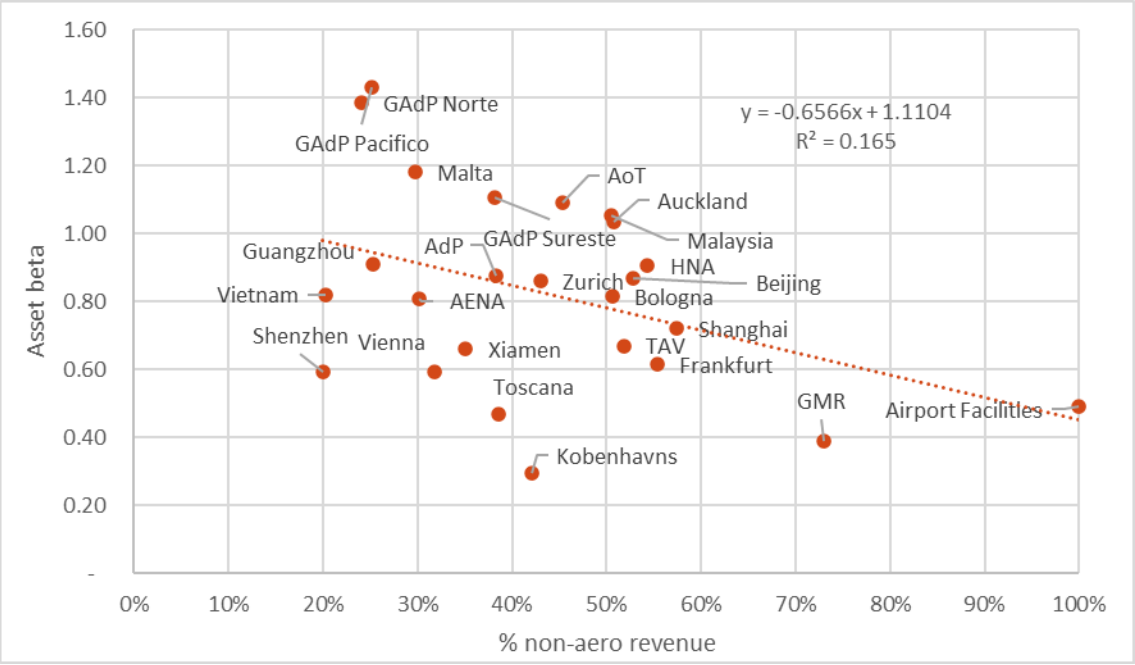


Source: annual reports, Bloomberg and CEG analysis. *5-year asset betas to 30 June 2022 estimated using NZCC methodology.

29. It can be seen that JAT is a high outlier in the sense that its asset beta is materially higher than predicted for an airport with such a high (the second highest) level of non-aeronautical revenues. However, for the reasons explained above, use of revenues to measure the importance of non-aeronautical operations materially overstates the importance to non-aeronautical operations at JAT relative to other airports in the sample.

30. If I remove JAT from the regression, the fit to the data improves and the coefficient on non-aeronautical revenues is statistically significant at the 5% level (where it was only statistically significant at the 10% level with JAT included in the sample).

Figure 2-2: Asset betas* ex JAT vs 2018 non-aeronautical revenue share



Source: annual reports, Bloomberg and CEG analysis. *5-year asset betas to 30 June 2022 estimated using NZCC methodology.

2.3.2.1 Conclusion

31. Based on a regression of measured asset betas against the share of non-aeronautical revenues, there is no evidence to support the NZCC's presumption that non-aeronautical operations tend to raise the measured asset betas for airports. In fact, the best evidence is that the opposite appears to be true.

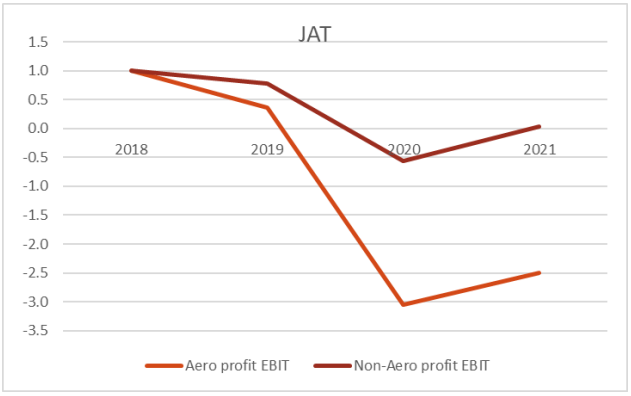
2.3.3 Event study: impact of COVID-19 on aero vs non-aero revenues and profits

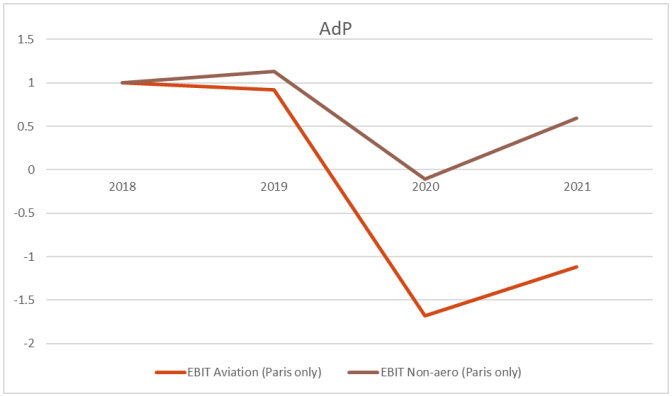
32. Another way of addressing whether aeronautical or non-aeronautical operations are higher risk is to examine the impact of COVID-19 on each. In order to do this, I have indexed profits and revenues for each segment to 1.0 in 2018. I have then plotted a time series to examine which is more affected by the dramatic reduction in passenger numbers due to COVID-19.

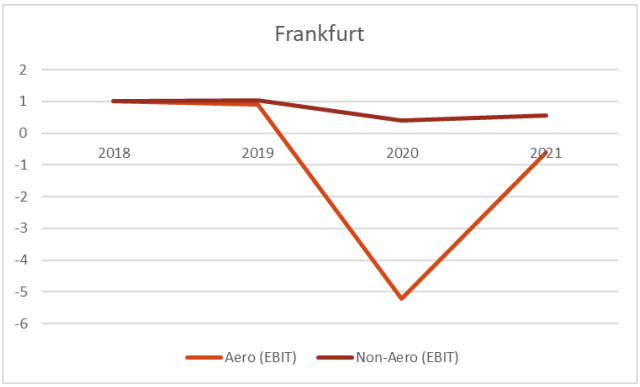
33. Five firms (AIAL, JAT, AENA, AdP and Frankfurt) provide EBITDA and/or EBIT on a segment basis. Figure 2-3 shows the time series for aeronautical and non-aeronautical profits at these airports.

Figure 2-3: EBIT and EBITDA time series for aero and non-aero (2018=1)

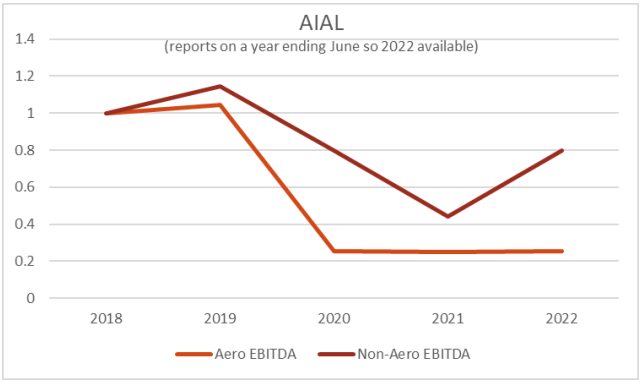
EBIT

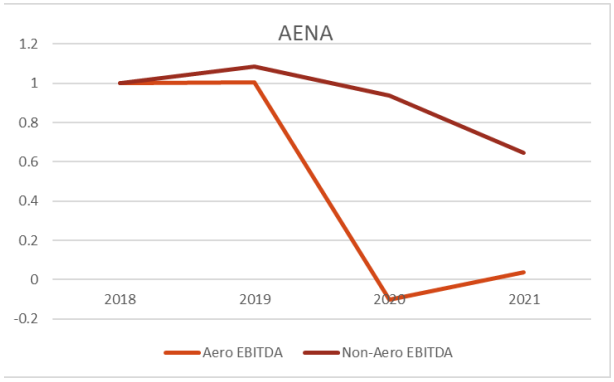


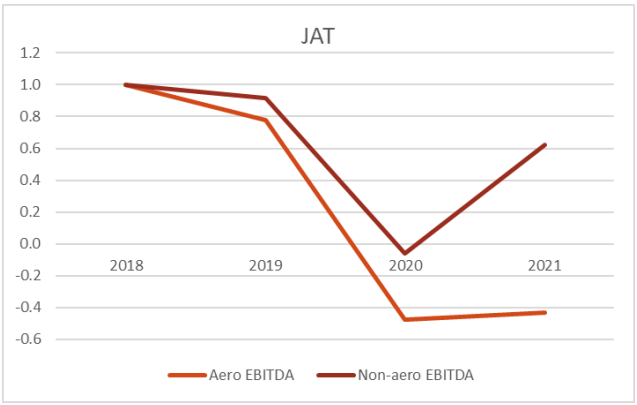


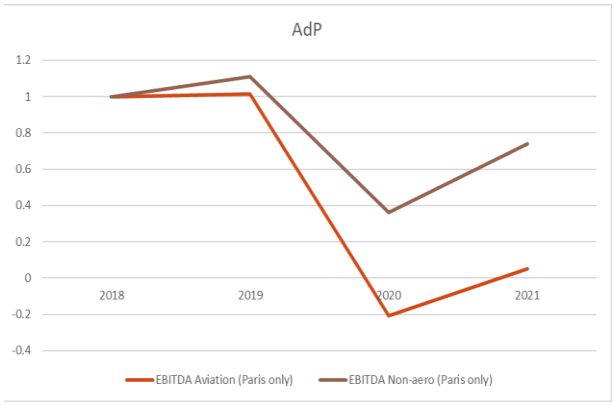


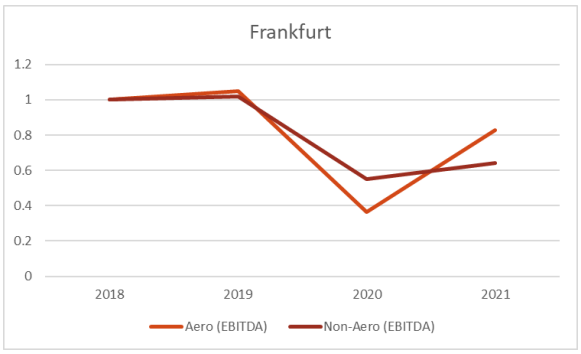
EBITDA







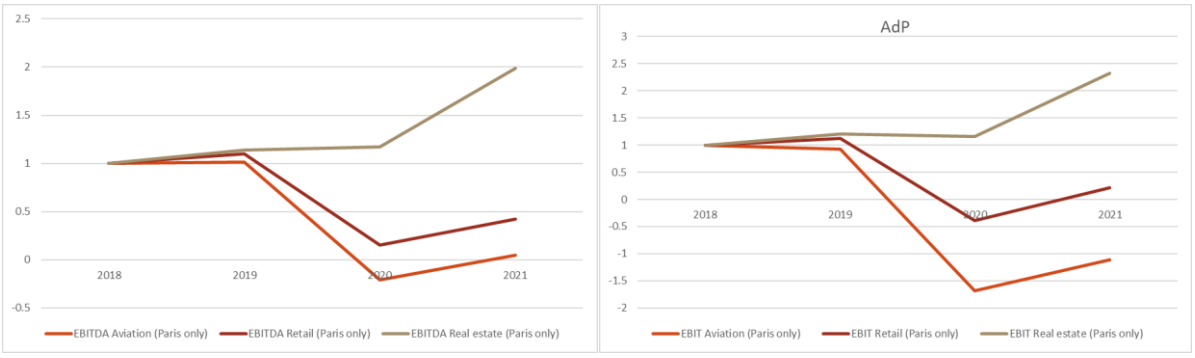




Source: annual reports and CEG analysis.

34. It can be seen that in all cases, aeronautical profits fell more than non-aeronautical profits following the unexpected passenger shock due to COVID-19. AdP reports three segments for its Paris airports: aviation (aeronautical) and retail and real estate (both non-aeronautical). In Figure 2-3, I have combined the retail and real estate segments. However, it is useful to show all three segments separately, which I do in Figure 2-4 below.

Figure 2-4: EBITDA time series for AdP's three segments (2018=1)



Source: annual reports and CEG analysis. .

35. As might be expected, the real estate segment was the least affected by the COVID19 passenger shock. The retail segment was heavily affected suffering an 85%/140% reduction in EBITDA/EBIT in 2020 versus 2018 but it recovered somewhat in 2021 (to 42%/21% of 2018 EBITDA/EBIT). However, aeronautical profits were even more heavily affected – with a 120%/270% reduction in EBIT/EBITDA relative to 2018 (i.e., a loss in 2020 that was 20%/170% of the profit in 2018).

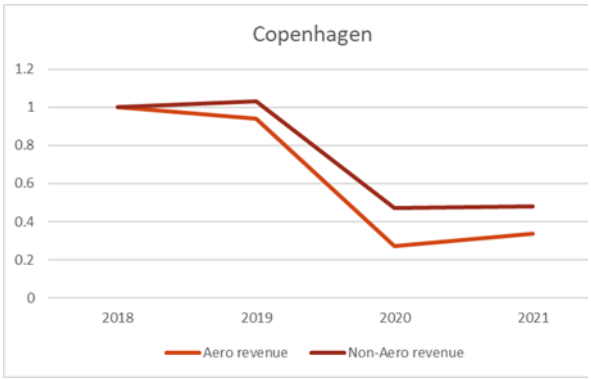
36. All of these profit time series suggest that aeronautical profits are most susceptible to negative passenger volume shocks of the kind experienced due to COVID-19. These results are consistent with the observed empirical relationship that the larger the share of non-aeronautical revenues the lower the asset beta for airports in the asset beta sample.

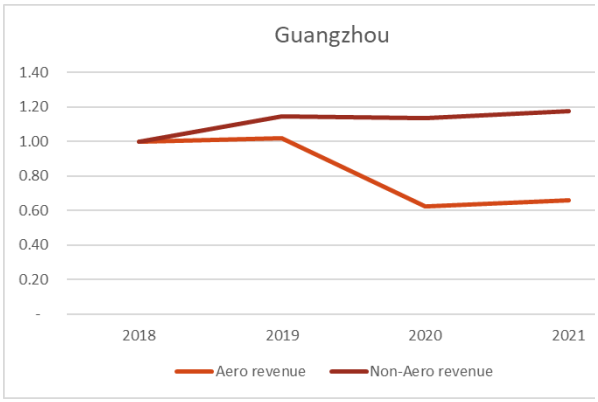
37. It can be seen that nothing turns on the choice of 2018 as the relevant index year. However, for completeness, I produce the same charts as above in Appendix C.

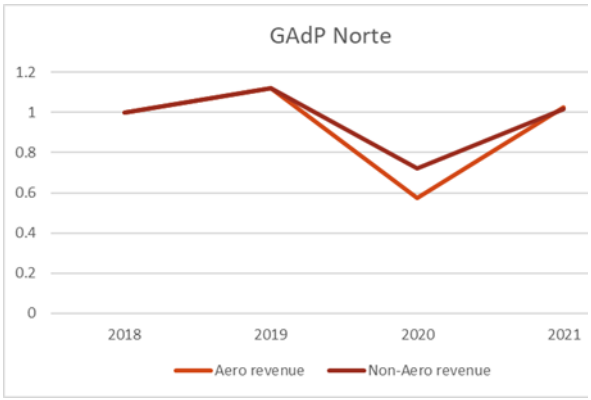
38. As noted, most airports only report revenue on a segment basis. I now report the results of the same analysis for all airports in the sample. It can be seen that out of 26 airports, aeronautical revenues fell by more than non-aeronautical revenues at 24 airports. The two airports where non-aeronautical revenues fell by more from 2018 to 2020 were HNA and JAT. However, I have already noted that JAT's revenues are a special case and that JAT's aeronautical profits fell by more than its non-aeronautical profits (as is the case for all airports that report profits on a segment basis). This leaves HNA as the only airport where the percentage fall in non-aeronautical revenues between 2018 and 2020 is larger than for aeronautical revenues.

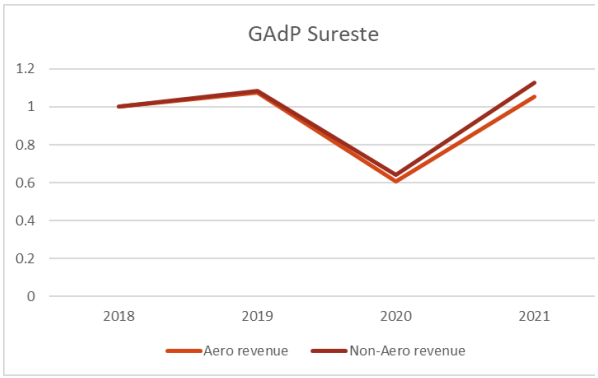
Figure 2-5: Revenue time series for aero and non-aero (2018=1)

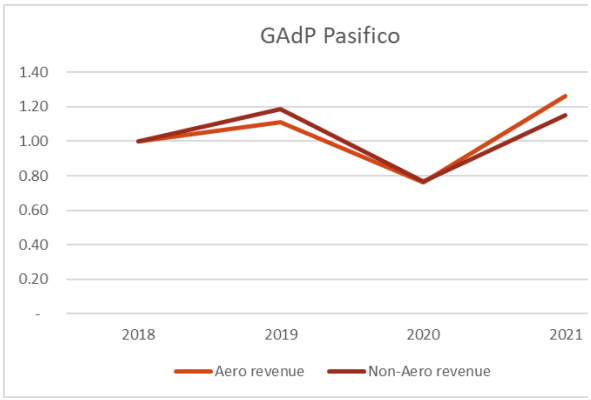
Figure 2-5 continued: revenue time series for aero and non-aero (2018=1)

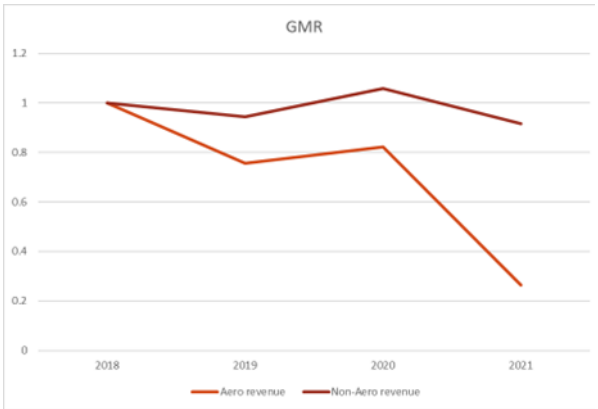


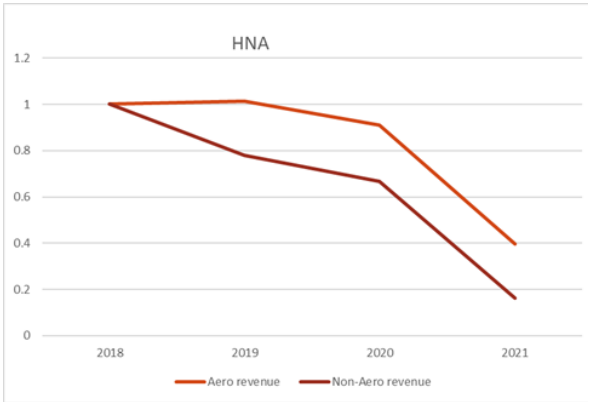












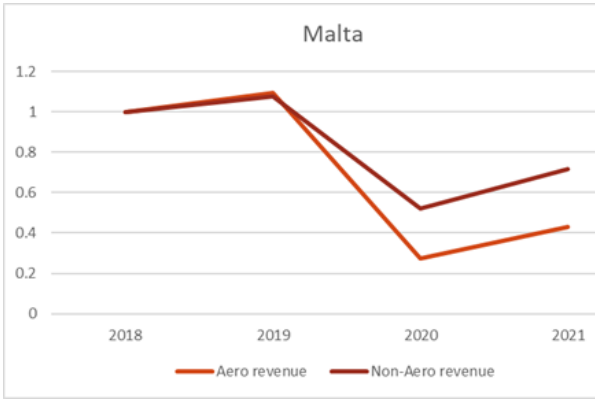
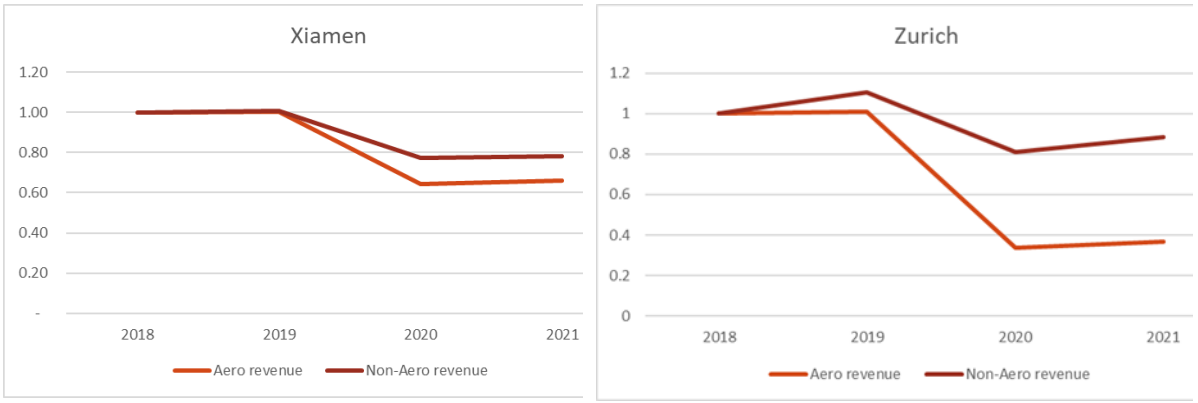


Figure 2-5 continued: revenue time series for aero and non-aero (2018=1)

Figure 2-5 continued: revenue time series for aero and non-aero (2018=1)



Source: annual reports and CEG analysis. .

2.4 Conclusion

39. It is not possible to determine the relative risk of aeronautical and non-aeronautical operations solely on the basis of conceptual analysis. There are reasons to believe that aeronautical operations are higher risk than all non-aeronautical operations in some circumstances (transient shocks) and some non-aeronautical operations in other circumstances (e.g., for non-transient shocks where non-aeronautical revenues are less sensitive to passenger numbers in both the short and long term (e.g., some land/building leases)).

40. On a purely conceptual basis, there is no justification for making a positive or negative adjustment to the sample average asset beta when attempting to estimate the asset beta for aeronautical operations from the asset beta of airport wide operations. This means that any adjustment would need to be based on empirical not conceptual analysis.

41. The empirical analysis undertaken in this report strongly suggests that, if anything, non-aeronautical operations are lower risk than aeronautical operations. This is based on evidence that:

- measured asset betas are lower the larger the share of non-aeronautical revenues;
- aeronautical profits were much more sensitive to COVID-19 than non-aeronautical profits; and
- aeronautical revenues were near universally also more sensitive to COVID-19 than non-aeronautical profits (across all but 2 out of 26 airports).

3 Expanding or shrinking the estimation window

42. This section provides my views on the following (very brief) statements by the NZCC to the effect that it is considering amending its method for estimating asset beta for airports by changing the estimation window.[12]

> *4. In relation to our calculation of asset beta, at the last review we focussed on asset betas from the two most recent five-year periods (2006-2011 and 2011-2016); however, we also had regard to earlier periods. The economic consequences of COVID have resulted in an increase in asset betas for airport services, as indicated in CEPA's calculation of the average asset beta for the 2020-22 period compared to the average asset beta for the periods 2012-2017 and 2017-2022. We are considering whether we should use a term for airports that is either longer or shorter than the last two five-year periods. For energy, CEPA's findings indicate there does not appear to be a need to vary the sampling timing we used last time; however, we welcome views on this.*

3.1 Estimated asset betas reflect the shocks that hit the economy in the specific estimation period

43. The estimated asset beta in any estimation period is determined by the types of economy wide shocks that occur in that estimation period. For example, asset betas estimated over the period 2007 to 2014 were strongly influenced by the global financial crisis – especially for European companies. Companies involved in financial markets (especially banks and the lenders to banks) had materially higher estimated asset betas in that period because their expected value was strongly affected by the economy wide shock to the financial system.

44. Similarly, companies that were less exposed to the financial system would have had lower asset betas in that same period. This is because the average equity beta (from which asset betas are derived) is, by definition, always 1.0, since equity beta is a measure of relative risk. Consequently, if financial companies' equity betas were raised, then other companies' equity betas must fall – so that the average equity beta remains at 1.0.

45. The same logic applies to the COVID-19 pandemic. This was an economy wide shock that strongly affected a range of companies including airports. My analysis suggests

[12] The NZCC's recent covering letter to a CEPA report dated 8 December 2022 and entitled "CEPA report on aspects of the cost of capital Input Methodologies for the 2023 review".

that the average estimated asset beta for airports is around 0.18 higher in the most recent 5-year period ending June 2022 that includes the effects of the COVID-19 pandemic, than in the earlier 5-year period ending June 2017 that does not.

Table 3-1: Sample average asset betas (CEG estimates and sample)

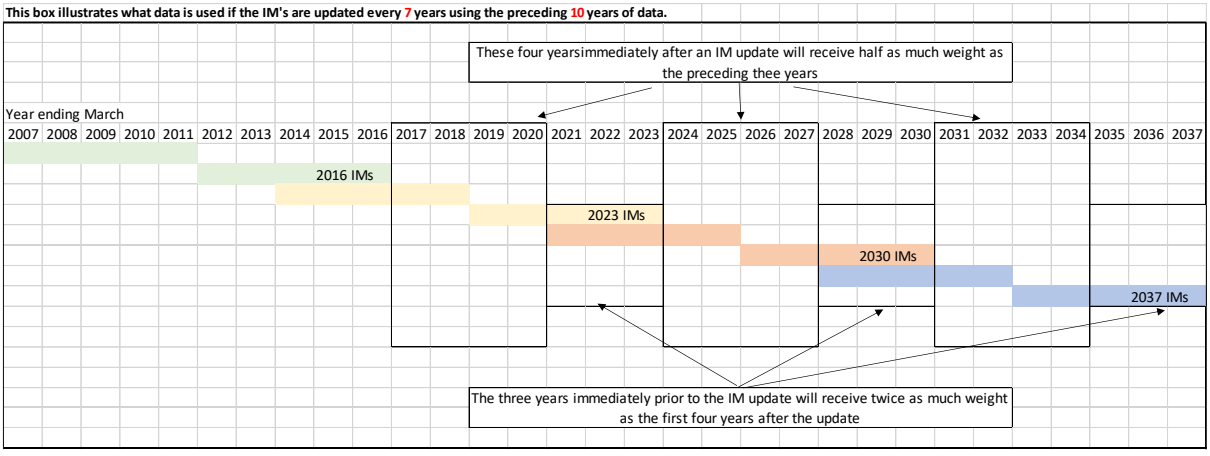
Weekly 2017	4 Weekly 2017	2017 average	Weekly 2022	4 weekly 2022	2022 average	Average of both periods
0.68	0.73	**0.71**	0.90	0.88	**0.89**	**0.80**

46. This is an unsurprising phenomenon. Airports, being reliant on air-travel, were materially affected by travel restrictions (both government and customer driven) due to the spread of the COVID-19 virus. Similarly, the COVID-19 pandemic had widespread negative effects on the economy (in large part driven by restrictions on travel and other forms of social mobility).

3.2 Use of IM asset beta estimate versus methodology in PSEs

47. The seven-yearly update of the IMs makes the estimated IM asset beta unsuitable as the asset beta to be repeatedly used in all PSEs. To see why, consider Figure 3-1 which graphically shows the result of 10-year estimation windows updated every seven years.

Figure 3-1: 10-year estimation window with seven-year IM update



48. It can be seen that with a seven-year update and 10-year estimation window, the IMs are not evenly sampling from all historical shocks hitting equity markets. Rather, six out of every 10-years are sampled twice, while four out of every 10-years are sampled only once.

49. This is not a problem if the main purpose of the IMs is to establish a methodology for estimating asset beta that is then applied every five years at the beginning of each PSE (as is my preferred approach discussed in section 3.3 below). However, it would be a serious problem if the NZCC were to take the view that the IM asset beta estimate (as opposed to methodology) must be applied in every PSE.

50. If the NZCC took this approach, it would be forcing the asset beta used in PSEs to be non-reflective of the true frequency and severity of historical shocks affecting airports and equity markets.

51. This can be well illustrated by reference to the COVID-19 shock. As can be seen from Figure 3-1, 1 April 2020 to 31 March 2023 will be included in the 2023 IM update and the 2030 IM update. That is, this three-year period will receive double the weight of the four-year period from 1 April 2016 to 31 March 2020 (and double the weight of the three-year period from 1 April 2023 to 31 March 2026).

52. As it just so happens, the collapse in global equity markets due to COVID-19 happened largely in February and March 2022 and the recovery happened post that period. Purely as a matter of happenstance, the NZCC IM asset beta, updated every seven years with a 10-year estimation window, would assign double the weight to the market recovery than the market collapse.

53. However, this weighting is restricted to an analysis of the IM asset beta. If the IM asset beta were applied in all PSE's that fall within its 7-year operation, then there would be further distortions away from equal weighting of historical events. In particular, the 2016 IM asset beta would be applied to two PSEs (PSE3 and PSE4) and the 2023 IM asset beta would only be applied to one PSE (PSE5) while the 2030 IM asset beta would be applied to two PSEs (PSE6 and PSE7). By way of example, this would mean that:

    - the four years ending 31 March 2017 to 31 March 2020 would only be used to set one PSE asset beta (PSE4); while
    - the next three years ending 31 March 2023 will be used to set asset betas for PSE5, PSE6 and PSE7.

54. As it happens, this means that the COVID-19 recovery period will receive 3 times the weight as the COVID collapse period (and 3 times as much weight as the pre-COVID period from 1 April 2016).

55. The above discussion illustrates how sampling equity markets every seven years using a 10-year estimation window will inevitably lead to average asset betas overtime that do not accurately reflect the historical frequency and severity of shocks hitting equity markets. In turn, this illustrates why it would be inappropriate to require that the IM asset beta, as opposed to the IM asset beta methodology, should be used to set asset betas in each PSE.

56. This is why it is my view that, ideally, PSE4 and all future asset betas are determined using a rolling 10-year estimation window ending just before the PSE starts. However, if an airport has already locked in a PSE4 asset beta that is based on the 2016 IM asset beta (estimation window ending in 2016) then a transition to a rolling estimation window may be applied that ensures that the years from 1 April 2016 to 1 March 2024 are given appropriate historical weight in determining asset betas.

3.3 Estimating asset betas for PSEs

57. In what follows I first explain why I consider that the asset beta used to inform the WACC for a PSE should be estimated:

    a. following the method established in the IMs (e.g., large sample, midpoint of average asset betas estimated from 5 weekly, and 20 four weekly sampling periods); but

    b. should be estimated using an estimation window ending at the beginning of the PSE;

    c. must be a multiple of 5-years (i.e., 5, 10 or 15-years) where 5-years is the length of a PSE; and

    d. should have an estimation window of 10-years based on a number of considerations including the historic practice of the NZCC in past IMs.

3.3.1 Rolling 10-year estimation windows updated at the beginning of every PSE provide actuarially fair asset beta compensation

58. In my view it would be appropriate in general, and in the specific context of the COVID-19 pandemic, to estimate asset beta using the most recent 10-years of data available at the start of each 5-year PSE (including PSE4 and future PSEs).[13]

59. At each future PSE, the older 5-years of data in the estimation window would be dropped and replaced with newer data. The effect of this method is that the asset beta estimate in every PSE reflects the balance of systematic shocks that occurred in the

[13] This is consistent with the NZCC IM asset beta methodology to date – which has been to retain a stable 10-year estimation window (made up of two five-year estimation windows) and to set the asset beta based on whatever systematic shocks occurred during that window. No attempt has been made by the NZCC to adjust the asset beta based on a view that the shocks that occurred in the 10 year estimation window were not representative of the expected frequency of that form of shock. For example, the NZCC did not attempt to adjust for the impact of the global financial crisis in the 2016 IM update – even though this was a large systematic shock of the kind that arguably occurs less than once every 10 years. Nor did the NZCC attempt to adjust Chorus' estimated asset beta for the impact of COVID-19.

previous 10-years, but these shocks only influence the asset beta applied in PSEs for a 10-year period (while they remain in the 10-year estimation window).

60. For example, if one were to (arbitrarily) define the COVID-19 pandemic shock as occurring in 2020 and 2021 then the COVID-19 shock would influence asset betas used in PSE4 and PSE5 but would drop out of the estimation window for PSE6.[14]

61. The major advantage of the proposed approach is that, in the long run:

- all systematic shocks that actually occur are captured in the asset beta estimates applied in PSEs;
- each shock is assigned an impact that matches the actual severity of the shock; and
- each shock receives the exactly correct weight based on its actual frequency through time.

62. The last two points are, in my view, critical. To elaborate on the last point, whatever the true frequency of a COVID-19 like pandemic, the proposed method will generate asset betas that include such an event with that exact frequency. If a COVID-19 like event (or a global financial crisis etc.) is a one in 50-year event, then one 5-year estimation window in 50 years will include such an event. But if the true frequency is one-in-20 or one-in-100, the rolling update will ensure that the event is captured in one estimation window every 20 or 100 years – as appropriate.

63. There is no bias in the proposed methodology because that methodology will, on average and over time, accurately reflect and compensate for the scale and frequency of all shocks.

64. The proposed method is largely the same as the existing NZCC IM method except it is applied once every 5 years (at the time of a new PSE).

65. It is true that no 10-year estimation window will be truly representative of the perceived economic shocks that are (actuarially) expected over any given PSE. For example, it is well understood that airport investors were exposed to the risk of pandemics over PSE1 to PSE3. That is, investors placed a non-zero probability on a major pandemic occurring over PSE1 to PSE3.

66. Nonetheless, asset betas applied in PSE1 to PSE3 provided no pandemic related asset beta compensation. This is because no major pandemic event occurred in the relevant period over which asset betas were estimated. Moreover, no stakeholders, including airlines or the NZCC, were advocating for an uplift to the estimated asset

[14] PSE6 is scheduled to begin on 30 June 2032, at which time a 10-year estimation window would only reach back to 1 July 2022.

beta in the 2011 and 2016 IM asset betas to reflect the real *ex ante* (but unrealised historically) risk of a major pandemic.

67. The obvious reason for not applying an uplift in PSE1 to PSE3 for the risk of a pandemic was that to do so would be extremely informationally difficult. In order to impute into an asset beta estimate the risk of a shock that did not occur in the estimation window, one needs a robust and credible estimate of both:

- the probability of that shock occurring in any given period; and
- the likely impact of that shock on asset betas.

68. For example, an analyst considering the asset beta for PSE1 to PSE3 could, conceivably, have gone through the following logical thought process:

i. I know a major pandemic did not happen in my asset beta estimation window (i.e., a realised *ex post* zero probability of a pandemic in the estimation window).

ii. But I also know that the *ex ante* probability of a major pandemic is not zero (call this probability "γ" (where 0<"γ" <1).

iii. When (if) a major pandemic shock occurs, I assess that it will have positive asset beta risk for airports and will raise estimated asset betas by a specific amount (call this amount α).

iv. I therefore will set my asset beta for PSE1 to PSE3 equal to the observed asset beta in my estimation window plus "$\alpha \times \gamma$" being my estimate of the expected systemic risk (not realised in my estimation window) of a major pandemic.

69. While there is nothing conceptually wrong with the above logical thought process, the obvious implementation problem is that neither the analyst nor anybody else would have any idea what the correct values for α and γ are. Indeed, having now experienced a major pandemic, we are not really any better placed to assess the likely frequency and severity of such events.[15] Either way, no such adjustment was applied in PSE1 to PSE3.

3.3.2 Adjusting the PSE4 asset beta to "de-weight" the impact of the pandemic

70. The fact that asset betas in PSE1 to PSE3 did not include an uplift for (unobserved) pandemic risk is an illustration for why it would be a mistake to argue that the asset beta for the asset beta for PSE4 should be adjusted downward to remove some part of the (observed) pandemic impact on asset betas.

[15] While we do have some data on the effect of the COVID-19 pandemic it is not possible to disentangle the effect of COVID-19 from other events occurring during the same period. Similarly, we don't know that a future pandemic shock will take the same form.

71. One might be tempted to argue that major pandemics occur less frequently than once in 10-years and, therefore, the 10 years to June 2022 are not "representative" of the true actuarially expected risk of pandemics for investors in airport companies. However:

- if a 10-year estimation window that includes a major pandemic overweights (relative to *a priori* probabilities) pandemic type shocks; then
- a 10-year estimation window that **does not** include a major pandemic **under**weights (relative to *a priori* probabilities) pandemic type shocks.

72. Once the second dot point is accepted as the logical corollary of the first, it can be easily seen that attempting to adjust the estimated asset beta to reflect some estimate of a shock's "*a priori* probability" creates more problems than it solves. Specifically, adjusting downwards the asset beta estimates affected by COVID-19 on the basis that COVID-19 type shocks are "overrepresented" in that period requires an offsetting upward adjustment to asset beta estimates derived from all other periods where COVID-19 type shocks are "underrepresented". This would include the historical PSE1 to PSE3 periods.

73. The difficulty and complexity of attempting to do so is described in detail in Appendix B. However, by way of simple illustration, note that by this logic:

a. the asset betas applied in PSE1 to PSE3 were all underestimated because there was no major pandemic effect in the estimation windows used to derive that estimate;

b. the 5-year estimate ending June 2017 was underestimated because there was no major pandemic during those 5-years;

c. all future asset beta estimates (e.g., for the 5-years ending June 2027 and beyond) will be underestimated if their estimation window does not include a major pandemic.

74. If one is to argue that the estimated asset beta for the 5-years ending June 2022 overstates the actuarial probability of a pandemic, then a direct corollary is that the asset beta estimated in other periods (without major pandemic shocks) understate that probability. That is, any downward adjustment in the 5-years to June 2022 should be offset by upward adjustments in other periods.

75. By definition, the net effect of these changes should be zero. That is, in order to be conceptually sound, one would need to mostly, but not fully, remove the impact of an infrequent event from the period in which it falls and then smear that removed effect across all other periods that are unaffected by the infrequent event. If done accurately, the net effect on average asset betas through time would be zero.

76. Of course, this could never be done precisely because the "true" frequency and severity of a COVID-19 like event (or, really, any major economic shock) is not known

with any accuracy. Attempting to adjust for an unknown (and unknowable) true probability of an event is, in my view, likely to end in a regulatory quagmire of competing claims, all based on assertions that are not, and cannot be, robustly evidenced.

77. These issues are discussed further in Appendix A where I also explain that any argument for a pandemic adjustment is not peculiar to pandemics. If applied to a pandemic, then it invites application to all large infrequent systematic shocks. For example, the following are examples of large systematic shocks of a kind that are also infrequent/unpredictable:

    i. The war in Ukraine, and subsequent sanctions on Russia, is affecting global energy markets and global inflation and interest rates.

    ii. The global financial crisis of 2008-09 and the subsequent Eurozone debt crisis extending out to at least 2015 represented a one in 100-year financial crisis and systemic shock.

    iii. The decades long industrialisation of China, and associated reduction in global manufacturing costs and a global excess of savings, has had profound impacts on the structure of the world economy but which cannot be expected to be repeated in the future.

    iv. In fact, all estimation windows for asset beta will be made up of a combination of shocks that do not reflect the "average" set of expected shocks. For example, New Zealand inflation has experienced a 32 year high of 7.2% pa. This is, by definition, a shock that is not expected to be repeated every 5 years. Therefore, the same logical case could be made for attempting to adjust measured asset betas that include 2022 in order to remove the effect of a one in 32-year record high inflation. However, going down such a path would make asset beta estimation unworkable.

78. This is an example of the regulatory quagmire raised above. With no clear and transparent basis for making any change in estimation methodology, stakeholders will be incentivised to engage in what ultimately ends in a "data-mining" exercise – choosing:

    a. what events to classify as happening inconsistent with their expected future frequency (noting that events such as the global financial crises have at least as much claim to this as does COVID-19);

    b. what period to classify as affected by those events (and which sub periods of that period are most affected etc);

    c. how to estimate the magnitude of the impact of the event on the estimated asset betas;

d. what probability to put on that event occurring in the future in order to "add back" the amount necessary to arrive at an appropriately weighted probability of "event X" asset beta; and

e. how to keep track of the impact of future "event X" like occurrences in order to also remove the impact of those (so that the "add back" from the previous step does not result in overweighting of "event X" like occurrences).

79. The more events that an estimation methodology seeks to adjust overtime, the more complex the asset beta estimate will become. Ultimately, the asset beta estimate would comprise mainly of previously determined estimates of increments/decrements for certain events X, Y and Z added to an asset beta estimate that becomes ever more contentious as stakeholders argue over whether the new estimation period is affected by X, Y and Z like events and, if so, how the impact of those events should be removed.

3.3.3 Must the estimation window be 10-years?

80. The rational for my proposed approach is that the same length estimation window is applied at the beginning of every PSE and that estimation window is a multiple of the length of the PSE. My proposed adoption of a 10-year estimation window fits these criteria in that:

- 10 years is a multiple of 5 years; and
- 10-years estimation windows have been standard practice in New Zealand regulation and are what I am informed asset betas in PSE1 to PSE3 were based on.

3.3.4 Why the estimation window must be a multiple of the PSE length

81. The estimation window must be a multiple of the length of the PSE because that ensures that all historical periods have the same weight in setting the asset beta actually applied in PSEs over time.

82. By way of illustration, imagine that the estimation window was only two years, and this was updated every 5 years (at the beginning of each PSE). Then, only two out of 5-years of historical data would receive any weight in determining the asset betas applied in future PSE's. If the estimation window was 7 years, a similar issue would exist. Under this scenario, every year of historical data receives some weight in setting asset betas for future PSEs. However, two out of every 5 years (being the two years immediately preceding each PSE) would receive twice the weight as the other three years. For example, a 7-year estimation window would mean that 2023 to 2025 would only be used to set asset betas for PSE5. However, 2026 and 2027 would be used to set asset betas for both PSE5 and PSE6.

83. By failing to give all historical periods the same weight in setting future asset betas, one cannot be sure that the asset betas estimated and applied over time will reflect the true (realised) frequency and severity of economic shocks that apply over time. For example, if a 7-year estimation window had been consistently applied in the past and in the future, then 1 July 2020 to 30 June 2022 would be over-represented in AIAL's PSEs (being used to determine asset beta in PSE4 and PSE5) while 1 July 2017 to 30 June 2020 would be under-represented (being only used to determine asset beta in PSE4).

3.3.5 Implication of lengthening the asset beta estimation window from 10 to 15-years

84. The historical practice to date in New Zealand has been to adopt a 10-year estimation window. Therefore, continuing with that practice will continue to give every year of historical data the same weight in determining asset betas applied in PSEs.

85. However, the NZCC (in the context of IM asset betas) has stated that:[16]

> *4. In relation to our calculation of asset beta, at the last review we focussed on asset betas from the two most recent five-year periods (2006-2011 and 2011-2016); however, we also had regard to earlier periods. The economic consequences of COVID have resulted in an increase in asset betas for airport services, as indicated in CEPA's calculation of the average asset beta for the 2020-22 period compared to the average asset beta for the periods 2012-2017 and 2017-2022.* ***We are considering whether we should use a term for airports that is either longer or shorter than the last two five-year periods****. For energy, CEPA's findings indicate there does not appear to be a need to vary the sampling timing we used last time; however, we welcome views on this.*

86. The NZCC does not provide any further context for what such reform would look like and I note that the IM asset beta is not the same as the asset beta that should be applied in PSE's (although, for the absence of doubt, I do consider that the IM methodology as it currently stands is a reasonable basis for estimating the asset beta at the beginning of each PSE).

87. In the context of the analysis I have set out above, if the estimation window to be applied at the beginning of each PSE was changed, it would either need to be:

- shortened to 5-years; or
- lengthened to 15-years.

[16] 8 December 2022 letter accompanying the release of the CEPA report. "CEPA report on aspects of the cost of capital Input Methodologies for the 2023 review"

88. Applied consistently on a forward-looking basis, either of these approaches would satisfy the criteria that all future years receive the same weight in setting asset betas for PSEs. However, there would be transitional effects in that:

- moving to a 5-year window would mean that the 5-years to June 2017 would be underweighted relative to other 5-year windows;[17] and
- moving to a 15-year window would mean that the 5-years to June 2012 would be overweighted.[18]

89. I think it is reasonable to rule out the first option. This would only serve to make the asset beta used in PSEs more volatile and even higher in PSE4 than it would otherwise be. This does not seem consistent with the NZCC's seeming concern over the increase in asset betas even when using a 10-year estimation window.

90. This leaves consideration of a 15-year estimation window. Applied consistently in all future periods, this can be expected to:

- lower the asset beta estimate in PSE4 and PSE5 by virtue of "diluting" the pandemic shock by adding more data pre-pandemic (by adding data from 1 July 2007 to 30 June 2012 to PSE4 and adding data from 1 July 2012 to 30 June 2017 to PSE5); but
- raise the asset beta in PSE6 by including the pandemic shock (in the 1 July 2017 to 30 June 2022 period) into the estimation window that would otherwise have been dropped with a 10-year estimation window.

91. If the period being overweighted due to the change (1 July 2007 to 30 June 2012) is in some sense "normal", then the net effect of the changes on the average asset beta applied overtime should be zero. All that is happening is that instead of recovering the revealed pandemic asset beta risk over 10-years this is being recovered over 15-years.

92. However, there are a number of concerns about *ad hoc* changes in standard practice:

- First, while the average PSE asset beta will not be changed, the time path for the PSE asset beta will be. That is, airports will need to wait for longer to be compensated for the realised impact of pandemic risk on asset beta (i.e., will suffer a time value of money loss).

[17] This period would only used in the context of informing one PSE and that would be in a context where those 5 years were only one half of the data (i.e., this 5 years of data would be given half the weight for a single 5 year PSE).

[18] This period would be used to determine asset beta in 3 PSEs but in two of those it would have 50% weight instead of on third weight.

- Second, the period 1 July 2007 to 30 June 2012 is clearly not "normal" (and no individual period ever really will be). This period captures the worst of the global financial crisis.
- Third, there is the potential for such a change to be perceived as an illustration of asymmetric regulatory risk. That is, an ad hoc change attempting to dilute a period of realised high risk when a period of realised low risk would be unlikely to elicit a similar response.

93. Finally, and for the absence of doubt, any change to the estimation window must be permanent. It would be entirely unreasonable to:

- adopt a 15-year estimation window for PSE4 and PSE5; and
- revert to a 10-year estimation window for PSE6.

94. This would leave the realised asset beta pandemic risk undercompensated in absolute terms.

3.3.6 Conclusion

95. Any methodology for setting compensation for systemic risk across multiple PSEs must seek to ensure that the estimated asset beta applied across PSE's will, over the long run, reflect the average systemic risks observed in equity markets for airports. The best, and likely only realistically manageable, way to achieve this is if:

- the asset beta is updated at the beginning of each PSE;
- each update uses the same estimation window; and
- the estimation window is a whole number multiple of the length of the PSE (e.g., if the PSE is 5-years then the estimation window is 5, 10, 15 etc years).

96. Historically, 10-years has been used to estimate the asset beta in New Zealand and, consistent with the second dot point, I consider that 10-years should continue to be used. If, nonetheless, a longer period (e.g., 15-years) was adopted, it should continue to be applied in all future PSEs.

3.4 Reforms to the IM estimation window

97. The NZCC does state that it is contemplating a reform to the IMs to use a longer or shorter estimation window than 10-years in response to the increase in estimated asset betas as a result of COVID-19 and that this potential change would be specific to airports (i.e., not apply to the energy sector IMs).[19]

[19] 8 December 2022 letter accompanying the release of the CEPA report. "CEPA report on aspects of the cost of capital Input Methodologies for the 2023 review"

4. We are considering whether we should use a term for airports that is either longer or shorter than the last two five-year periods. For energy, CEPA's findings indicate there does not appear to be a need to vary the sampling timing we used last time; however, we welcome views on this.

98. The NZCC does not clearly enunciate the rationale for this potential reform. However, for the same reasons set out in section 3.3.2, I consider that it would be poor policy to implement any reform with the intention of:

    a. Requiring that the 2023 IM asset beta estimate be used to set asset betas in PSEs;

    b. Lowering the asset beta estimated in the 2023 IM by somehow "de-weighting" the impact of the COVID-19 shock on the basis that the COVID-19 shock in the last 10-years is over-weighted relative to the true underlying probability and severity of such events; while

    c. not having an intention to create an equal and opposite "re-weighting" in future estimation periods to include a COVID-19 premium to all future estimation windows not affected by a major COVID-19 like pandemic.

99. I also note that even if there was an express intention to perform the future "re-weighting" envisaged in "c" above this would still be a policy mistake because, as explained in section 3.3.2 and Appendix B, this would create a regulatory quagmire of competing estimates of future frequency and severity of pandemics and, indeed, all major shocks.

100. However, I do note that a move to a 14-year estimation window (2×7 years) at each 7-year IM update would have the following effects:

    - It would (prospectively) remove the current inconsistent weighting of historical events by ensuring that every year is used to estimate asset betas in two consecutive IM updates.
    - It would reduce the weight given to the COVID-19 shock in the current IM update (by adding 4 years unaffected by that shock to the IM estimation window).
    - It would increase the weight given to the COVID-19 shock in the 2030 IMs by including the months of February and March 2020 which were the months of the largest equity market decline.
    - If a 14-year estimation window for the IMs (2×update frequency) was explicitly paired with a 15-year estimation window for PSEs (3×update frequency) then there would continue to be somewhat close correspondence between proximate PSE and IM asset beta estimates.[20]

[20]

101. However, as noted in section 3.3.5, there are a number of concerns about *ad hoc* changes in standard practice:

- First, moving to a 14 (15) year estimation window for the IMs (PSEs) might not change the average future asset beta, but the time path for the asset beta will be changed. That is, airports will need to wait for longer to be compensated for the realised impact of pandemic risk on asset beta (i.e., will suffer a time value of money loss).
- Second, the period being added to the estimation window is clearly not "normal" in that it includes the period of the global financial crisis (from circa 2007 to 2012 including the recovery phase). Adding:
  - Four-years to the 2023 IM estimation window will add the period 1 April 2009 to 31 March 2013;
  - Five-years to the AIAL and CIAL 2022 PSE estimation windows will add the period 1 July 2007 to 30 June 2012; and
  - Five-years to the WIAL 2024 PSE estimation windows will add the period 1 April 2009 to 31 March 2014.
- Third, there is the potential for such a change to be perceived as an illustration of asymmetric regulatory risk. That is, an ad hoc change attempting to dilute a period of realised high risk when a period of realised low risk would be unlikely to elicit a similar response.

102. Finally, and as explained in in section 3.3.5, any change to the estimation window must be permanent. It would be entirely unreasonable to do the following:

- Adopt a 14-year (15-year) estimation window for the 2023 IMs (2022 to 2029 PSEs) in order to de-weight the impact of COVID-19.
- Revert to a 10-year estimation window for 2030 IMs (2032 and 2034 PSEs) in order to remove the COVID-19 affected period. Noting that:
  - Only using 10-years from March 2030 would remove the COVID-19 affected February and March 2020 from the 2030 IMs that would otherwise be included with a 14-year estimation window;
  - Only using 10-years from AIAL and CIAL's June 2032 PSE would remove the COVID-19 affected February to June 2020 that would otherwise be included in a 15-year estimation window;
  - Only using 10-years from WIAL's March 2034 PSE would remove all months from April 2019 to March 2024 that would otherwise be included in a 15-year estimation window;

103. This would leave the realised asset beta pandemic risk undercompensated in absolute terms.

4 Proposals to shrink the sample

104. This section provides my views on the following (very brief) statement by the NZCC to the effect that it is considering amending its method for estimating asset beta for airports by shrinking the sample of comparator airports to exclude airports based on them: [21]

    a. having large variance in estimates based on daily, weekly, and four-weekly data; and

    b. being located in countries with different MRPs.

105. The relevant quote is reproduced below.

> *8. … For example, we are considering whether we should exclude companies from countries that have a market risk premium that is substantially different to the market risk premium for New Zealand. We are also considering whether we should exclude companies that have a large variance in estimates based on daily, weekly and four-weekly data. We are concerned that companies that do not have a stable estimate of asset beta may not be suitable comparators.*

4.1 A large diverse sample is best practice

106. The "true asset beta" for a company needs to be distinguished from "the empirically estimated asset beta" for that company. The true asset beta reflects investors' expectations of how volatile (and how correlated with the rest of the equity market) a company's returns will be in the future (given an actuarial assessment [22] of what events the future might hold). The empirically estimated asset beta represents an estimate of how volatile (and how correlated with the rest of the equity market) a company's returns have been over some specific finite past estimation period. An empirically estimated asset beta is only a very noisy proxy for the true asset beta.

107. I regard the NZCC's 2016 IM methodology as highly robust. The most important fact that a robust methodology must deal with is the high levels of noise in asset beta estimates. These include noise in:

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[21] The NZCC's recent covering letter to a CEPA report dated 8 December 2022 and entitled "CEPA report on aspects of the cost of capital Input Methodologies for the 2023 review".

[22] That is, a probabilistic assessment of all the possible shocks that might hit the economy while the asset is being held. This includes low probability but high impact events – such as the global pandemic that actually did hit the global economy in 2020.

- Asset beta estimates for the same firm over the same time period but using different sampling periods (e.g., weekly asset betas estimated over the same 5-year period but defining the week as starting on Monday instead of Tuesday etc);
- Asset beta estimate for the same firm estimated over different time periods (e.g., 5-years ending June 2022 vs 5-years ending June 2017);
- Asset beta estimates for different firms in different geographical locations over the same period.

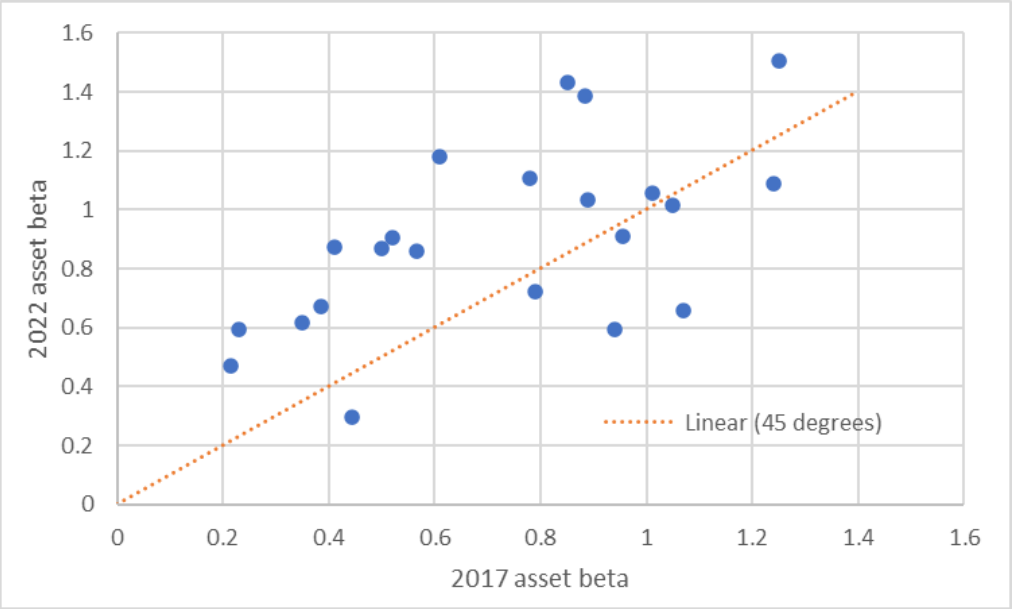
4.2 Shrinking the sample based on "stability" of asset beta estimates

4.2.1 All airports have (and should be expected to have) unstable asset beta estimates

108. Asset beta estimates are highly noisy -both within the same estimation window (but with different sampling periods (e.g., weekly vs monthly) and across time. Figure 4-1 illustrates this noise across time by comparing the asset beta estimated for the same airport using the NZCC methodology for the 5-years ending June 2022 vs June 2017. These do not line up neatly on a 45-degree line because asset betas are noisy. Most asset betas are higher in the 2022 estimation period but one third (7 out of 22)[23] are lower.

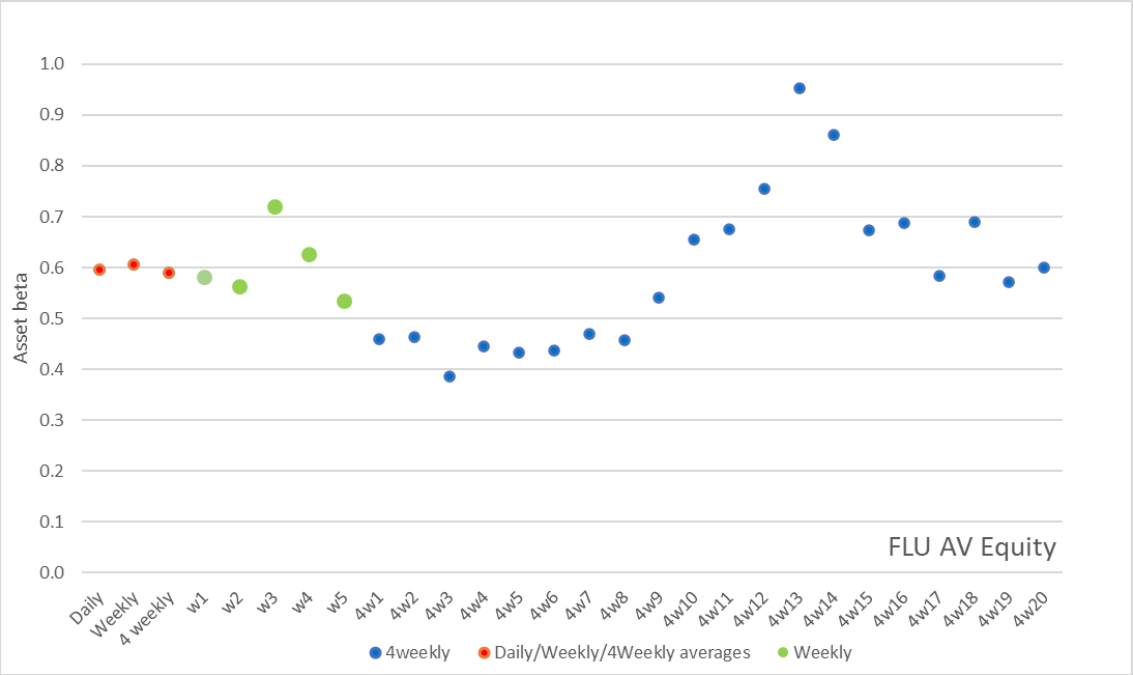
[23] 22 comparators with estimates in both periods.

Figure 4-1: Illustration of noise across time



109. The noise within estimation windows (due to variation across sampling periods) is illustrated using Vienna Airport in Figure 4-2 below. There are 28 asset beta estimates for Vienna Airport for the 5-years ending 30 June 2022. There are 5 different estimates of weekly asset betas and 20 different estimates of monthly asset betas. There is also one estimate of daily asset betas and two estimates of the average weekly (average of 5 estimates) and average four weekly (average of 20 estimates).

Figure 4-2: Vienna Airport: 28 asset beta estimates for the 5-years ending 30 June 2022



110. This chart clearly illustrates a problem with the idea, seemingly raised in the NZCC's cover letter to the CEPA report, that the NZCC is:

> *… considering whether we should exclude companies that have a large variance in estimates based on daily, weekly and four-weekly data. We are concerned that companies that do not have a stable estimate of asset beta may not be suitable comparators.*

111. The NZCC does not clearly define what it means by "variance in estimates based on daily, weekly and four weekly data". It seems plausible that the NZCC is referring to its average estimates for each of these three categories (i.e., the red dots in the above chart). Based on this metric, Vienna airport has (by chance) very similar daily, average weekly and average four weekly asset betas.

112. However, these obscure very large variations in asset beta estimates that make up the average weekly and average four weekly estimates. It is difficult to understand how one could argue that Vienna Airport has a "stable" asset beta estimate on the basis of Figure 4-2.

113. Moreover, there is no basis for believing that volatility in asset beta estimates is a sign of unreliability in asset beta estimates. Airports are volatile companies and volatile companies have noisy asset betas. That is a why the NZCC practice has been to use 25 asset beta estimates for every company and to have a large sample.

114. Clearly, no single one of the individual asset beta estimates can be viewed as the true asset beta. The estimated asset beta for Vienna Airport over this period varies from less than 0.4 to more than 0.9. The true asset beta for this airport is unknown. Moreover, the range for the estimated asset betas would be even larger looking at other estimation windows. For example, over the five years ending June 2017 the average weekly asset beta was only 0.19 (and the average four-weekly asset beta was 0.27).

115. Vienna Airport is far from unusual in exhibiting this variability in asset beta estimates. See also below illustration for Copenhagen Airport. This is why it would be a serious error to attempt to identify a single or even a small number of airports with "small variance" in their asset beta estimates and seek to estimate a sample average from these.

4.2.2 Arbitrary measures of "stability" and thresholds for exclusion?

116. The NZCC has not been very clear about how the "variance in estimates based on daily, weekly and four-weekly data" would actually be measured. As illustrated with Vienna Airport, different approaches would have very different estimates.

117. For the purpose of illustration consider the following three possible measures:

    a. Standard deviation of 3 estimates of asset beta for each airport (being one daily estimate, one weekly estimate (which is itself the average of 5 underlying estimates) and one four weekly estimate (which is itself the average of 20 underlying estimates).

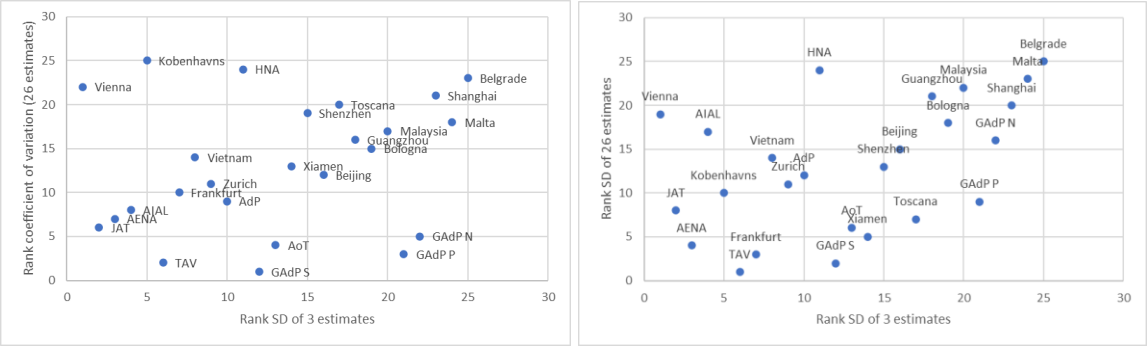
    b. Standard deviation of 26 estimates (being all the underlying estimates before any averaging described above); and

    c. Coefficient of variation of the 26 estimates (being the ratio of the standard deviation to the mean).[24]

118. Restricting myself to the 2022 asset beta estimates and comparing a. with b., a. with c., I can plot the relationship between the rankings using the various measures of "stability" (with a high ranking meaning low stability).

[24] For the purpose of this illustration, we use the NZCC asset beta estimate as the "mean" where the NZCC asset beta estimate takes the average of the average weekly and four weekly estimates. That is, we use a weighted mean that gives 4 times as much weight to each weekly estimate as to each four-weekly estimate (and zero weight to daily estimates).

Figure 4-3: Scatter plot of relationship between different measures of "stability" of asset beta estimate (5-years to 2022)



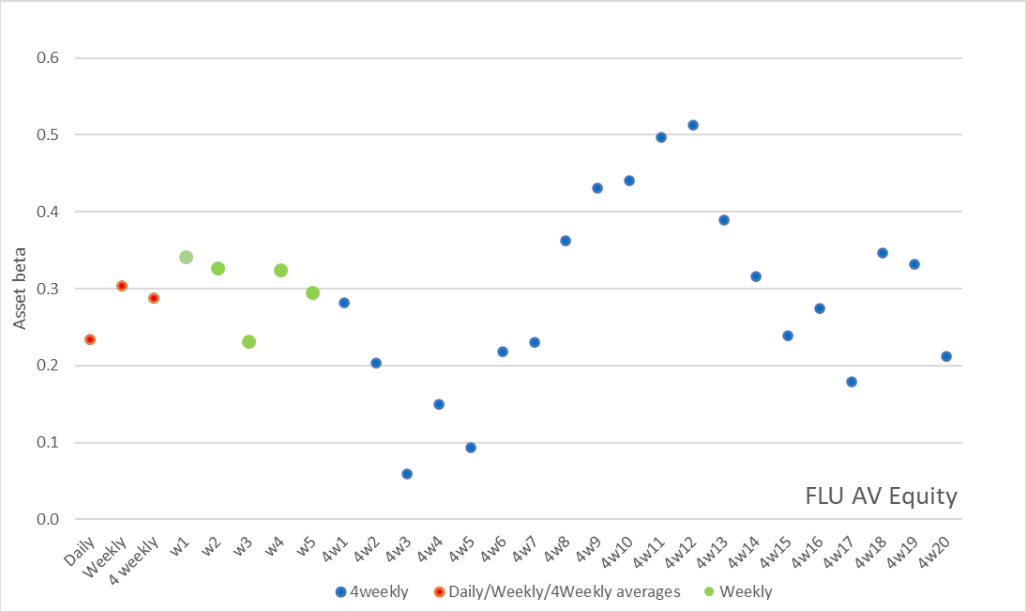
Source: Bloomberg and CEG analysis

119. It can be seen that there is a positive relationship between all three measures, but it is far from strong. This means different measures of "stability" will result in very different rankings for some airports.

120. Consider Copenhagen Airport (Kobenhavens in the figures). This has one of the lowest standard deviations of three estimates and, therefore, has a rank of 5 using the three NZCC averages (the horizontal axis in both charts). That is, Copenhagen Airport is the fifth most stable using this measure. However, Copenhagen Airport has a rank of 25, i.e., the **least stable** estimate in the sample, when using the coefficient of variation.

121. This is because, like Vienna Airport, Copenhagen Airport has a much higher standard deviation of the underlying estimates. The apparent similarity between the 3 beta estimates that the NZCC seems to be referring to disguises very significant variation in the underlying asset beta estimates upon which they are based.

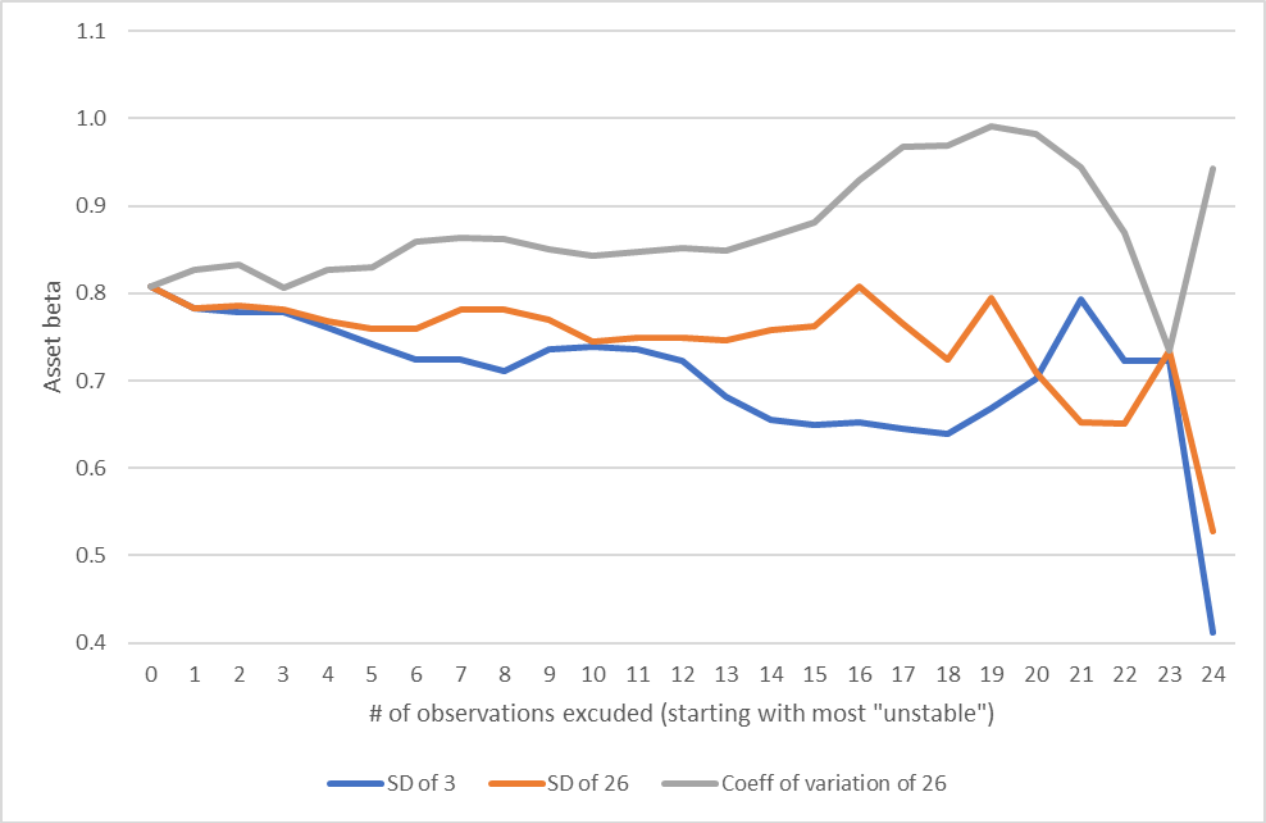
Figure 4-4: Copenhagen Airport: 28 asset beta estimates for the 5-years ending 30 June 2022



122. The following figure illustrates the impact on sample average asset betas if the three measures of "stability" are used to eliminate observations from the sample. The left most point on all three lines is the asset beta for the full sample (0.80) estimated across the 10-years to June 2022. As one moves to the right on each line different airports are dropped from the sample.

123. On the "SD or 3" and the "SD of 26" lines the first airport dropped is Belgrade. This has the highest asset beta in the sample so the lines both drop. On the "Coeff of variation of 26" line the first comparator dropped is Copenhagen which has the lowest asset beta in the sample and, consequently, the line rises. As we move further to the right the lines sometimes move in the same and sometimes in the opposite direction as different airports are dropped from the sample.

Figure 4-5: Sample average asset beta 10-years ending 30 June 2022 ex



124. This analysis highlights that the impact on the sample average asset beta would be highly sensitive to both:

- What definition of "stability" the NZCC adopted; and
- What threshold for "stability" the NZCC adopted.

125. For example, the fact that the "SD of 26" starts at 0.80 with both zero exclusions and with 16 exclusions tell you that the 16 "least stable" and the 9 "most stable" comparators on this measure have the same average asset beta (0.80) (which is the same as the full sample average). However, if the NZCC set its threshold to only exclude the 10 "least stable" estimates then the remaining sample would have an average of 0.74.

126. Similarly, focussing on the "SD of 3" measure the NZCC could achieve a 0.64 asset beta if it excluded the 18 "least stable" comparators. But this would rise back to 0.80 if it excluded the 21 "least stable" comparators (leaving just Vienna, JAT, AENA and AIAL).

4.2.3 Conclusion

127. In my view, it would be unwise and unprincipled to develop a regulatory methodology in which such arbitrary decisions would play a critical role. This is especially the case given that there is no sound conceptual basis for wanting to exclude comparators with "unstable" asset beta estimates.

4.3 Shrinking the sample based on country MRP

128. The NZCC's states that they are "considering whether we should exclude companies from countries that have a market risk premium that is substantially different to the market risk premium for New Zealand".

129. In response I note:

    a. There is no reason to believe that the asset beta for an airport is affected by the country risk premium for the country in which it operates. In fact, the average equity beta in a country is, by mathematical definition, unaffected by the riskiness of the market (MRP). There is no reason to believe that airports in markets with high risk have high (or low) asset beta.

    b. Even ignoring the fact that there is no conceptual basis for such an exclusion, excluding comparators based on their country MRP will involve adopting:

        i. Arbitrary measures of country MRP; and

        ii. Arbitrary thresholds for what constitutes a "substantially different" MRP to NZ.

        (This is problematic in the same way that arbitrary measures of, and thresholds for, "stability" of asset beta estimates would be as discussed in section 4.2.2.)

4.3.1 Conceptual problem

130. As a matter of basic finance theory, country risk cannot raise the average equity beta in a country. The average equity beta in any equity market is, by construction, 1.0. Arguments to use country risk as a filter for estimating asset beta may appear intuitive to a lay person.[25] However, such a position is deeply flawed when considered in the context of finance theory. Beta risk in the CAPM is a measure of one firm's risk *relative* to other firms in the *same* equity market. The average of the equity betas of firms in a market is equal to 1.0. This is the case in every market and is true by its

[25] Indeed, there may be good reasons to believe that an airport operating in a les developed country has, other things equal, higher overall investment risk premia, including systemic risk premia and non-systemic risks (such government or other regulatory interference that would impact the cashflows for the airport), than an airport operating in a developed country. This may be due, amongst other reasons, to the greater stability of the economies of developed countries.

very definition. Firms that have lower/higher than average risk *for their equity market* will have an equity beta of less/more than 1.0, but, on average, equity beta is equal to 1.0 in every equity market. It is a nonsensical to suggest that higher risks in one equity market raise the average beta in that equity market.

131. Country specific risk premia due to different country risks have no effect on asset betas measured relative to equity markets in the same country, and it is not my practice to screen asset beta comparators for the country risk they may face. Put simply, any country specific risk premium "cancels out" because it is in both the numerator and the denominator of the relative risk assessment.[26]

132. A widely used finance textbook summarises this fact as follows:[27]

> *" Stocks with betas greater than 1.0 tend to amplify the overall movements of the market. Stocks with betas between 0 and 1.0 tend to move in the same direction as the market, but not as far. Of course, the market is the portfolio of all stocks,* ***so the "average" stock has a beta of 1.0.****"*

133. It follows that the average empirically estimated asset beta in a country's equity market will be the same in a developing country and a developed country. In fact, the average equity beta will be unchanged by even the most extreme events, including: revolution; civil war; foreign invasion; natural disaster; etc. These events may well raise the risk of investing in that equity market but they will do so by raising the market risk premium for that country's equity market. These events will not, and mathematically cannot, raise the average equity and asset betas in that country (because the former is constructed to be 1.0 in all circumstances by definition and the latter is derived from the former).

4.3.2 Arbitrary measures and thresholds

134. In any event, it is not obvious how the NZCC would expect to derive a reliable estimate of the MRP across all of the relevant countries. Purely for illustration I have downloaded Bloomberg estimates of MRP gathered using its spreadsheet API using the function

> *=@BDH(Equity Ticker,"COUNTRY_RISK_PREMIUM","1/1/2007","01/15/2023","DAYS=A").*

[26] In regulatory proceedings it is not uncommon to compensate for the country risks faced by the regulated entity. This is typically done by an adjustment to the allowed return or in the allowed cash flows. It would be incorrect to consider that a screen on the equity beta comparators was in any way an alternative to either of those approaches.

[27] Page 174 in Brealey, Myers and Allen, "Principles of Corporate Finance", Tenth Edition, McGraw-Hill

135. This allows me to calculate the annual average across daily MRP estimates (where the MRP estimate is based on the expected market return using a discounted earnings growth model less the relevant risk-free rate).[28] The Bloomberg terminal describes its market return and risk-free rate as being:

> *Market return: The implied return expected from the market(s) using forecasted growth rates, earnings, dividends, payout ratio, and current values.*
>
> *Risk-free rate: The yield of the 10-year treasury security. If such a security is not available, then a long-term swap rate is used.*

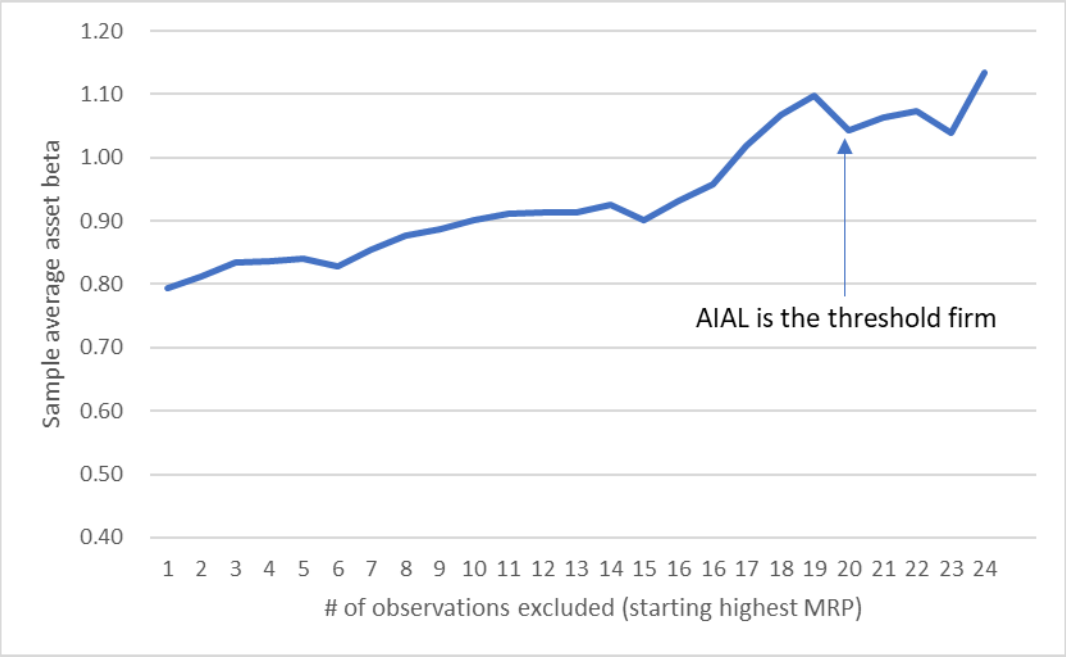
136. Figure 4-6 plots the relationship between this measure of country MRP and the asset beta for airports estimated using the NZCC method (using the 10-years to June 2022). Somewhat surprisingly, rather than there being no relationship, there is a reasonably strong negative relationship. However, this is likely to simply be due to chance.

Figure 4-6: Bloomberg MRP vs airport asset beta (10-years to June 2022)

137. If I rank all airports by their Bloomberg MRP (averaged from 2014 to 2022) and gradually exclude the airports in countries with the highest MRPs I derive the line in Figure 4-7 below.

[28] For Malta, Serbia, and Vietnam, the MRPs are gathered manually using the Bloomberg EQRP function. The value reported for each year are based on the value reported on December 31st.

Figure 4-7: Sample average asset beta as high MRP countries are excluded



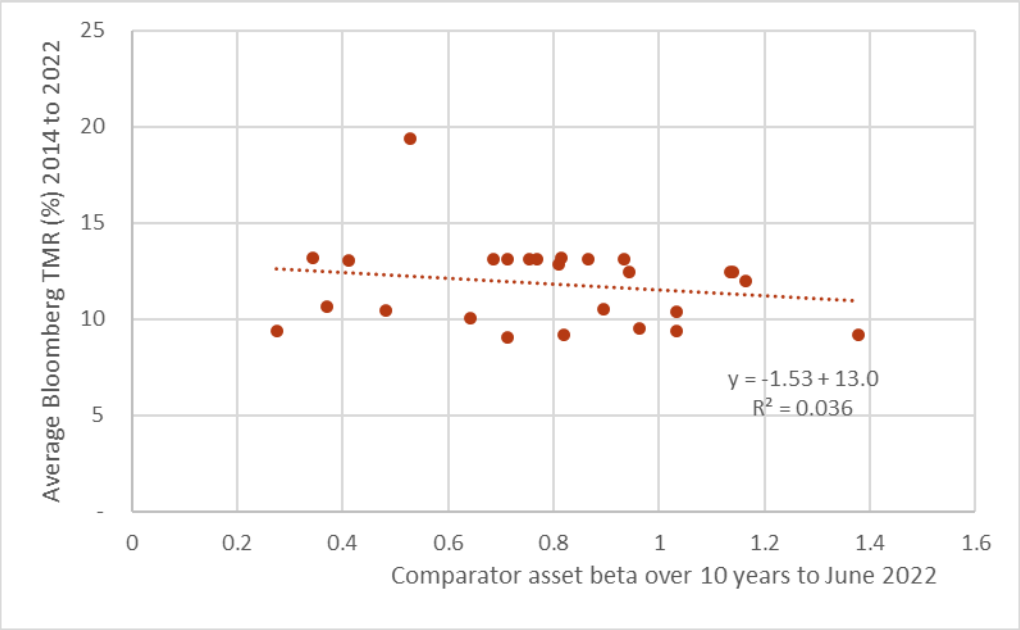
Source: Bloomberg and CEG analysis

138. Consistent with the negative relationship in Figure 4-6, there is a generally positive slope in Figure 4-7. That is, as airports operating in countries with high MRP are removed from the sample the sample average increases. Based on this measure of MRP any attempt to only include countries similar to New Zealand would lead to a material increase in asset beta.

139. Part of what is driving this result is that Bloomberg is estimating high market returns in many Eurozone countries and these countries have very low risk-free rates – leading to these countries (which typically have low asset beta estimates) having high MRP estimates.

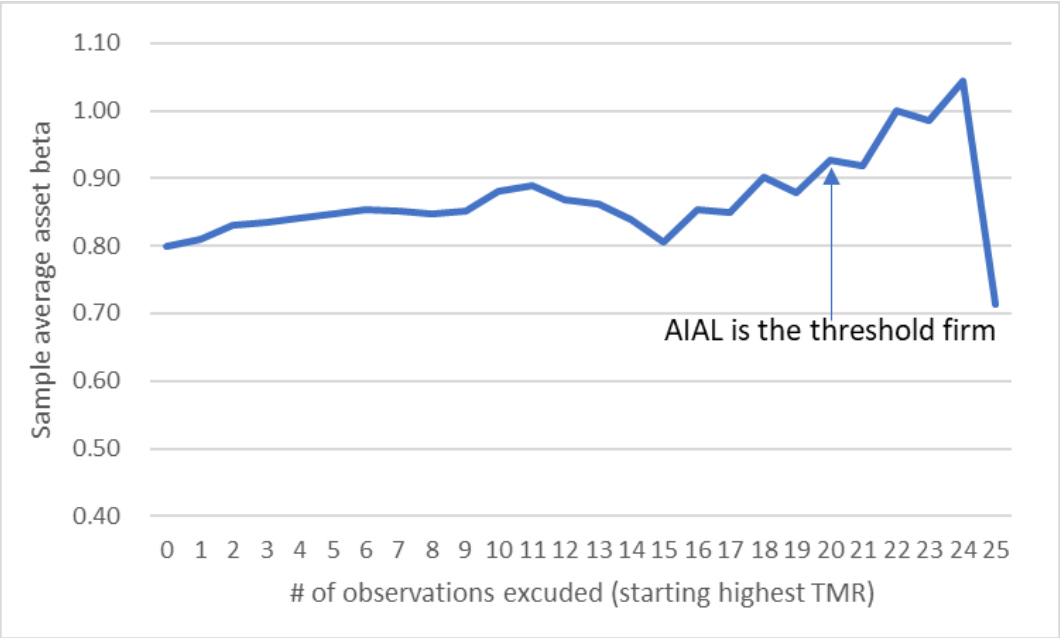
140. If, instead of using MRP I use the Bloomberg estimate of the total market return (TMR) in each country (again averaged from 2014 to 2022) then I derive the following relationship between asset betas and TMR. In this case there is no relationship between TMR and asset beta.

Figure 4-8: Bloomberg TMR vs airport asset beta (10-years to June 2022)



141. If I once more rank all airports by their Bloomberg TMR and gradually exclude the airports in countries with the highest TMRs I derive the line in Figure 4-9 below.

Figure 4-9: Sample average asset beta as high TMR countries are excluded



Source: Bloomberg and CEG analysis

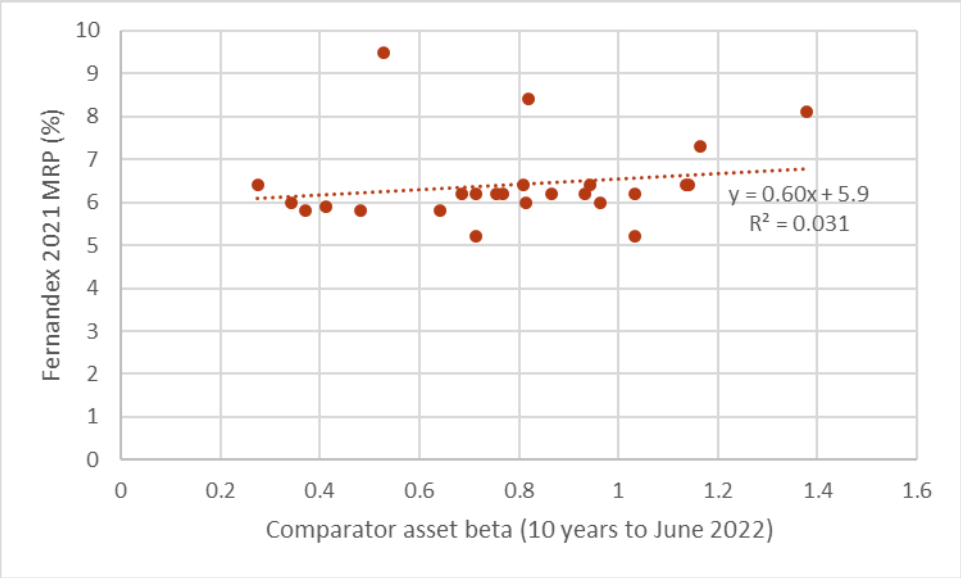
142. Of course, there are other measures of MRP that will yield different results. For example, the Fernandez survey of academics and practitioners is a source of MRP estimates in 2021 for all countries other than Malta.

Table 4-1Fernandez 2021 survey MRP

Country	MRP
Japan	5.2
Switzerland	5.2
Denmark	5.8
France	5.8
Germany	5.8
Austria	5.9
Italy	6.0
NZ	6.0
Malaysia	6.2
China	6.2
Spain	6.4
Australia	6.4
Mexico	6.4
Thailand	7.3
Serbia	8.1
Vietnam	8.4
Turkey	9.5

143. New Zealand's MRP estimate in this sample is 6.0% with Switzerland and Japan being the lowest MRP (5.2%) while Turkey is the highest (9.5%). Once more, there is no significant relationship between asset beta and this measure of MRP.

Figure 4-10: Fernandez 2021 MRP vs comparator asset betas (10-years to June 2022)



144. However, most MRP estimates are tightly bounded within 2.1% (5.2% to 7.3% MRP). If that was adopted at the criteria then only TAV (9.5%), Vietnam (8.4%) and Belgrade (8.1%) would be excluded. The average asset beta would hardly change from 0.79 to 0.78 (noting that Malta is excluded from the analysis because it has no survey MRP which is why the full sample average is not 0.80). If only airports with an MRP of between 5.2% and 6.4% are included then that also would drop Airports of Thailand and the average asset beta would fall to 0.76.

145. All this serves to illustrate the arbitrary nature of any analysis that seeks to form a sample based on country MRP estimates (or TMR estimates or any other measure of country risk).

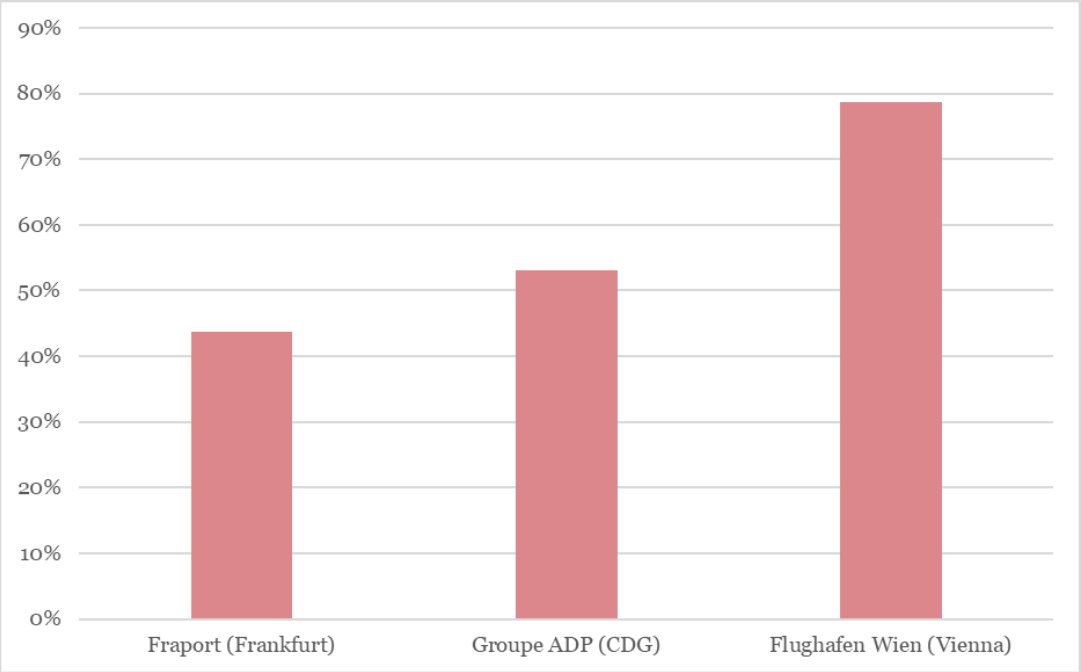
- There is no conceptually valid reason to assume that country risk affects equity beta risk (which is a measure of relative risk within an equity market and must average to 1.0 by definition no matter what the country risk).
- There is no obvious or consensus measurement of "country risk";
- There is no obvious of consensus definition of "substantially different to New Zealand".

146. Ultimately, there is no way in which inclusions or exclusions from the sample can be rigorously determined based on such analysis. To attempt to do so will invite gaming by parties submitting to the NZCC and the risk that investors perceive the regulatory environment as unpredictable.

4.3.3 Assigning a country MRP to international airports

147. All of the above illustrative analysis has been formed on the simplistic assumption that the "home" country MRP is assigned to airports that have operations across a large number of countries (such as AdP, Frankfurt and Vienna). Figure 4-11 shows the share of home country ("domestic") passengers in total group passengers for these airports.

Figure 4-11: Domestic share of group total passengers numbers



Source: Collected from Fraport, Groupe ADP and Flughafen Wien 2018 annual reports. Passenger numbers are based on the year 2018 and adjusted based on group ownership percentage of individual airports.

148. It is far from obvious that allocating Fraport and AdP groups the MRP of Germany and France respectively would be appropriate given that, even in 2018, German and French operations accounted for less than half of the combined passengers of the groups.

149. AdP's practice and stated business strategy is to grow by investing in a range of other airport companies. Since 2018 AdP has acquired stakes in a number of airport companies including GMR Airports and its current holdings include:

- TAV (Turkey);
- GMR Airports (India);
- Royal Schiphol Group (Netherlands);
- AIG (Jordan);
- Liège Airport (Belgium);

- SNCP (Chile);
- MZLZ (Croatia);
- Société Guinéenne (Guinea);
- Matar (Saudi Arabia);
- ATOL (Republic of Mauritius); and
- Ravinala Airports (Madagascar).

150. Fraport is similarly, diversified across countries (with interests of over 50% in Slovenia (1), Brazil (2), Greece (14) Bulgaria (2) Peru (1) Turkey (1) and interest of less than 50% of airports in China, India and Russia.[29] Vienna Airport owns stakes in Malta and Košice airport. In 2021 these airports accounted for 21% of total passenger volume accounted for an on equity basis.

151. This creates another source of complexity created by any attempt to include and exclude airports based on country MRP estimates.

4.4 Shrinking the sample makes the ultimate estimate less reliable not more reliable

152. As emphasised already, and illustrated by Vienna and Copenhagen Airports, empirically estimated asset betas are by their very nature "noisy". Using a large sample will allow the noise in these individual empirically estimated asset betas to cancel out, giving a more reliable estimate of the true average asset beta for the sample. Using a small sample means this noise is less likely to cancel out.

153. That is why I consider that the NZCC 2016 IM methodology of adopting a large sample is best practice. A large sample ensures that the sample average that is being used is less affected by noise in the empirical beta estimation (as a proxy for the comparator's true asset betas). If there was good reason, based on a robust relative risk assessment, to believe that the regulated airport in question had risk that was different to the large sample average then some departure from the large sample average might be contemplated. However, that departure should be achieved by adding or subtracting from the large sample average – not by removing comparators from the large sample average.

154. For the same reasons, it is also important to have a geographically diverse set of comparators because noise in the empirically estimated asset betas will often be geographically correlated. Different geographies are subject to different economic shocks at different times (e.g., European airport stocks were most affected (and asset

[29] Fraport 2018 annual report, page 55.

betas likely depressed)[30] by the financial turmoil surrounding the financial crisis of 2008-09 and the subsequent Eurozone crisis.

155. Focussing on one, or a limited, geography will increase the variance of the estimates because there will be a lack of diversity in the shocks being captured. These considerations point to the value of the NZCC sample having a diversified set of airports from many countries in order to maximise the effective diversity of economic shocks being analysed. Including airports from a large number of jurisdictions reduces the likelihood that our asset beta estimate is unduly influenced by specific shocks that were peculiar to a narrow set of economies during the estimation period.

156. Consistent with this logic, the NZCC 2016 IM methodology does not base its estimate of the true asset beta for Auckland Airport solely, or even primarily, on the empirically estimated asset beta for Auckland Airport. [31]

> *"Auckland Airport has provided information on its observed asset beta which indicates its asset beta is higher than what it was estimated to be by our comparator sample, and that the asset beta is increasing. Nonetheless, we do not consider this information can, by itself, justify a departure from our mid-point WACC estimate. In our view, asset beta estimates for a single company and over a limited period of time are not sufficiently reliable."*

157. This is true even though, by definition, Auckland Airport has exactly the same risk as Auckland Airport. If the task were to identify the single closest comparator in terms of risk relative to Auckland Airport and adopt that as the primary comparator then the NZCC would, obviously, have adopted Auckland Airport as the primary comparator. The NZCC did not do so for precisely the reasons that I have set out above. This approach would be unsafe and unreliable because every empirically estimated asset beta is a noisy estimate of the true asset beta for that comparator. Rather, the NZCC gave Auckland Airport's empirically estimated asset beta the same

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30 During the Eurozone crisis, the Eurozone/European sovereign debt crisis (with the threatened exist of Greece Spain and Portugal from the Eurozone "Grexit") financial sector shocks spread throughout the economy as financial institutions, threatened by insolvency, found it difficult to maintain prior levels of lending. However, the effect was largest in the finance sector and this acted to raise the measured equity betas for financial institutions and depress measured equity betas for other industries on average. While global in its impact, these shocks were most strongly felt in the US and Europe whose banking systems were placed under the greatest strain.

3 Consistent with this, the Western European airports tend to have lower than sample average asset betas when estimated over this period. One might be tempted to conclude that this suggests that the Western European airports have lower than average risk. However, an equally plausible explanation of this is that systemic shocks that hit Western European economies and equity markets over this period were dominated by financial shocks and this depressed the betas of non-financial stocks.

31 NZCC, Review of Auckland International Airport's pricing decisions and expected performance (July 2017 –June 2022) Final report –Summary and analysis under section 53B(2) of the Commerce Act 1986, 1 November 2018, p. 8.

weight in its analysis as every other one of its comparators (one 26th weight in the 2016 IMs).

158. The ACCC, when it was regulating airports, also relied on advice from Dr Lally that is consistent with my views (and past NZCC 2016 IM practice). [32]

> *A further complication is that selecting a **single entity's** beta as the appropriate beta is **highly problematic** from a statistical point of view. Lally states that,*
>
> > *…**estimates from a single company are subject to considerable statistical error.** A typical standard error is about 0.20 so that the 95 per cent confidence interval would be about +0.4. **So an average company with an estimated beta of 1.0 will have a 95 per cent confidence interval ranging from 0.6 to 1.4**.[355]*
>
> *Therefore, even for listed companies, it can be argued that the use of comparisons is still of benefit, as a form of reality check on the point estimate.*
>
> *Thus, the method of taking one or just a few beta observations as the basis for an asset beta is considered by some experts to give rise to inaccurate and unrepresentative beta estimates.*
>
> 355. *Lally, M., The cost of equity capital and its estimation, Vol. 3 McGraw-Hill series in Advanced Finance, 2000,*

159. Here the ACCC is giving voice to the critical issue of the noise in empirically estimated asset betas and the fact that any one empirically estimated asset beta is an unreliable estimate of the true asset beta for that company. The ACCC quotes Dr Lally suggesting a wide range (± 0.40) for the true beta relative to any single empirical estimate of a company's beta.

160. In the middle passage the ACCC states that, even if the regulated entity were itself listed, it would be sensible to have regard to other comparators' empirically estimated asset betas precisely because the regulated company's own empirically estimated asset beta is an unreliable estimate of the regulated company's true asset beta.

32 ACCC (May 01), Sydney Airports Cooperation, Aeronautical Pricing Proposal, Decision at p.188.

4.5 If the NZCC now rejects the benefits of a large and diverse sample, why not give primary weight to AIAL's asset beta?

161. For the reasons set out above, I consider that it would be a mistake to solely, or even predominantly, rely on the asset beta estimate for AIAL. However, if the NZCC now rejects that reasoning and is seeking to find comparators that are most similar to NZ Airports, it is difficult to understand why such a change would not result in a methodology that gave primary weight to AIAL's estimated asset beta.

5 Airport specific proposed methodological changes

162. The NZCC cover letter to the CEPA report might reasonably be interpreted as countenancing a number of methodological changes that would apply only to airports and not to estimates for asset beta in other industries.

> *4. In relation to our calculation of asset beta, at the last review we focussed on asset betas from the two most recent five-year periods (2006-2011 and 2011-2016); however, we also had regard to earlier periods. The economic consequences of COVID have resulted in* ***an increase in asset betas for airport services****, as indicated in CEPA's calculation of the average asset beta for the 2020-22 period compared to the average asset beta for the periods 2012-2017 and 2017-2022.* ***We are considering whether we should use a term for airports that is either longer or shorter than the last two five-year periods****.* ***For energy****, CEPA's findings indicate there* ***does not appear to be a need to vary the sampling timing*** *we used last time; however, we welcome views on this.*
>
> *…*
>
> *8. We are also considering whether* ***some airport companies*** *identified by CEPA should be excluded from the comparator sample on the basis that the markets in which they operate are substantially different to the New Zealand market. For example, we are considering whether we should exclude companies from countries that have a market risk premium that is substantially different to the market risk premium for New Zealand. We are also considering whether we should exclude companies that have a large variance in estimates based on daily, weekly and four-weekly data. We are concerned that companies that do not have a stable estimate of asset beta may not be suitable comparators.*

163. Paragraph 4 from the above passage appears to be explicit in expressing the view that only the estimation window for airports should be altered and that this is only desirable due to a rise in estimated airport asset betas due to COVID-19.

    - Paragraph 8 is less explicit that the potential changes are proposed in response to higher estimated asset betas but, in the context of paragraph 4, it might still be reasonable to infer that is the case.

164. Either way, I consider that it would be poor regulatory practice to adopt a separate methodology for estimating asset beta for airports than for the energy sector. This is especially the case if the selective change in methodology is, or is seen to be, driven by an increase in the measured asset beta of the affected sector. This could be

expected to have adverse outcomes associated with an unpredictable regulatory environment and may impact investor confidence and the regulated entities' confidence to make critical infrastructure investments.

Appendix A Basis for aeronautical vs non-aeronautical revenues

165. As a rule, airports' financial statements are generally fairly clear about distinguishing aeronautical versus non-aeronautical revenues in their segment analysis.

166. One exception to this rule is airport companies, such as AdP that report aeronautical and non-aeronautical revenues only for their domestic operations and then report "international revenues" as its own segment; where "international revenues" captures both aeronautical and non-aeronautical revenues derived from international operations. In this situation we have relied only on the domestic segment. For example, AdP's 2021 percentage of revenues that are aeronautical (50.1%) is calculated as revenues from the Aviation segment that relates only to Paris airports (€ 1.028bn) divided by total 2021 revenues (€ 2.777bn) less revenues from "international and airports developments" in 2021 (€ 0.726bn).

167. I note that airports are on different reporting schedules. This means that, for example, "2020" revenues might relate to the 12 months ending March, June, September, or December 2020. This should be kept in mind especially when attempting to interpret the impact of COVID-19 on any measures.

168. Airports where I have amended segment information to arrive at Aeronautical revenues are as follows:

- JAT where I have exclude the "Rent" component from the Facilities Management segment; and
- Toscana, where I have removed "network development expenses" from reported "aviation" revenues (noting that "network development expenses" are essentially volume discounts of the list price for aviation services).

Appendix B There is no workable alternative method that could accurately adjust asset beta for COVID-19 or other economic shocks

169. I first describe the kind of simplistic logic and assumptions that underpin an approach that attempts to adjust asset betas to remove some of the impact of the pandemic.

    a. Let $\beta^{No\ pandemic}$ be the underlying asset beta estimated in an estimation window without a pandemic.

    b. Let the existence of a pandemic in an estimation window raise the asset beta by "α" such that $\beta_{Raw}^{With\ pandemc} = \beta^{No\ pandemic} + \alpha$.

    c. Let "γ" (where 0<"γ" <1) be the frequency/probability of a pandemic like COVID-19 occurring in any given 5-year estimation window.

170. With these assumptions in hand, an investor who does not know in advance whether a pandemic will occur during their investment horizon will demand compensation based on the probability weighted average of the with/without pandemic asset betas - with the weights being γ/(1-γ) respectively. In that case, the probability adjusted asset beta will be given by:

$$\beta_{Adjusted}^{Probability} = \beta^{No\ pandemic} + \alpha \times \gamma$$

171. Note that this "add on" to the asset beta of "α×γ" needs to be applied to all estimates derived from estimation windows that do not include a "COVID-19 like pandemic". For example, if such an adjustment was applied in PSE4, then "α×γ" would need to be added to the asset beta estimate derived from the 5-year estimation window ending June 2017. (This would, naturally, partly offset the "α×(1-γ)" deduction from the 5-year estimation window ending June 2022.) Similarly, all future 5-year estimation windows in all future updates would need the same "α×γ" uplift – unless they happened to have a "COVID-19 like pandemic" in them.

172. In order for an alternative to my proposed method to be accurate (which requires that it gives the same answer as my method on average over time), the alternative method needs to accurately estimate the frequency of pandemic events (i.e., needs an accurate estimate of "γ"). If the alternative method underestimates the true frequency then the method will apply too large/small a deduction/uplift to the COVID-19 affected/unaffected asset betas. That is, the average asset beta over repeated

applications of the alternative method will be too low if "γ" is underestimated and too high if "γ" is overestimated.

173. TDB underlines the difficulty of estimating "γ" accurately when they state:[33]

> *"We note too that while the future scale and nature of pandemics is unknown, the risk of pandemics is not a surprise."*

174. I would add that the future frequency and scale of pandemics not only "unknown" but it is also "unknowable".

175. This is a fundamental reason why I consider pursuing an alternative method is problematic. When an adjustment requires an estimate of an unknowable variable that adjustment should not be pursued unless it is absolutely required in order to correct a known bias.

176. However, in the current case, there is no bias in my proposed methodology because that methodology will, on average and over time, accurately reflect and compensate for the scale and frequency of all shocks. An alternative method adjustment can only achieve the same result if the estimate of the unknowable variables "α" and "γ" are perfectly accurate. If not, as will invariably be the case, the alternative method adjustment will result in a biased estimate of asset beta on average over time.

177. Moreover, any bias associated with a misestimate "γ" is likely to be compounded by a misestimate of the impact of COVID-19 in the current estimation window (a misestimate of "α"). Disentangling the impact of COVID-19 from other factors affecting asset beta in the current estimation window is extremely contentious.

178. However, the key issue is that any attempt to estimate "α" would be an extremely contentious issue. One would need to identify, at a minimum:

    a. When the impact started;

    b. When the impact ended; and

    c. How the intensity of the impact varied over the relevant period?

179. By way of illustration, the large and steep decline in equity market valuations in mid-February 2020 (associated with an around 20% fall for the NZSX 50) is probably the easiest to identify direct impact of COVID-19. However, this was short lived, with most of the fall regained by early April and all of it regained by the end of 2020. It is far from clear when one should assume the impact of COVID-19 has ended (or, indeed, if it has at all). Moreover, one should surely assume that the impact of COVID-19 on data points in February and March 2020 was significantly greater than in any subsequent period.

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33 TDB Advisory Ltd, Process and Issues and Draft Framework Papers, May 2022 P. 4.

B.1 Applying an adjustment only after the first pandemic is NPV biased

180. A further critical problem is that, even if "α" and "γ" were estimated accurately, starting this series of adjustments only once COVID-19 has happened is not NPV neutral. As explained above, the logic for the adjustment requires that α×γ is added to the asset beta estimated in all periods not affected by a pandemic and that α×(1-γ) be removed from all periods that are affected by a pandemic.

181. If these adjustments are applied systematically to all periods and if the timing of each decrement/increment is random (randomly occurring consistent with the assumed frequency "γ") then this approach is NPV neutral. For example, imagine that "γ" implied that a pandemic was a one in fifty-year event. If that estimate was accurate, then the expected timing of the first pandemic would be roughly after 25-years and would be just as likely to happen in the second 25-year period as the first 25-year period.

182. This means that systematic application of increments and decrements would result in an expectation of 25-years' worth of small increments being applied before the first large decrement was applied. This would result in an expectation of NPV neutral adjustments – with no reason to believe that the large decrement will be applied earlier, on average, than the small decrements.

183. By contrast, the NPV compensation will be seriously biased downwards if one applies a zero pandemic increment to asset betas until a pandemic hits and, only then, begins the process of applying large decrement followed by small increments. Under this approach, a large decrement is applied in the first instance followed by a series of small increments. The average value of these may cancel out (if "α" and "γ" were estimated accurately) but the present value of these will be negative.

184. Such an approach would be the equivalent of a regulator:

- providing zero compensation for insurance against earthquake damage over multiple regulatory periods that did not include an earthquake;
- waiting until the first major earthquake hit and damage was incurred and then deciding that:
  - earthquakes are a rare occurrence, and it is inappropriate to provide compensation for the damage just caused by the earthquake; but
  - in recognition of the fact that another earthquake may occur in the future, the regulator will provide a self-insurance premium to cover the expected cost of future earthquakes.

185. Even if that self-insurance premium (α×γ) is perfectly accurately estimated it will only provide compensation for the expected cost of future earthquakes. It will leave

the regulated business completely uncompensated for the cost of the earthquake that just occurred.

186. In the context of pandemics, the NZCC provided no asset beta uplift in the 2011 and 2016 IM asset betas. Notwithstanding that these risks were well understood to exist the NZCC did not apply an uplift to the estimated asset betas in 2011 and 2016 to reflect this risk. (Noting that this risk was not reflected in the 2011 IM and 2016 IM asset betas because no pandemic of similar scale to COVID-19 occurred in the respective asset beta estimation windows).

187. Having chosen not to adjust asset betas for this risk in the past, it would be unreasonable to only begin a process of adjustment in the first instance when the adjustment would be negative (i.e., in the first period immediately after a pandemic had actually occurred).

188. Indeed, the logic set out in this appendix clearly demonstrates that, if any asset beta adjustments for pandemics were to be contemplated, it would need to:

- Make no adjustment in the 2023 IM to its method for estimating asset beta; but
- Signal that in all future IM's[34] that:
  - an uplift of "$\alpha \times \gamma$" will be applied if there is no pandemic in the estimation window; but
  - a decrement of "$\alpha \times (1-\gamma)$" will be applied if there is a pandemic in the estimation window.

189. Only if this approach was adopted could the present value of the adjustments be expected to be NPV neutral (even if α and γ were estimated accurately). Of course, for the reasons set out above and below I do not recommend attempting any adjustment is appropriate.

B.2 Any reasonable estimate of "γ" is currently elevated above its long term average

190. I am not an expert on the course of pandemics. However, as a lay person it appears reasonable to believe that the near term probability of "pandemic" events is higher than the long-term average. That is, it seems reasonable to assume that consumer and/or public health reactions to changes in the state of the current pandemic are elevated relative to any estimate of the long term average probability of pandemic related events.

[34] Strictly speaking, in all future IM's using an estimation window that begins after March 2023.

191. Put simply, attempting to estimate an asset beta with a "long term average" pandemic risk while the COVID-19 pandemic is ongoing appears to be, on its face, unreasonable.

B.3 The logic does not stop at pandemics

192. The logic for a pandemic adjustment is not peculiar to pandemics. If applied to a pandemic then it invites application to all large infrequent systematic shocks. For example, the following are examples of large systematic shocks of a kind that are also infrequent/unpredictable:

    i. The war in Ukraine, and subsequent sanctions on Russia, is affecting global energy markets and global inflation and interest rates.

    ii. The global financial crisis of 2008-09 and the subsequent Eurozone debt crisis of extending out to at least 2015 represented a large systemic shock;

    iii. The decades long industrialisation of China, and associated reduction in global manufacturing costs and a global excess of savings, has had profound impacts on the structure of the world economy but which cannot be expected to be repeated in the future.[35]

    iv. Etc.

193. In fact, any given 5-year estimation window for asset beta will be made up of a combination of shocks that are unlikely to reflect the "average" set of expected shocks. For example, New Zealand inflation is, at the time of writing, at a 32 year high of 7.2% pa.[36] This is, by definition, a shock that is not expected to be repeated every 5-years. Therefore, the same logical case could be made for attempting to adjust measured asset betas that include this year in order to remove the effect of a 1-in-32 year record high inflation. However, going down such a path would make the IM's unworkable – as is discussed further below.

B.4 Unworkable complexity

194. Much of the previous discussion was centred around a stylised mathematical description of the problem – as set out in paragraph 169 above. This was useful in order to clearly describe some the issues and problems associated with making an alternative method adjustment. Even within that stylised mathematical framework it could be shown that there would be fundamental problems with estimating the

35 Chinese GDP per capita grew at 10% pa from 1992 to 2012 inclusive and 6% pa for the next 10 years. Data from the World Bank (GDP per capita growth (annual %)).

36 https://www.stats.govt.nz/news/annual-inflation-at-7-3-percent-32-year-high

relevant parameters ("α" and "γ") and in implementing the adjustment in an NPV neutral way.

195. The simplicity of that framework was useful for illustrating these issues clearly. However, that simplicity also elided over fundamental complexities that would be created by any attempt to actually implement alternative method on an ongoing basis (e.g., at future PSEs).

196. To illustrate these complexities, imagine that a determination on "α" and "γ" was made in the context of PSE4. Consistent with the mathematical logic of the adjustment set out in paragraph170, the analyst would need to:

- Remove α×(1-γ) from the asset beta estimated using 5-years of data ending June 2022 and all future periods affected by a "COVID-19 like pandemic";
- Commit to add α×γ to all future asset beta estimates that are not affected by a "COVID-19 like pandemic" (as well as the estimate for the 5-years ending June 2017).

197. "COVID-19 like pandemic" is easy to say in the above dot points but is, of course, something that is unlikely to be possible to meaningfully implement in the real world.

198. For example, imagine that in any future update there has been a new "pandemic lite" (or, indeed, a "flare up" of COVID-19)[37] but which has a different assessed severity to the original COVID-19 shock. For example, an event somewhere between "swine flu" and the original COVID-19. In that context, logically the NZCC would need to:

- create a new category of "pandemic lite" event and assign to it values of $\propto_{lite}$ and γ_{lite}.
- remove the "pandemic lite" impact ($\propto_{lite} \times (1 - \gamma_{lite})$) and commit to add $\propto_{lite} \times \gamma_{lite}$ to all future asset beta estimates not affected by a "pandemic lite"
- add back the previously assessed COVID-19 increment (α×γ) necessary to arrive an asset beta that probability weights a "COVID-19 like pandemic" and "pandemic lite" pandemic.

199. Alternatively, there might be a pandemic that is assessed to have had a larger impact than COVID-19. The same issues would be created.

200. The point that is being made here is that the mathematical description of the adjustments required at paragraph170 relied on an implicit assumption that the impact of all future pandemics will be carbon copies of COVID-19. This allows us to arrive at the oversimplified policy solution:

37 For example, a new COVID-19 variant that causes changes in the pattern of passenger flights and more generally affects the New Zealand economy. However, for the sake of this hypothetical, let the impact be something like "half" the impact of the COVID-19 pandemic in 2020.

- Just remove $\alpha \times (1-\gamma)$ when there is a pandemic;
- Add $\alpha \times \gamma$ when there is no pandemic; and
- The adjustments will all wash-out in the long run (provided γ is accurately estimated) so that the correct pandemic risk is compensated in the long run.

201. But the real world will not be that simple. There will be future pandemics, but they will, likely, be very different in their impact than the COVID-19 pandemic. When they occur, they will require their own adjustments that are overlayed on the COVID-19 ongoing adjustment.

202. The above is far from a full imagining of the complexity and "pandora's box" that is opened up when attempting to remove or re-weight data in an attempt to reflect the stakeholder's views about the "true probability" certain events happening. It is my view that this sort of analysis will ultimately result in a regulatory quagmire – both now and in future IM updates. With no clear and transparent basis for making any adjustments, stakeholders will be incentivised to engage in what ultimately ends in a "data-mining" exercise – choosing:

    a. what events to classify as happening inconsistent with their expected future frequency (noting that events such as the global financial crises have at least as much claim to this as does COVID-19);
    b. what period to classify as affected by those events (and which sub periods of that period are most affected etc);
    c. how to estimate the magnitude of the impact of the event on the estimated asset betas;
    d. what probability to put on that event occurring in the future in order to "add back" the amount necessary to arrive at an appropriately weighted probability of "event X" asset beta; and
    e. how to keep track of the impact of future "event X" like occurrences in order to also remove the impact of those (so that the "add back" from the previous step does not result in overweighting of "event X" like occurrences).

203. A good way to test whether this is a sensible regulatory path to go down would be to imagine having applied the same approach to the global financial crisis. For example, imagine that, in the context of PSE2 and PSE3, it was determined that the global financial crisis was a large systemic shock that of the kind that is expected to occur relatively infrequently (e.g., once every 25-years) and was, therefore, over-represented in its then estimation period (covering April 2006 to March 2016 inclusive).

204. Had this been done in the past, it would be necessary to now, in 2022/23, to:

    a. Assess the extent to which a "financial crisis" type event was included in the current estimation period (June 2012 to June 2022). In doing so, it would have

to grapple with whether the dramatic fall in stock valuations in February 2020, which were especially large for banks, was a "financial crisis". It would also have to consider the extent to which the period 2013 to 2015, which included the eurozone crisis, was a "financial crisis";

b. Remove any impacts of "financial crisis" from the estimated asset beta for June 2017 to June 2022 in order to arrive at a "financial crisis free" asset beta estimate;

c. Add back the financial crisis increment/decrement that was estimated in PSE3 to arrive at an appropriately weighted probability of "financial crisis" asset beta; and

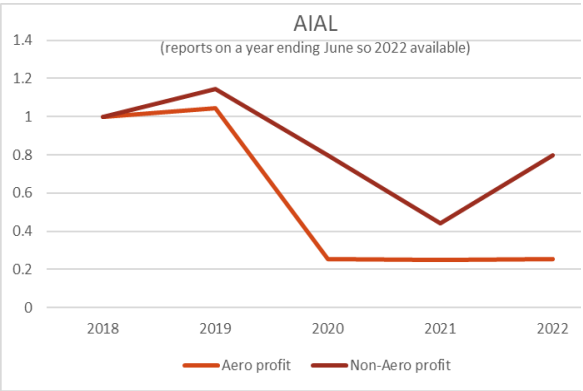
d. Grapple with the overlay of new COVID-19 adjustments.

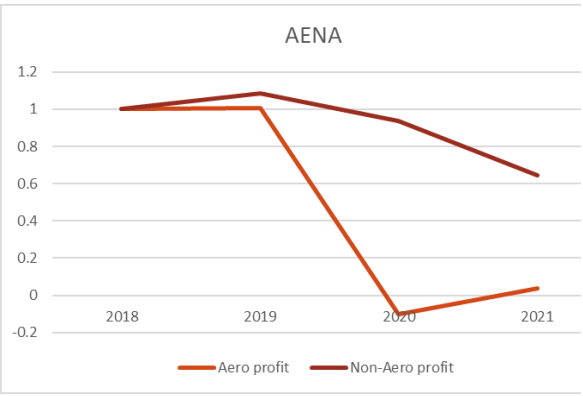
205. The more events that are adjusted for overtime the more complex the asset beta estimate will become. Ultimately, the asset beta estimate will comprise mainly of previously determined estimates of increments/decrements for certain events X, Y and Z added to an asset beta estimate that becomes ever more contentious as stakeholders argue over whether the new estimation period is affected by X, Y and Z like events and, if so, how the impact of those events should be removed.

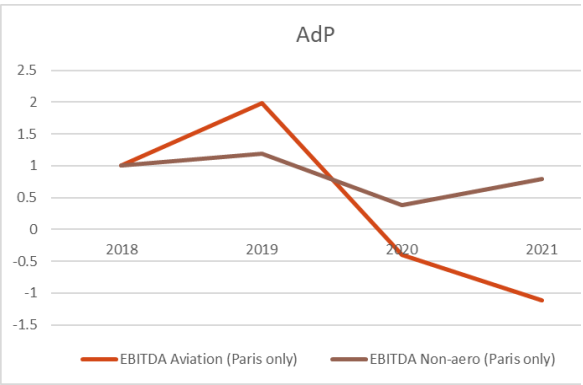
Appendix C Charts indexed to 2019 vs 2018

Figure 5-1: EBITDA time series for aero and non-aero (2018=1 vs 2019=1)

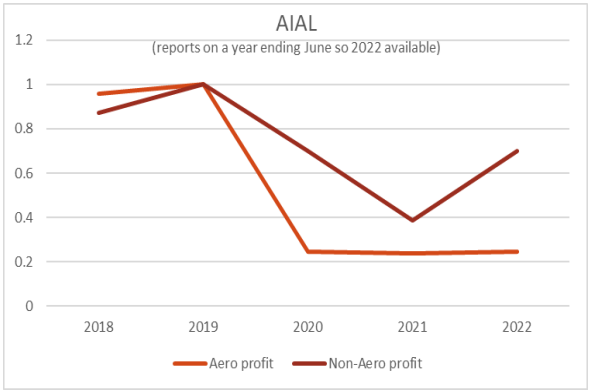
2018=1

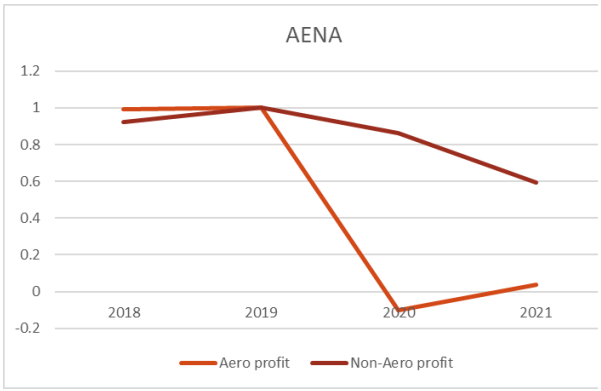


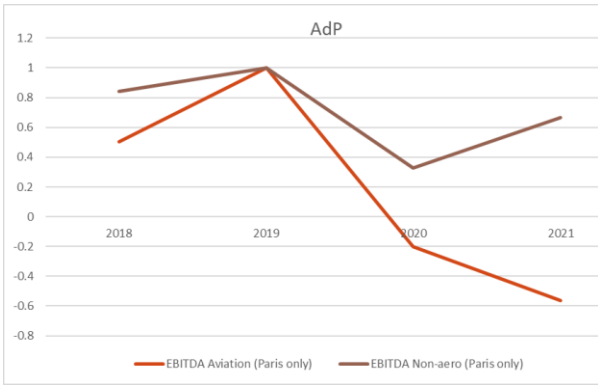




2019=1







Source: annual reports and CEG analysis. .

Figure 5-2: EBITDA time series for AdP's three segments (2018=1 vs 2019=1)

Source: annual reports and CEG analysis. .

Appendix D Curriculum Vitae

COMPETITION ECONOMISTS GROUP

Economics of competition, regulation and damages

Curriculum Vitae

Dr Tom Hird / Director

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Key Practice Areas

Tom Hird is a founding Director of CEG's Australian operations. CEG has been recognised by Global Competition Review (GCR) as one of the top 21 worldwide economics consultancies with focus on competition law. Tom has a Ph.D. in Economics from Monash University. Tom has also been named by GCR in its list of top individual competition economists globally. Tom's area of practice has a focus on financial economics both in regulatory settings and commercial strategy and commercial disputes.

Tom has given expert witness testimony to the Federal Court of Australia, the Australian Competition Tribunal, the Supreme Court of Victoria, and the Supreme Court of Western Australia in addition to numerous regulatory proceedings in Australia and New Zealand.

Selected recent assignments are set out below.

Selected recent projects

Ongoing retained by the Australian Energy Networks Association (ENA) since 2015 to be the industry expert collating and analysing cost of debt data incurred by all privately owned energy network businesses regulated by the Australian Energy Regulator.

2022 Retained by nbn to provide an expert report on the cost of capital.

2022 Retained by ATCO to provide an expert report on the costs of debt raising.

2022 Retained by APGA to provide an expert report on estimating the cost of equity for regulated businesses.

2022 Retained by nbn to provide advice on pricing structures.

2021 Retained by Jemena to advise on benchmarking of operating costs.

2021 Retained by various parties to provide advice in relation to the compensation for stranding risk for gas transport businesses.

2021 Retained by Aurizon to provide advice in relation to the appropriateness of moving from an on-the-day cost of debt allowance to a trailing average cost of debt allowance without transition.

2021 Retained by G+T to provide advice on how to assess economically efficient investment in the Port of Melbourne.

2021 Retained by DLA Piper to provide expert testimony on the cost of capital for Perth Airport in the context of legal proceedings by Perth Airport against QANTAS Airways and others.

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Dr Tom Hird / Director

2021	Retained by Vector to advise on the potential utility of funding itself with inflation indexed debt instruments and/or engaging in the inflation derivative markets to achieve similar exposure.
2020	Retained by Seven West Media and Nine Entertainment to advise on the value of news content used by Google and Facebook in the context of the News Media and Digital Platforms Mandatory Bargaining Code.
2020	Advice in relation to competition concerns raised by the ACCC about TVSN's proposed requirements for exclusivity with its suppliers. Retained by Gilbert + Tobin.
2020	Retained by the ENA to provide an expert report to the AER on the treatment of inflation when estimating a real WACC under the National Electricity Rules and National Gas Rules.
2020	Retained by the Australian Pipelines and Gas Association to assist with drafting a submission to the AER on estimation of the rate of return for regulated pipeline businesses.
2020	Retained by WaterNSW to provide an export report estimating the WACC for its water infrastructure business.
2020	Retained by Vector in New Zealand to provide an export report on estimating the WACC for its electricity and gas businesses.
2020	Advice to the Australian Gas Pipeline Association in relation to application of Rule 546(1) of the National Gas Rules in relation to valuation of gas pipelines.
2019	Advice in relation to Dalrymple Bay Coal Terminal's submission to the QCA's Declaration Review process. Retained by DLA Piper.
2019	Advice in relation to the competitive effects of a merger between building materials companies. Retained by Clayton Utz (Australia) and Chapman Tripp (New Zealand).
2019	Competition analysis of the Australian mortgage sector in the context of proposed regulation of mortgage broking commissions.
2019	Advice on the proposed merger between Malt suppliers Cargill and BBM. Retained by Gilbert and Tobin.
2019	Advice in relation to the impact of price transparency on competition.
2019	Advice in relation to a dispute between Esso and the Australian Tax Office in relation to the use of WACC in royalty calculations for stabilised crude oil and liquid petroleum gas. Retained by Allens-Linklater.
2019	Advice to a number of Australian and New Zealand businesses on the optimal design of the regulatory system for the treatment of inflation forecast errors (under the National Gas Rules and the National Electricity Rules in Australia and the New Zealand Input Methodologies).
2019	Advice to Vector on the implications of historically low nominal and real risk free rates on the design of the New Zealand regulatory "Input Methodologies" for electricity and gas distribution businesses.

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Dr Tom Hird / Director

2019	Advice on the quantification of 'timing benefits' in the AER's PTRM model. Retained by Jemena and SAPN separately.
2018	Expert report for Sydney Water in the context of the IPART review of its financeability test.
2018	Advice to Aurizon on the cost of capital and estimation of expected inflation.