Review of Oxera's Report, *Is a WACC uplift appropriate for UCLL and UBA?*

By Ingo Vogelsang, Boston University

June 29, 2015

I. Executive summary

(1) The New Zealand Commerce Commission (hereafter: the Commission) has asked me to peer review Oxera's report *Is a WACC uplift appropriate for UCLL and UBA?*, prepared for the New Zealand Commerce Commission, June 12, 2015 (hereafter: either Oxera or the Report).

(2) In adapting a methodology that it had developed for the Commission last year (Oxera, 2014) Oxera now assesses the expected costs and benefits of an uplift in the allowed WACC appropriate for UCLL and UBA and numerically derives optimal ranges for such an uplift.

(3) In contrast to Oxera (2014), which focused on network reliability, the current model addresses innovation incentives potentially created by a WACC uplift. Other than being substitutes these innovations do not directly concern the regulated activity and may be done by currently non-regulated firms, making the connection between WACC uplift and innovation less direct than for the case of network reliability. The theoretical literature suggests such a direct link for innovations by others but is ambiguous regarding innovations by the regulated incumbent. The latter holds in particular if, as in the current case, migration incentives are explicitly excluded. While there is no empirical literature referring to the case at hand, related papers suggest a positive innovation effect for incumbents from a WACC uplift.[1]

(4) Rather than assuming that the incentivized firm generates innovations that others do not generate Oxera assumes that a WACC uplift accelerates innovations that would come anyhow but would arrive later without such an uplift. This sensible assumption triggers Oxera's more problematic assumption that for an allowed WACC at the midpoint of the WACC distribution there will be no innovation acceleration at all. Besides that the TSLRIC measurement may under- or overestimate the costs relevant for innovation incentives there are probabilistic reasons discussed below why assuming no innovation acceleration for the midpoint WACC does not fit well into the Oxera (2014) framework.

(5) In measuring the costs to consumers of a WACC uplift Oxera makes several sensible simplifying assumptions. These costs for the old services result from applying the uplift to the firm's RAB and adding the value of the consumer welfare loss triangle from the

[1] Note that Oxera is not concerned with any contractual obligations by the New Zealand UFB providers that may yield innovations without a WACC uplift for UCLL and UBA.

resulting price increase, assuming a full cost pass-through at the retail level. Oxera then doubles the resulting number to account for the WACC uplift effect on the innovative new product. Since Oxera applies rounding to these numbers the resulting otherwise convex cost functions exhibit some concave regions.

(6) While Oxera starts out with four areas of innovations and a differentiation of "incremental" and "disruptive" innovations, which are following cycles of different lengths, Oxera ends up using only a single type of disruptive innovation with a single 20-year innovation cycle. This innovation is modeled on the broadband innovation that seems to be most appropriate in the current UCLL/UBA context and for which Oxera could provide empirically based benefit estimates and estimates for likely innovation acceleration. These simplifications cut through a lot of complexities and are probably necessary for a tractable analysis. Since Oxera views the applicable discount rate and the acceleration lag as particularly uncertain it does sensitivity runs for 5% and 10% discount rates and for 2-year and 5-year acceleration lags.

(7) In deviating from last year's approach, where the midpoint WACC yielded benefit probabilities based on the WACC probability distribution Oxera now assumes that at the midpoint WACC there is a zero probability of innovation acceleration. This strongly simplifying assumption triggers further deviations from a straightforward probabilistic approach to the WACC uplift effects on innovation benefits. Oxera now only uses the 50^{th} and 95^{th} percentiles and interpolates linearly in between. This purposely generates "wrong" probabilities for the in-between percentiles and can therefore only be seen as a rough approximation. Oxera's own numbers, illustrated in Figures 6.1 and 6.2 (on pp. 33 and 34) suggest that under the 2-year acceleration at most a very modest WACC uplift may be optimal, while under a 5-year acceleration a large uplift would dominate. In my view, these results are biased upward by the assumption that at the midpoint WACC there would be no acceleration at all.

(8) I tested this conjecture by essentially applying the Oxera (2014) approach to Oxera's current benefit and cost assumptions. The results are provided in Tables 1 and 2 below. They suggest that only for the high valuation under 5-year acceleration would WACC uplifts be optimal and that the advantages from such uplifts would be quite modest. At the same time, for all lower valuations (5-year lower value and both 2-year values) the midpoint WACC (or even lower) would be optimal.

(9) I can therefore back Oxera's conclusion that the evidence even for a modest WACC uplift is not strong.

II. **Review**

(10) In this report Oxera uses a very similar methodology to the one it had developed last year for assessing a potential WACC uplift for electricity and gas networks (Oxera, 2014). Many basic ingredients of the modeling approach are therefore known to the Commission and have already withstood some discussion in the New Zealand regulatory context. The current report is clearly laid out and provides a lot of valuable material not discussed in the following.

(11) The main difference between Oxera's 2014 model and the current approach is that the 2014 model was about investments by the regulated firm in its regulated network that would yield benefits in the form of increased network reliability. In contrast, the current model concerns investments in innovative new technologies that (a) other than being substitutes do not directly concern the regulated activities and (b) may actually be done by firms that are (currently) not regulated. As a result of these differences the connection between an uplift in the allowed WACC and the claimed benefits in the form of innovations is much less immediate than in the network reliability setting of last year's model. The connection between a WACC uplift and innovative investment in telecommunications also appears to be more speculative than the connection between a WACC uplift and reliability investment in electricity networks. Oxera (in Section 2.2) now uses adjectives such as "reasonable" or "plausible" to characterize the positive relationship between the allowed WACC and innovations or (in Section 6) says that there is "some link between … allowed WACC ... and pace and/or scale of investment" (p. 32) for the WACC-innovation connection. Oxera, however, does not provide any empirical basis to show such a connection.

(12) My critique of the CEG model adaptation of the Dobbs-Frontier model presented in this proceeding made clear that it is by no means easy to show that incumbents get increased innovation incentives for *new* services from an uplift in the allowed WACC for access regulation of *old* services (Vogelsang, 2015). It is much easier to show such a relationship between the regulated access charge for an old service and the innovation incentives of other firms for the new services. There is a small theoretical literature on those relationships that Oxera could use as a better starting point (reviewed in Briglauer, Frübing and Vogelsang, 2015). This literature is ambiguous w.r.t. incumbents' investments and fairly clearly positive w.r.t. other firms' investments. In particular, in a theoretical article Bourreau et al. (2012) distinguish between a replacement effect, a wholesale revenue effect and a migration effect. The replacement effect holds for innovations by other firms, who replace the old services of the incumbent. At higher access charges for the old service the incentives by other firms to replace the old service will be increased. In contrast, the wholesale revenue effect and the migration effects work in opposite directions. An increase in the wholesale access charge for the old service makes providing the old service more profitable relative to innovating in a new

service (wholesale revenue effect). At the same time the higher wholesale charge increases the price of the old service and therefore induces more consumers to migrate to the new service (migration effect). My conclusion from this is that Oxera would have to make a case (a) why the incumbent's situation in New Zealand might be such that the migration effect[2] dominates the wholesale revenue effect and (b) what "weight" prospective investments by other firms in New Zealand could possibly have. To the best of my knowledge there have been no empirical tests about the effect of the wholesale access charge on innovation investments. Closest to Oxera's conjecture come Jeanjean (2013) and Briglauer (2014), who show empirically that tighter regulation tends to reduce adoption of next generation access networks.[3]

(13) Oxera (in Section 1.2) makes a number of contextual assumptions that relieve Oxera from pursuing certain issues, but these assumptions should be kept in mind when assessing Oxera's results. One such assumption is that the TSLRIC and WACC measurements are outside Oxera's scope. This appears to have triggered Oxera's further assumption that at the 50th percentile the allowed WACC has zero effect on innovation incentives (p. 32). There are two issues with this. The first, as discussed below in paragraph 23, is that even at the 50th percentile the allowed WACC (with 50% probability) may substantially exceed the true WACC and therefore may provide innovation incentives. The second is that the measured TSLRIC may be above or below the costs relevant for the regulated firm's decisions. This could be because of the modeler's measurement decisions and/or because TSLRIC as such may not correctly reflect the firm's decision-relevant costs, for example, because it hardly invests in copper lines any more. Such differences between measured TSLRIC and decision-relevant costs are important for the Commission's determination about a potential WACC uplift, because such an uplift consciously deviates from the legally prescribed costs in order to achieve other legal goals, the LTBEU in particular. If, for example, the measured TSLRIC already contain an uplift compared to the firm's decision-relevant costs then this may already be enough if only a small uplift is called for.

(14) On p. 5 (Section 2.2) Oxera remarks that the allowed WACC can act as a signal to investors for the regulatory climate and regulatory commitment. Since this affects both the old and the new products, the innovation effect would be ambiguous for the incumbent and clear only for other firms. It should be noted that other firms would benefit from a higher allowed WACC for the old product if they fear they might get regulated. If they will not be regulated they might still benefit if their new products are substitutes for the old product.

[2] Migration has been considered separately in this proceeding in a paper by Cambini (2015) for the Commission.
[3] These authors measure adoption of rather than investment in UFB networks.

(15) Oxera's objective is to measure the costs and the benefits of an increase of the allowed WACC above the midpoint of the WACC distribution and then derive the net benefits (in terms of expected values). Oxera identifies here as costs the consumer surplus lost through price increases resulting from applying the WACC increase to the RAB for the old product (assuming a 100% pass-through of the wholesale price increase). These numbers are rounded to the closest 5 million NZ$ per year. Note that this rounding can have a significant effect on the net results obtained. Oxera then adds to this the (again rounded) area of the consumer deadweight loss triangle from the price increase. Last, Oxera assumes that the new product will have a similar asset base and therefore doubles the cost found for the old product to account for the cost effect of a WACC uplift for the innovation in the new product. The first two of these steps signify that Oxera uses a consumer welfare standard. The last step is a simplification that, in Oxera's view, overestimates the costs from the WACC increase for the new product. I agree with this last assessment but would like to point out a few subtleties not discussed in Oxera's report. First is the question whether the RAB for the old product continues, once the new product is introduced and for how long. One might assume some kind of economic depreciation, which makes the RAB of the old product endogenous to the innovation. Second, the RAB of the new product should only matter, once the innovation in the new product occurs. Thus, in the final analysis there should be a probability attached to it. Third, the consumer deadweight loss will depend on cross-elasticities between the two products. This last effect is likely to be small, since (given that the innovation is undertaken)[4] the WACC uplift is assumed to affect both prices, the old and the new.

(16) Oxera's approach to innovations is that an increased allowed WACC will not trigger innovations that otherwise would not happen but rather that the higher WACC will only accelerate innovations that would otherwise occur at a later time (p. 6). This appears to be a sensible approach. Oxera classifies past innovations by type of technology and by their property of being "incremental" or "disruptive". In table 4.1 (p. 20) Oxera lists 19 innovations in four technology areas, classifying six of them as disruptive. For its modeling exercise Oxera chooses to concentrate on disruptive innovations only, based largely on the argument that most incremental innovations are of a cost-saving nature and would be adopted at a similar speed with or without a WACC uplift. I agree that the literature shows (under the Arrow effect) cost-reducing innovations to be adopted quickly under TSLRIC regulation anyhow but I am less sure that the incremental innovations in Oxera's list are just of a cost-saving nature (e.g., digitized switching, 3G or 4G mobile or Wi-Fi).

(17) Oxera then determines the frequency of disruptive innovations for each technology type, coming up with an average of about 22 years (Table 4.1, p. 19). From here onward Oxera concentrates on fixed broadband technology and does not use the distinction of

[4] For potential pitfalls in assessing the effects of cross-elasticities see Dobbs (2015) and Vogelsang (2015).

technology types any more. This obviously simplifies the approach and makes it easier for the reader to follow the arguments but it takes away potential innovations and may bias the results.

(18) Such potential bias could come from Oxera's resulting assumption (p. 23) that a disruptive innovation would occur about every 20 years, which seems to have been derived from the 22 year average of Table 4.1. However, if one looks across technology types a disruptive innovation (under my rough calculation based on Table 4.1) would occur every 4.4 years. Even if one only concentrated on transmission technologies it would occur every 13.3 years. It is of course questionable if a WACC uplift would affect all technology areas but that should have been discussed. Oxera (p. 26) conjectures, however, that the length of the innovation cycle will not matter much because it has two effects. First, a shorter cycle means that the benefits of an innovation occur over a shorter time span, thus reducing the present value of such innovations. Second, a shorter timespan means that innovations occur more often, increasing the present value of all future innovations. To what extent these two effects cancel out has not been shown, though. As far as I can see Oxera currently only calculates the benefits and costs for a single innovation cycle. Doing more than one cycle would require assumptions about the perpetuation (or not) of innovation lags and thus could be quite complicated. There can also be leap-frogging. For example, some eastern European countries seem to have skipped DSL and moved directly to FTTH (Cave, 2014). It is therefore unclear if the restriction to a single innovation cycle reduces or increases the overall acceleration effects of an increase in the allowed WACC. In my view, the justification for modeling a long innovation cycle is purely pragmatic. With short cycles it would have been imperative to model a sequence of several cycles accompanied by the pitfalls just mentioned.

(19) A second potential bias from concentrating on a single technology is that its welfare contribution may differ from that of other technology innovations. For the broadband innovation as the chosen example data are available that can be used to assess the contribution to the LTBEU. This contribution is particularly large. Oxera provides some empirical literature on the net benefits from the broadband innovation. Not all of the cited papers are strictly empirical. For example, the paper by Crandall, Jackson and Singer cited as Criterion (2003) was purely an ex ante projection based on assumptions about elasticities, penetration rates, etc. These authors obviously used good judgment, since the results come close to those found later by Alcatel-Lucent (2011), but their results can hardly be used as an empirical reference.

(20) In Table 4.3 (p. 22) Oxera presents ADSL2+ adoption dates as the basis for an estimate of the acceleration in innovation achieved by a WACC uplift and states that the difference of 28 months between the earliest ADSL+ adopters and New Zealand would give a reasonable upper bound for the acceleration effect of a WACC uplift. On this

basis Oxera chooses a time period of two years for the assumed acceleration. Since at the time of ADSL+ introduction in 2007 New Zealand Telecom was under a different regulatory regime from now, it is not clear that the upper bound assumption is justified. However, the 28 months are already close to the maximum delay on the list of OECD countries in Table 4.3 so that the assumption of two years may be conservative. In light of the small sample size in Table 4.3 and in light of the possibility of more complex innovations Oxera adds a scenario with a 5-year acceleration of the innovation. The last number, in particular, looks very ad hoc and could be seen as a large upper bound. Oxera provides no information about possible reasons why other countries are leading New Zealand in their innovations. Is it because they grant higher regulated returns, or are there other reasons?

(21) Oxera then calculates the net benefits from an acceleration of an innovation with equal LTBEU effects as broadband based on a 20 year time horizon with 2- and 5-year acceleration and for 5% and 10% discount rates and converts those benefits into an annuity with a range of 150 to 550 million $ per year. Longer acceleration and higher discount rates (which increase the benefits of innovating early) lead to larger annuities. These benefits will have to be compared to the costs (as explained in paragraph 7 above). This is where probabilities come in. Similar to Oxera's approach in its 2014 report the probabilities of achieving the gross benefits are derived from the probabilities that the allowed WACC exceeds the true WACC by at least a certain margin. In Figure 5.3 (p. 30) Oxera illustrates the result of this calculation for margins of 0%, 0.5% and 1.0%. These calculations, however, are not used by Oxera in its assessment. The approach for calculating expected benefits would have been to multiply the probabilities with the benefit annuities, resulting in weighted benefits and then compare these to the costs of each level of WACC uplift.

(22) Rather Oxera derives the relevant innovation probabilities for its overall assessment by taking the raw probabilities at the 95th percentile for all three cases and connecting those with the origin for the 50th percentile. That way the case of 0% leeway gets a 95% probability of innovation acceleration, the case of 0.5% leeway gets 89% and the case of 1.0% leeway gets 80% probability. This suggests lower innovation incentives for the 1.0% case than for the 0.5% case and for the 0% case. What should matter, however, is the differential between the relevant probabilities at the 50th percentile and the 95th percentile (and actually for the values in between, because only the 0% case is linear). Here the 0% case has an increase from 50% to 95% probability, the 0.5% case an increase from about 32% to 89% and the 1.0% case an increase from about 18% to 80%. Now the 1.0% case appears to show the largest increase in incentive to innovate relative to the 0% case. However, as seen in paragraphs 17 and 18 below, the level of benefits and the value of raw probabilities also matter.

(23) A peculiarity of Oxera's overall assessment illustrated in Figures 6.1 and 6.2 (pp. 33 and 34) and Table 6.1 (p. 36) is the assumption (already mentioned above in paragraph 5) that at the 50% level of the WACC distribution there is no innovation acceleration incentive. This is meant largely as a simplifying assumption, but it has major drawbacks that, in my view, make it highly problematic. The main drawback is that it does not fit in the probabilistic framework that has been the real strength of Oxera (2014). According to the Oxera (2014) approach the reason why investment (or, in the current case, an acceleration of innovation) occurs is because the allowed WACC exceeds (by at least 0%, 0.5% or 1.0%) the firm's actual WACC. The assumption that at the midpoint of the measured WACC distribution there is no such acceleration (although there is a certain probability that the midpoint WACC is above the actual WACC) does not have such a neat interpretation. Rather, it appears deterministic and ad hoc. Furthermore, Oxera applies some form of probabilistic approach to allowed WACC values *above* the midpoint. Oxera does so only for the 95th percentile and then linearly interpolates between the midpoint and the 95th percentile. The 95th percentile is chosen as an extreme value, but it is essentially arbitrary. If we repeat this procedure with lower percentages then we find out that the lines become steeper and steeper as we approach the midpoint. That is because, under the assumption that there is no innovation acceleration at the midpoint, there is a discontinuity at the midpoint. If one moves ε above the midpoint the probability essentially moves from 0 to 50+% (for the case of 0% leeway for the innovation acceleration). Another way of looking at it is that, for example, we know that at the 55% of the WACC distribution the likelihood that the allowed WACC exceeds the actual WACC is 55% and not the 11% found in Oxera's Table 6.1 (p. 36).

(24) In my view, Oxera could have generated cleaner results by following its 2014 report to the Commission more closely. In that report investments are triggered by the actual WACC exceeding the allowed WACC (by 0%, 0.5% or 1.0%). Translated into the current framework innovation would be accelerated by the actual WACC exceeding the allowed WACC (by 0%, 0.5% or 1.0%). An allowed WACC at the midpoint level could then still be used as the starting point from which acceleration effects of higher allowed WACC percentiles could be measured. The effects would then be about incremental acceleration. This would also explain why the chosen innovation lag at the midpoint WACC is not equal to the maximum difference between the fastest innovating country and New Zealand.

(25) In Tables 1 and 2 below I have done this approach numerically for the case of a 5-year acceleration of the innovation and have otherwise used Oxera's numbers. The 5-year case is taken because it is the most extreme case and is most likely to generate an uplift at the optimum. Table 1 below repeats the first five columns of Oxera's Table 1, but adds a row for the 45 percentile of the WACC distribution and adds adjusted probabilities for the 0%, 0.5% and 1.0% cases in columns 6-8. Concentrating on the net

benefits columns shows that at high innovation benefits of 550 million NZ$ per year and a large 5-year acceleration of innovations an uplift could be beneficial and that the optimal uplift is larger if there is a hurdle rate above the actual WACC. As seen from Table 2, with a 0% hurdle rate the optimum would be in the 65% to 75% range, with a 0.5% hurdle rate in the 75% to 85% range and with a 1.0% hurdle in the 90% range. The ranges result because, while overall being convex, the cost function includes concave areas on account of rounding. Note that the net benefit curves are quite flat in all cases and that the 90% optimum for the case of a 1.0% hurdle looks almost like an outlier.

(26) **Table 1 Adapted summary of Oxera's analysis**

Step:	Measuring the direct costs, NZ$m		Defining potential annual benefits of innovation (not probability-weighted, NZ$m)		Measuring the benefit: what is the probability of the benefits being realised?		
Percentile	Existing asset base	New asset base	Two-year delay	Five-year delay	Based on Pr (allowed WACC > true WACC)	Based on Pr (allowed WACC > true WACC by more than 0.5%)	Based on Pr (allowed WACC > true WACC by more than 1%)
50%	0	0	150-250	300-550	50%	32%	18%
55%	10	10	150-250	300-550	55%	37%	21%
60%	25	25	150-250	300-550	60%	42%	25%
65%	35	35	150-250	300-550	65%	47%	29%
70%	50	50	150-250	300-550	70%	52%	34%
75%	60	60	150-250	300-550	75%	58%	40%
80%	80	80	150-250	300-550	80%	65%	46%
85%	100	100	150-250	300-550	85%	72%	54%
90%	120	120	150-250	300-550	90%	79%	64%
95%	160	160	150-250	300-550	95%	86%	76%
45%	**-10**	**-10**	**150-250**	**300-550**	**45%**	**28%**	**15%**

(27)

(28) Source: Partially adapted from Table 6.1 and Figure 5.3 of Oxera (2015).

(29) Turning to the case of lower innovation benefits of 300 million NZ$ per year but still a 5-year acceleration of innovations shows a very different picture. Now the midpoint is always superior to an uplift. In this case a reduction to the 45th percentile would generate even higher benefits and that holds for all three hurdle rates.[5] The reason is that the costs in general increase in a convex fashion and that is independent of the benefits, while the weighted benefits curves become flatter at lower benefit levels. It is easy to see that these results extrapolate to the cases of a 2-year acceleration, because here the gross benefits are either the same or smaller than the current cases. Thus, these results suggest that it takes very high expected innovation benefits to overcome the costs to consumers of a WACC uplift.

[5] Using a percentile below 50% may maximize net benefits from innovation acceleration but such a percentile is not advisable for many other reasons, for example, long-term regulatory commitment.

Table 2: Numerical example for net benefits: 5 year case

	Upper level of benefits: 550						Lower level of benefits: 300					
	0% case		0.5% case		1.0% case		0% case		0.5% case		1.0% case	
WACC percentile	Gross benefit	Net benefit	Gross benefit	Net benefit	Gross benefit	Net benefit	Gross benefit	Net benefit	Gross benefit	Net benefit	Gross benefit	Net benefit
45%	247.5	267.5	154	173.5	82.5	102.5	135	***155***	84	***104***	45	***65***
50%	275	275	176	176	99	99	150	150	96	96	54	54
55%	302.5	282.5	203.5	183.5	115.5	95.5	165	145	111	91	63	43
60%	330	280	231	181	137.5	87.5	180	130	126	76	75	25
65%	357.5	287.5	258.5	188.5	159.5	89.5	195	125	141	71	87	17
70%	385	285	286	186	187	87	210	110	156	56	102	2
75%	412.5	***292.5***	319	***199***	220	100	225	105	174	54	120	0
80%	440	280	357.5	197.5	253	93	240	80	195	35	138	-22
85%	467.5	267.5	396	196%	297	97	255	55	216	16	162	-38
90%	495	255	434.5	194.5	352	***112***	270	30	237	-3	192	-48
95%	522.5	202.5	473	152.5	418	98	285	-35	258	-62	228	-92

Source: Own calculations based on Table 1 above

(30) As in Oxera's 2014 report the current one postulates some relationships without further discussion. Most important in the current context is the assumption that a certain excess of the allowed WACC over the true WACC will trigger an innovation acceleration of two or five years. Given that this excess is achieved the acceleration occurs with probability one. This is assumed independent of the type of investor, the type of innovation and whether or not regulation will be imposed on the new technology. I can see that no satisfactory probabilities can be developed for such relationships. Nevertheless, the assumption is very strong and may therefore lead to excessive uplift recommendations. The sensitivities provided by using different WACC threshold levels, different acceleration times and different benefit levels are therefore helpful.

III. Conclusions

(31) Oxera provides an insightful quantitative analysis of the relationship between different levels of WACC uplift and the expected benefits and costs of such uplifts for consumers.

(32) The report is vague about the incentives for innovation associated with a WACC uplift. This void could at least partially be filled from the literature but the results from the literature may need some adjustment for the specifics of the New Zealand context. Whether the result will back the assumed strong relationships between WACC uplift and innovation acceleration remains doubtful.

(33) By choosing a 20-year cycle Oxera may underestimate the frequency of disruptive innovation but overestimate their potential value (by choosing a very valuable innovation as the basis for consumer welfare contributions).

(34) Although I do not agree with all points of Oxera's methodology, my estimates based on the Oxera (2014) approach come to very similar results. It therefore appears that for the most likely scenarios the 50^{th} percentile with no WACC uplift would be optimal.

IV. References

Alcatel-Lucent (2011), "Building the Benefits of Broadband: How New Zealand can increase the social & economic impacts of high-speed broadband".

Bourreau, M., Cambini, C., and P. Doğan (2012),"Access pricing, competition, and incentives to migrate from "old" to "new" technology", *International Journal of Industrial Organization* 30, pp. 713-723.

Briglauer, W. (2014), "The Impact of Regulation and Competition on the Migration from Old to New Communications Infrastructure: Recent Evidence from European Union Member States", *Journal of Regulatory Economics* 46, pp. 51-79, available at: http://ftp.zew.de/pub/zew-docs/dp/dp14085.pdf.

Briglauer, W., S. Frübing, and I. Vogelsang (2015), "The Impact of Alternative Public Policies on the Deployment of New Communications Infrastructure – A Survey", *Review of Network Economics*, forthcoming; an earlier version available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2567253.

Cambini, C. (2015): "Economics aspects of migration to fibre and potential welfare gains and losses from an uplift to copper prices", Paper prepared for the New Zealand Commerce Commission, March 16, 2015.

Criterion (2003), "The Effects of Ubiquitous Broadband Adoption on Investment, Jobs and the U.S. Economy", paper written by R.W. Crandall, C.L. Jackson, and H.J. Singer for Criterion Economics.

Cave, M. (2014), "The Ladder of Investment in Europe, in Retrospect and Prospect", *Telecommunications Policy* 38, pp. 674-683.

Dobbs, I.M. (2015), "Welfare effects of UCLL and UBA uplift: Comments on the Application of the Dobbs (2011) Model", Report to the New Zealand Commerce Commission, 29/05/2015.

Jeanjean, F. (2013), "Forecasting the Fiber Penetration According to the Copper Access Regulation", Working paper. SSRN. Available at: http://ssrn.com/abstract=2209693.

Oxera (2014), "Input Methodologies – Review of the '75th percentile' approach", Report prepared for the New Zealand Commerce Commission.

Vogelsang, I. (2015), "Reply to Comments on my November 25, 2014, paper 'Current academic thinking about how best to implement TSLRIC in pricing telecommunications network services and the implications for pricing UCLL in New Zealand'", prepared for the New Zealand Commerce Commission, June 23, 2015.