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Competitive effects of MVNOs and assessment of regulated MVNO access

Spark New Zealand

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Contents

1. Introduction and Summary

1. On 31 August 2018 the New Zealand Commerce Commission released an issues paper for its 2018 study into the New Zealand mobile market (the "Issues Paper").[1] In the issues paper it is noted that mobile virtual network operators ("MVNOs") are not a major feature of the New Zealand market, particularly compared with Europe.[2]
2. It has been suggested by some market participants that this low share/number of MVNOs in New Zealand is a problem, warranting consideration of regulatory invention to provide mandated MVNO access.[3]
3. A key difference between the mobile market and other markets where access regulation is typically considered (e.g., fixed broadband) is, of course, that there are multiple networks (e.g., in New Zealand there are three mobile network operators ("MNOs")) – the upstream input required to compete is not a natural monopoly.[4] Access regulation of markets characterized by multiple competing networks is not at all common, and would require, in our view, compelling evidence of a competition problem or market failure.
4. We have been asked by Spark New Zealand to address two questions:
   a) Does the limited number of MVNO agreements in New Zealand indicate a lack of competition that warrants access regulation?
   b) Would regulating MVNO access be likely to improve consumer outcomes/pass a cost-benefit test?
5. Regarding the first question:
   a) Wholesale agreements are not an end in and of themselves. To intervene at *wholesale* the Commission would need to identify that there is not workable competition between the three MNOs (and the existing MVNOs) at the *retail* level. If the downstream market is producing competitive outcomes, a regulatory intervention in the wholesale market to encourage competition in the downstream market would likely result in net costs.
   b) In a competitive market, a lack of MVNOs may simply indicate there are not many profitable niches for MVNOs to reach that are not already served by the MNOs.
   c) Particularly in a dynamic, repeated investment market like mobile, competition should be assessed by examining end consumer outcomes, rather than just a mechanical measurement of market structure (including the market share and number of MVNOs/MNOs).
   d) An assessment of outcomes in New Zealand implies the market is competitive.[5] This suggests that having multiple MVNOs is not a requirement for competitive outcomes.
   e) International evidence corroborates this – OECD prices have no statistically significant correlation with MVNO market shares or the number of independent MVNOs.

[1] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, 31 August 2018.

[2] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, figure 14 and par.125.

[3] See Vocus, *Mobile Market Study Scoping: Submission to the Commerce Commission*, 30 November 2017. NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, par.129 and Trustpower, *Promoting a vibrant mobile market in New Zealand*, 3 November 2015.

[4] However, it could be a "natural oligopoly", if the minimum efficient scale is such that only a small number of networks can efficiently operate concurrently.

[5] See our accompanying report titled, "Competition in the New Zealand Mobile Market", dated 26 October 2018.

f) This is not surprising, given:

i. MVNOs serve the purpose of acting as distribution channels for MNOs – the limited number of MVNOs in New Zealand could simply indicate they provide little incremental value to the competing MNOs, or have limited scope for success given the competitiveness of the market, rather than a competition problem; and

ii. MVNO access regulation can deter investment – we return to this below.

g) There is also no reason to believe that MNOs would not offer MVNOs competitive access terms. Because of the high fixed cost nature of their businesses, MNOs have an incentive to increase volumes on their networks, and if an MVNO would be better at winning that volume than the MNO would be, the MNO would want to deal with the MVNO. In a competitive market it would not be profitable for an MNO to offer a supra-competitive wholesale price to an MVNO, as that MVNO could take its prospective volumes to another MNO.

6. On the second question, because the retail market is competitive, the incremental benefits of regulatory intervention are likely to be small, meaning that even low regulatory costs could outweigh these benefits.

7. In a dynamic market characterised by repeated sunk investments, the potential costs of undermining investments by introducing regulation could be high. In effect, access regulation might achieve (at most) small efficiency gains ("lower prices today")[6] at the expense of large dynamic efficiency losses ("lower investment tomorrow").

8. With the impending transition to 5G, dynamic efficiency considerations are particularly important. While 5G has the potential to be transformative, the exact business case for it is currently unknown. The NZCC's discussion of network slicing and the role of firms like Google and Apple further illustrates the uncertainty surrounding the business model of MVNOs and MNOs going forwards.[7]

9. Accordingly, our answer to Spark's second question is, MVNO regulation in New Zealand would likely result in net detriments.

10. In the remainder of this report we:

a) Describe the MVNO model and the incentives for MNOs to provide access, including a review of the relevant literature (Section 2);

b) Briefly examine the relationship between benchmark performance data and MVNO market shares (also Section 2); and

c) Assess the costs and benefits of MVNO access regulation (Section 4).

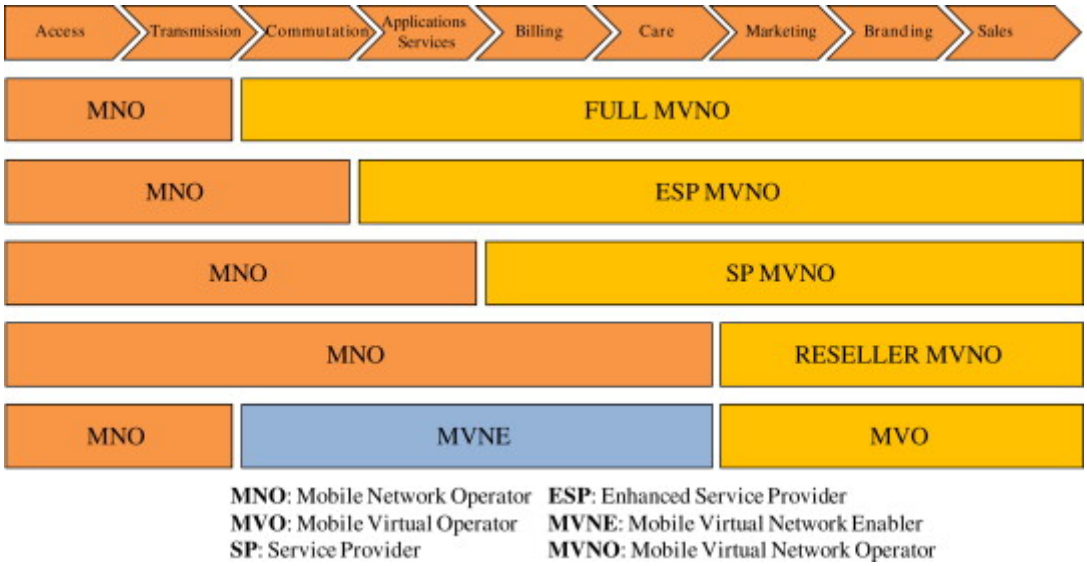
[6] We note that service innovation may also result from MVNO access, which could be considered a form of dynamic efficiency.

[7] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, pars. 240-247.

2. MVNO agreements

11. MVNO business models can take various forms, defined by the degree of control the MVNO has over the product. Or put another way, how far up the value chain the MVNO is. See Figure 1 below.

Figure 1
MVNO business models



Source: Nicoletta Corrocher and Laura Lasio (2013), "Diversification strategies in network-based services: The case of mobile virtual network operators", Telecommunications Policy, Volume 37, Issue 11.

12. In the issues paper the NZCC makes a similar distinction between "light MVNOs" and "full MVNOs".[8]

13. Given their reliance on a wholesale input from MNOs, to understand the impact that voluntary MVNO agreements have on competition, we first need to analyse an MNO's incentives to provide access.

14. An MNO in a competitive market would only provide access if it expected an MVNO arrangement to increase the MNO's profits. If an MNO faces competition from other MNOs, its incentives to do a deal with MVNOs that have a valuable business proposition would be strong, because if the approached MNO does not offer a deal, its rival MNOs might. In other words, cannibalisation (by providing access) would occur anyway, so the MNO is better off hosting the MVNO than having it on another MNO's network. For example, an MNO might consider that an MVNO would be better at targeting a certain customer segment than the MNO would be itself.[9]

15. If an MVNO doesn't offer a value proposition (i.e. it can't better target a customer segment than the existing MNOs), then it is unlikely to reach an agreement with any MNOs. There will be no concern about cannibalisation as the MNO will not consider that the MVNO will expand its own demand or be concerned that the MVNO will enable other MNOs to compete better.

16. The GSMA has identified eight different categories of MVNO, based on the segment they target:

[8] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, par.46.

Figure 2
GSMA MVNO segmentation

Source: GSMA intelligence (2015), The global MVNO footprint: a changing environment.

17. An MNO will always seek the most efficient or profitable distribution network, and in some circumstances, this might involve outsourcing the distribution to a MVNO.

18. The mutually beneficial nature of MVNO agreements has been examined by the theoretical MVNO literature:

    a) Brito & Pereira (2007) use a theoretical model and find the entry of an MVNO does not necessarily have a competitive effect on the provider MNO or a decrease in retail prices.[10]

    b) Banerjee & Dippon (2009) look at sufficient conditions for profit maximising for MNOs and MVNOs in strategic partnerships.[11] If MNOs voluntarily enter into partnerships with MVNOs, there must be some benefit to the MNO - the MVNO must add value for the MNO that resellers cannot. For instance, a company from another industry might create an MVNO and use its existing brand appeal to attract customers the MNO could not. The ability to differentiate products allows the MNO and MVNO to price discriminate to a degree unattainable to each provider alone.

    c) Kalmus and Wiethaus (2010) find, using a two stage Cournot model, that MNOs only host MVNOs if they do not cause a competitive constraint on the MNO.[12]

    d) Cricelli, Grimaldi, and Ghiron (2011) use a theoretical simulation competition model[13] to look at MVNO and MNO host relationships. They look at two different agreement pairings (the MVNO being hosted by the incumbent MNO or the 'follower' MNO),[14] and three different 'types' of relationships (competitive, hostile, and collaborative).[15] The study finds

[10] Duarte Brito and Pedro Pereira, 2010,"Access to Bottleneck Inputs under Oligopoly: A Prisoners' Dilemma?" Southern Economic Journal, Vol.76, No.3, 660–677.

[11] Aniruddha Banerjee and Christian M. Dippon, 2009 "Voluntary relationships among mobile network operators and mobile virtual network operators: An economic explanation" Information Economics and Policy, Volume 21, Issue 1, 72-84.

[12] Philip Kalmus, and Lars Wiethaus, 2010, "On the competitive effects of mobile virtual network operators", *Telecommunications Policy*, Volume 34, Issues 5–6, 262-269.

[13] Using three Italian MNOs to calculate the parameters.

[14] Where the MNOs are asymmetric, and the follower MNO has smaller market share and the incumbent MNO has larger market share when prices are equal. See: Carter, M., and Wright, J., 2003, "Asymmetric network interconnection", Review of Industrial Organization, 22(1), 27-46.

[15] Where these three relationships are defined by the interconnection charges between the MNO and MVNO, e.g., the collaborative relationship has low interconnection charges between the MNO and MVNO.

that an MVNO is best off being hosted by the incumbent MNO and establishing a collaborative relationship with that MNO, to compete against the other MNO.[16]

19. It is likely that an MNO will not see much benefit from having an MVNO if the MNO can compete effectively using its existing brands/channels or by creating sub-brands. Similarly, if there is competition between the MNOs and they are able to serve the various niches an MVNO would target (e.g., through sub-brands), the business case may not exist for an MVNO. That is to say, the relationship between an MVNO and MNO is symbiotic - the ability of an MVNO to provide a differentiated offer is the source of value to the MNO and the profit opportunity to the MVNO. In a competitive market, an MVNO that does not provide a differentiated offer or reach an untapped segment is unlikely to be successful.
20. An example of MNOs being able to reach different segments using sub-brands in New Zealand is Skinny, which is Spark's discount sub-brand. Figure 5 of the issues paper suggests that Skinny has had material impact in stemming market share loss for Spark, presumably by enabling it to better compete for price sensitive customers. Pre-paid and post-paid plans are also means of price discriminating and targeting different customer groups within a single "brand".
21. As another example, Optus has described its MVNO strategy in Australia as follows:[17]

    Like crackers and cheese, the relationship between an (sic) Mobile Network Operator (MNO) and a Mobile Virtual Network Operator (MVNO) should be just as complementary in order to compete in saturated markets and fast changing environments.

    …

    Our wholesale strategy is complementary because our name brand will never corner every market, but if we find partners that can, it is symbiotic – we get paid wholesale dues and the MVNOs leverage the capacity and networks investments from us.

22. Furthermore, 2degrees' late entry and initial targeting of pre-paid customers may have meant it had little need for MVNOs, as it was already targeting the customers which MVNOs might target. 2degrees has indicated that following the completion of its national mobile network, it is better placed to offer wholesale services (i.e. MVNO access).[18] It is not clear why 2degrees would turn away MVNOs who identify mutually profitable ways to compete against Spark and Vodafone.
23. The role of MVNOs as distributors of, rather than competitors to, host MNOs, is supported by the empirical literature:
    a) Garrido & Whalley (2013), in an empirical study using panel data from 2000 to 2010, look into the competition between MVNOs and their host MNOs.[19] The study looks at five different European countries (Belgium, Germany, The Netherlands, the UK and Spain) and shows that the wholesale market concentration has decreased over time as a result of an increase in competition between hosting MNOs. MVNOs become alternative sales channels for MNOs, focusing on differentiated services and do not directly compete with MNOs. Later MNO entrants to the market mitigated the incumbents' market power by hosting MVNOs.

[16] Livio Cricelli, Michele Grimaldi and Nathan Levialdi Ghiron, 2011, "The competition among mobile network operators in the telecommunication supply chain", International Journal of Production Economics, Volume 131, Issue 1

[17] See: https://yescrowd.optus.com.au/t5/Optus-Spark/MNO-and-MVNO-When-Great-Partnerships-Zing/ba-p/210062

[18] 2degrees, *Mobile Market Review – Issues for consideration*, 30 November 2017, p.1.

[19] Elisabet Garrido and Jason Whalley, 2013, "Competition in wholesale markets: Do MNOs compete to host MVNOs?" Telecommunications Policy, Volume 37, Issue 11, 1124-1141.

b) Corrocher & Lasio (2013) use case studies of Italy and France, analysing the entry process and competitive strategies of MVNOs.[20] At the time of the study, France had the highest number of MVNOs in Europe whereas Italy had a relatively low MVNO presence. Neither country has MVNO entry regulations. The research shows that the most successful MVNOs have the ability to find a match between the "core competencies in the sector of origin" (for example, brand recognition or network management) and specific needs of specific segments of the market to fulfil demand that had not previously been fulfilled. The authors also find that while some MVNOs have failed, overall, in relation to range of services offered and prices, customers can benefit from increased competition between the remaining MVNOs and MNOs; and

c) A NERA report by Attenborough, Dippon & Sorensen (2007) for the Israeli Ministry of Communications uses case studies for 13 different countries and concludes that in these countries MVNOs serve segments of the market underserved by the MNOs rather than directly competing with the MNOs.[21]

24. In conclusion:

a) An MNO will contract with an MVNO if that maximises the MNO's customer base and market share. Similarly, MVNOs will only be successful in a competitive market if they can add value relative to the existing MNO offerings. An MNO may decide that for certain customer segments it is more efficient for it to "in-house" its distribution and MVNOs may not seek to enter if they cannot identify profitable niches; and

b) Despite the relatively few MVNOs in New Zealand, the mobile market is competitive – this suggests that having multiple MVNOs is not a requirement for competitive outcomes.

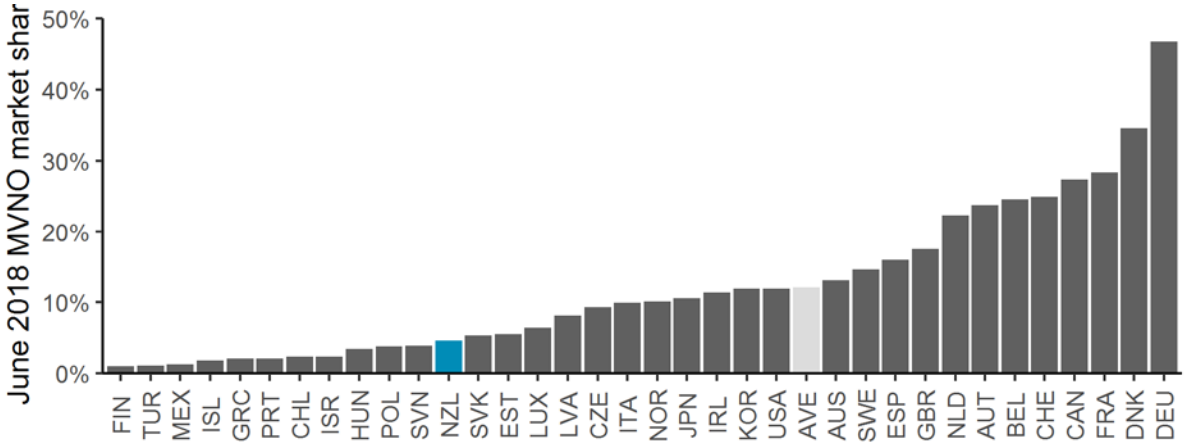
[20] Nicoletta Corrocher and Laura Lasio, 2013, "Diversification strategies in network-based services: The case of mobile virtual network operators", Telecommunications Policy, 37, no. 11, 1110-1123.

[21] Nigel Attenborough, Christian Dippon and Soren Sorensen, 2007, "Mobile virtual network operators (MVNOs) in Israel." Prepared for the State of Israel, Ministry of Communications and Ministry of Finance, August 2007

3. Factors besides MVNO penetration appear to be the main drivers of mobile market performance

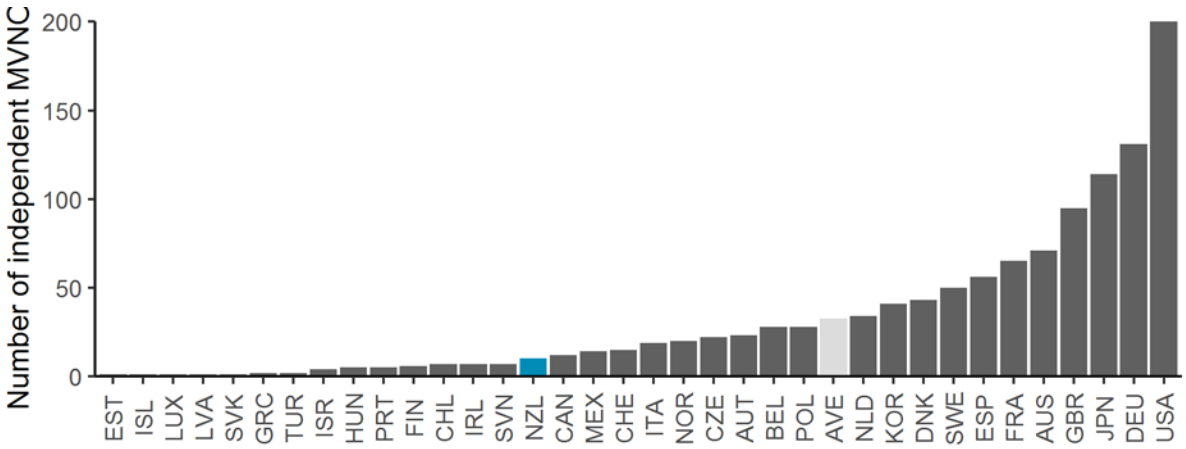
25. Corroboratively, it is difficult to discern any statistically significant correlation between MVNO penetration and consumer outcomes globally. It is correct that New Zealand has a low share of MVNOs relative to international peers. Figure 3 and Figure 4 below present, respectively, the MVNO market share, and the count of independent MVNOs by country for the OECD.[22]

Figure 3
MVNO subscriber market shares in OECD countries



Source: Telegeography GlobalComms database.
Note that the Telegeography data appears to include own-brand MVNOs in the MVNO market share calculation.

Figure 4
Number of Independent MVNOs in OECD countries

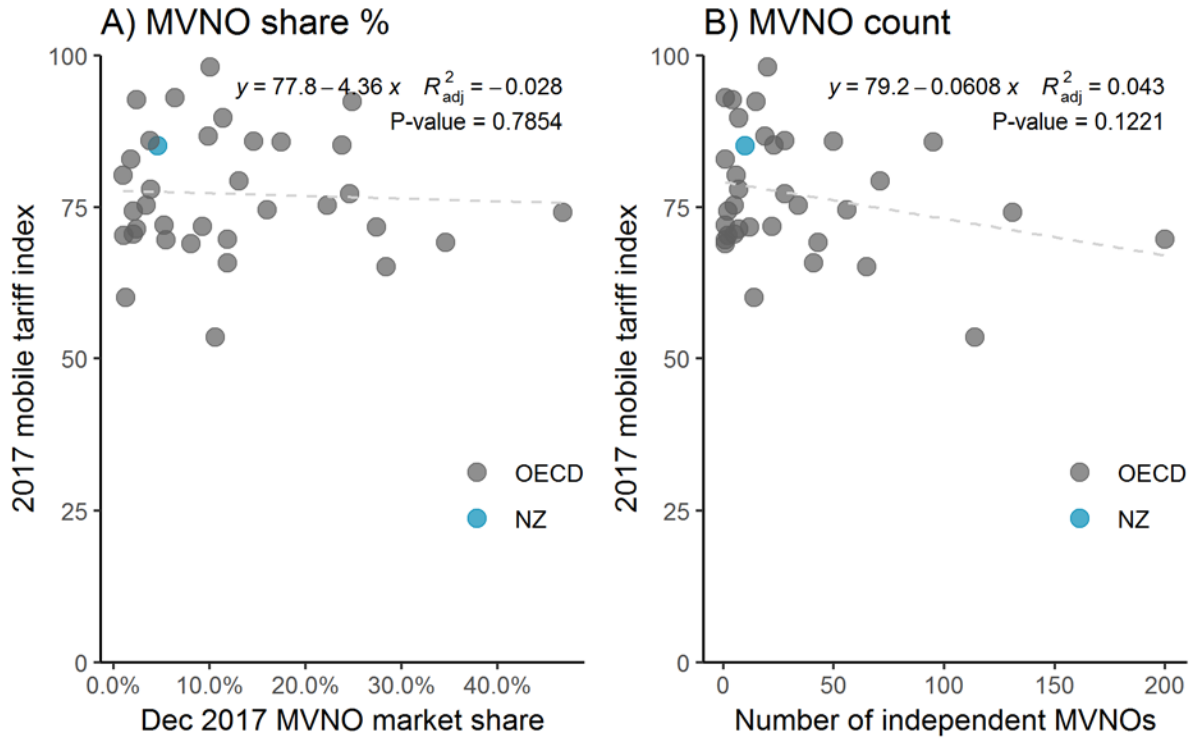


Source: NERA, Telegeography GlobalComms database.
Note: This graph shows of count of the "live" MVNOs and excludes those tagged as "MNO-owned".

[22] Note that the Telegeography data appears to include own-brand MVNOs in the MVNO market share calculation, and therefore is not comparable to the Analysys Mason data, which focused on independent MVNOs. Analysys Mason, *Input to the Commerce Commission mobile market review*, report for Trustpower, 28 November 2017.

26. Figure 5 below plots the GSMA mobile tariff index[23] against Telegeography's measure of MVNO market share and count of independent MVNOs for OECD countries. This suggests there is no statistically significant correlation between MVNO market share/the number of independent MVNOs and the tariff "score" for OECD countries (where a higher "score" indicates lower prices), although we have not controlled for any other variables which might explain prices. The figure also demonstrates that prices in New Zealand are better (a higher score) than countries with similar MVNO penetration and also better than many countries with higher MVNO penetration.

Figure 5
GSMA mobile tariff index vs MVNO market share and number of independent MVNOs: OECD countries (higher score = lower price)



Source: NERA analysis, Telegeography GlobalComms, GSMA Mobile connectivity index.
Note: A higher score indicates cheaper prices.

27. The GSMA mobile tariff index uses a 40:40:20 weighting of an entry level basket (100 MB), a medium usage basket (500 MB) and a high usage basket (1 GB). Given the Commission has noted that prices for high usage baskets are relatively expensive, particularly when compared to Australia,[24] we have also examined whether there is any correlation between the Teligen price benchmarks for high usage plans and MVNO market shares and counts as measured by Telegeography. The results of this analysis are presented in in the table below and Appendix A.

[23] Where a higher score indicates cheaper prices.

[24] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, pars. 100-102.

Table 1: Regressions of MVNO market share against benchmarked Teligen prices for high usage baskets

	MVNO Market share	
Benchmark plan price	**co-efficient**	**p-value***
Unlimited voice, 20 GB	-51.6463	0.6430
900 calls, 10 GB	-35.2607	0.5620
300 calls, 5 GB	-8.4321	0.7930
100 calls, 2 GB	-4.7938	0.8260
900 calls, 2 GB	-27.2450	0.3910

Source: NERA analysis, Telegeography and Teligen. Q3 2018 Benchmarks.
values greater than 0.05 are **insignificant at the 95% significance level.*

Table 2: Regressions of independent MVNO count against benchmarked Teligen prices for high usage baskets

	Independent MVNO count	
Benchmark plan price	**co-efficient**	**p-value***
Unlimited voice, 20 GB	-0.1469	0.8000
900 calls, 10 GB	0.0061	0.9850
300 calls, 5 GB	0.0068	0.9660
100 calls, 2 GB	-0.0398	0.7230
900 calls, 2 GB	-0.0891	0.5950

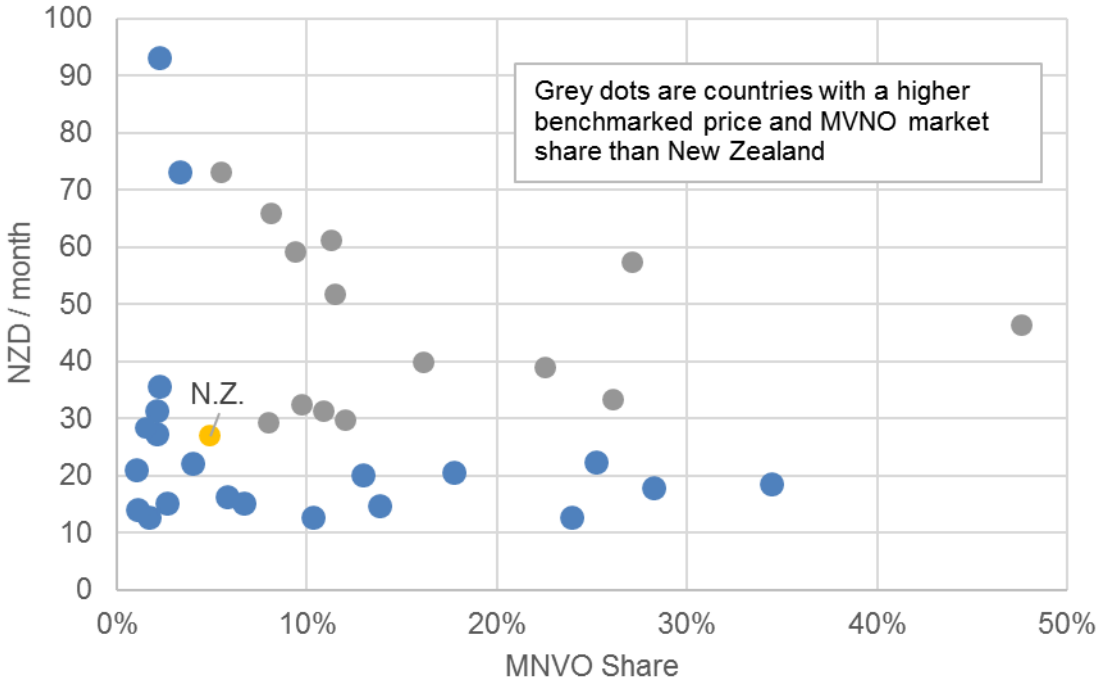
Source: NERA analysis, Telegeography and Teligen.Q3 2018 Benchmarks.
values greater than 0.05 are **insignificant at the 95% significance level.*

28. In short, at least on this simple analysis, there is no statistically significant correlation between price outcomes for high usage plans and either the MVNO market share or independent MVNO count in OECD countries. While simple correlations are not definitive evidence, this analysis suggests that factors besides MVNO penetration are the key drivers of price outcomes. This is illustrated graphically in Figure 6 below, which shows that for 5GB plans, there are OECD countries with higher benchmarked prices and higher MVNO market shares than NZ.

29. We discuss price comparisons in more detail in our companion report.[25] Consistent with New Zealand's position in Figure 5 (where a higher score indicates cheaper prices) New Zealand has below average prices relative to the OECD and prices have continued to trend downwards. This suggests the lack of MVNOs is not resulting in poor consumer outcomes.

[25] Titled, "Competition in the New Zealand Mobile Market", dated 26 October 2018.

Figure 6: Teligen benchmarked prices for the 5GB, 300 calls basket vs MVNO market share



Source: NERA analysis, Telegeography and Teligen Q3 2018 Benchmarks.

4. The costs and benefits of regulated MVNO access

30. The primary objective of access regulation is to promote competition in markets that require the accessed input. Therefore, the first step when considering the imposition of access regulation is to analyse the level of competition in the market in which access regulation would promote competition.[26]

31. As MVNO regulation would be a form of access regulation, the assessment of whether it is warranted must begin with an assessment of competition in the retail mobile market. This is the logic that the Commerce Commission[27] and Ofcom[28] use when applying "indirect constraints" to fixed broadband networks - if there is sufficient competition between the networks at retail, even if one of them does not compete at wholesale, then wholesale regulation is not required.

32. The analysis contained in our accompanying report shows that:

    a) Monitored New Zealand mobile prices are generally lower than the OECD average, and prices are declining in both nominal and real terms;

    b) New Zealand mobile subscriptions, call minutes and particularly data traffic have increased over time faster than population and GDP growth;

    c) New Zealand mobile churn rates are high compared to the average of other developed countries;

    d) New Zealand MNO profitability (as measured by EBITDA) is lower than the average of other developed countries;

    e) The coverage and quality of New Zealand's mobile networks compares favourably to other countries; and

    f) Spark has improved mobile service quality despite dramatic increases in traffic over its network.[29] Mobile download and upload speeds in New Zealand are close to the highest in the OECD.

33. Accordingly, we think it is appropriate to conclude that the New Zealand mobile market is competitive, and therefore, that any benefits of MVNO regulation would be minimal at best.

34. It is relevant to note the view of Martin Cave in a fixed line context that infrastructure-based competition provides greater benefits than access based competition:[30]

    > *Until recently there was little consensus on the effects of unbundling. In the light of the many studies now completed, however, it seems that the following conclusions can more confidently be drawn, at least in application to copper networks, to which the overwhelming bulk of the European data analyzed relate:*

[26] Whether or not there is competition at the wholesale level is not relevant if end consumer outcomes are competitive. As already noted in this report, vertical integration may be efficient in many circumstances.

[27] Commerce Commission, *Review of Designated and Specified Services under Schedule 1 of the Telecommunications Act 2001*, Decision no. NZCC 13, 30 June 2016, Par.22.3.

[28] Ofcom, *Wholesale Local Access Market Review: Statement – Volume 1*, 28 March, 2018, pars. 3.40-3.41.

[29] We do not have specific quality data for Vodafone or 2degrees.

[30] Martin Cave (2014), "The ladder of investment in Europe, in retrospect and prospect", Telecommunications Policy, 38, p.678.

> *–inter-platform competition is the gold standard, conferring considerable benefits;*
> *–bitstream access by itself produces limited benefits; and*
> *–competition based on unbundled loops has generally positive, but not very large results.*

35. He then concludes (p.682):

> *There is good evidence that benefits accrue to broadband customers from full end-to-end competition between a telecommunications operator and a cable company. Access-based competition seems to confer fewer benefits.*

36. Given New Zealand already has three infrastructure-based competitors,[31] which appear to be delivering competitive outcomes, the benefits of MVNO regulation in New Zealand are unlikely to be material. In contrast, the costs are likely to be substantial. The revenues the MNOs earn are already constrained by competition (as noted above). Any further constraint (e.g., by mandating MVNO access) could undermine their ability to recover existing sunk investments, and fund new sunk investments. Access regulation grants a "free option" to access seekers - they can choose to access only those investments that are successful and do not have to share the costs of unsuccessful investments. This has the effect of truncating the expected returns of access providers, despite the risks remaining with them.

37. Accordingly, there is a risk MVNO regulation would reduce overall investment levels by MNOs. As we have noted, mobile network investment is recurring and sunk. The industry is currently considering the investment required to offer 5G services, and the business case for those services is uncertain. As the GSMA notes:[32]

> *Over the past 30 years, the mobile industry has demonstrated its ability to transform society through 2G, 3G and 4G. 5G will build on these successes to deliver the networks and platforms to support existing and new services, with new business models and use cases that are unknown today.*

38. The ACCC has recently touched on how technological evolutions relating to 5G may change the MVNO business case:[33]

> *We note that with mobile technology evolving to 5G services there is likely to be greater network functionality through network slicing, which may enable different wholesale MVNO service offerings (e.g. in relation to IoT). As 5G services evolve, and are deployed, we will examine their impact, if any, on MVNO services.*

39. More generally, the development of e-SIM technology may fundamentally change the MNO/MVNO relationship, or even the relationship between MNOs and the end customer. For example, McKinsey note that:[34]

> *Mobile-device manufacturers may be able to take control of the relationship with the customer because e-SIM, at least technically, allows for disintermediation of network operators from the end-to-end relationship.*

and

[31] And there are questions as to whether it could support a fourth.

[32] Page 5 of https://www.gsmaintelligence.com/research/?file=0efdd9e7b6eb1c4ad9aa5d4c0c971e62&download

[33] ACCC, *Communications Sector Market Study: Final Report*, April 2018, p. 61.

[34] McKinsey, *E-SIM for consumers— a game changer in mobile telecommunications*, January 2016.

> *Wholesalers contracting with several network operators in a market could offer a tariff selection without disclosing which network is providing the connectivity. The customer could then be "auctioned" dynamically among network operators for a period of time.*

40. As noted in the issues paper both Google (the Pixel 2 phone) and Apple (iPad Pro) currently have e-Sim devices available[35] and that:[36]

> *Google and Apple's involvement in the e-SIM space could signal their interest in becoming 'mega-consumers' who marshal the collective purchasing power of all of the users on their mobile operating systems to get competitive deals from MNOs. In this scenario MNOs become mainly wholesale access providers for large overseas companies.*

41. Against this dynamic and uncertain context, regulation could crowd out or distort the development of alternative commercial arrangements as technology evolves. Accordingly, given the upcoming investment in 5G and uncertainty over the actual MNO and MVNO business models/relationships, the potential costs of MVNO regulation at this time are high.

42. Empirical work by Kim et al. (2011) is consistent with the preceding analysis. They use an empirical model to examine the effects of MVNO entry and access regulation on MNO investment in 21 OECD countries.[37] The study finds that mandating MVNO entry is related to lower investment in infrastructure by MNOs, while voluntary access of MVNOs has no effect on investment.

43. The Canadian Radio-television and Telecommunications Commission (CRTC) has also been concerned about the effect of mandated access on the investment incentives of MVNOs themselves: [38]

> *Accordingly, if the Commission were to mandate GSM-based wholesale MVNO access provided by the national wireless carriers, this permanent network access would likely discourage continued investment by wireless carriers, because they could rely on this access rather than investing in their own mobile wireless network infrastructure.*

44. In 2016 the CRTC reaffirmed this view in an appeal, citing that mandating access would "significantly undermine the investments of other wireless carriers".[39]

45. We conclude that MVNO regulation in New Zealand would likely result in net detriments.

[35] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, pars. 206-261.

[36] NZCC, *Study of mobile telecommunications markets in New Zealand: Issues Paper*, par.262.

[37] Jihwan Kim, Yunhee Kim, Noel Gaston, Romain Lestage, Yeonbae Kim and David Flacher, 2011, "Access regulation and infrastructure investment in the mobile telecommunications industry". Telecommunications Policy, Volume 35, Issue 11, 907-919.

[38] Telecom Regulatory Policy, CRTC 2015-177 See: https://crtc.gc.ca/eng/archive/2015/2015-177.htm

[39] Telecom Decision, CRTC 2016-60 See: https://crtc.gc.ca/eng/archive/2016/2016-60.htm

Appendix A. Correlation between Teligen price benchmarks and MVNO penetration

Unlimited voice, 20 GB.

*Regression of **Price** on **MVNO market share***

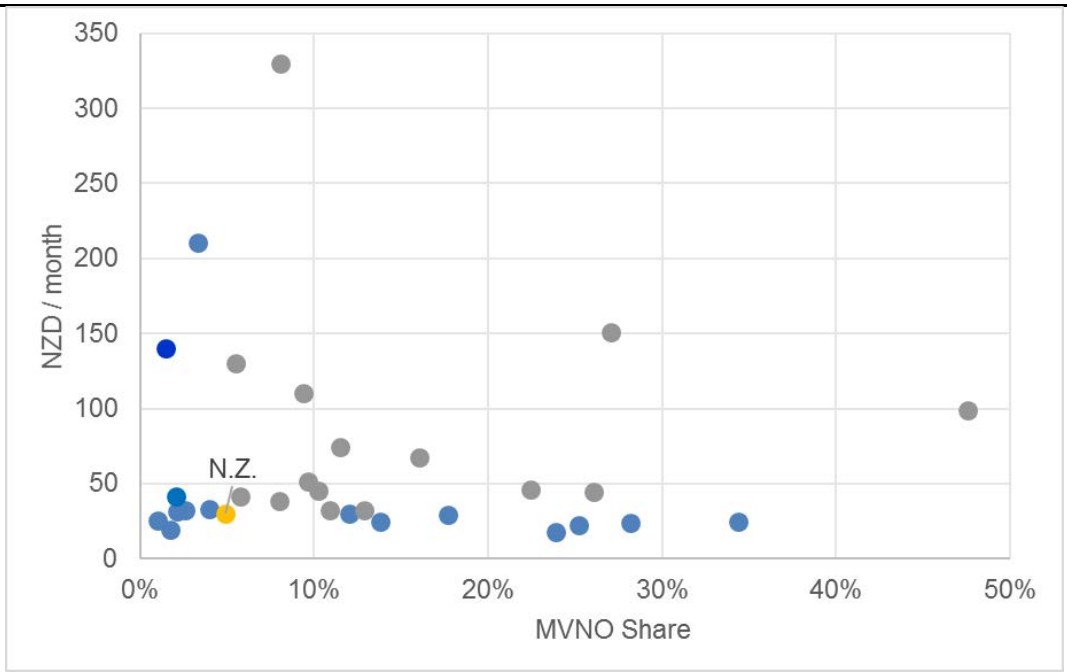
Coef:
-51.6463

Std. Err:
110.3544

P value:
0.643

R-squared:
0.0075

Number of obs:
31



*Regression of **Price** on **independent MVNO count***

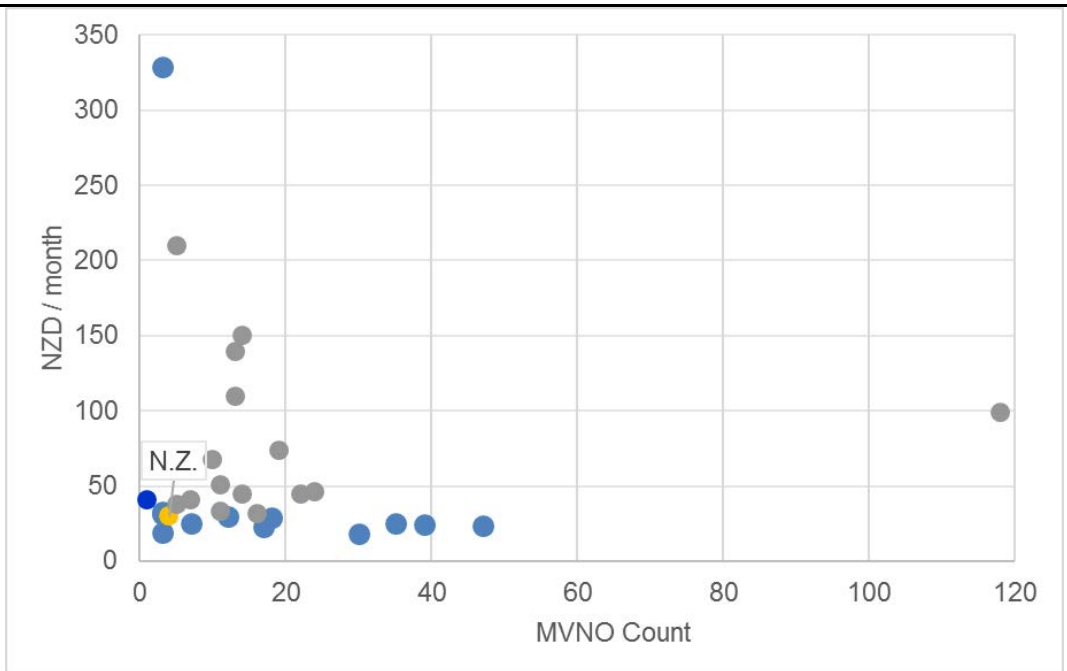
Coef:
-0.1469

Std. Err:
0.5747

P value:
0.800

R-squared:
0.0023

Number of obs:
30



900 calls, 10 GB.

*Regression of **Price** on **MVNO market share***

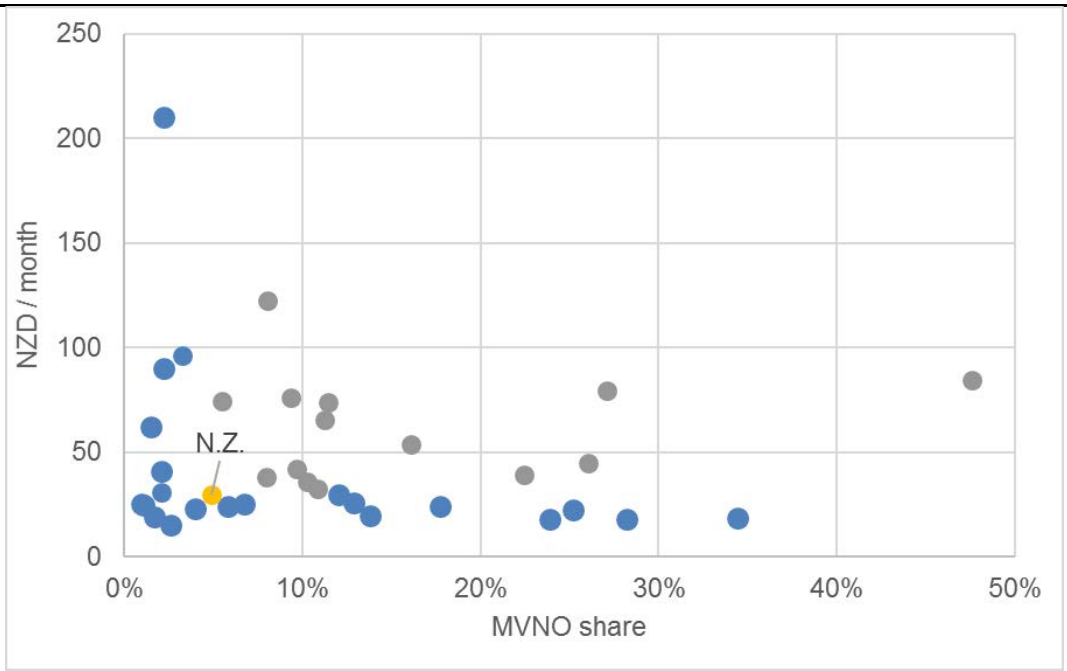
Coef:
-35.2607

Std. Err:
60.1411

P value:
0.5620

R-squared:
0.0100

Number of obs:
36



*Regression of **Price** on **independent MVNO count***

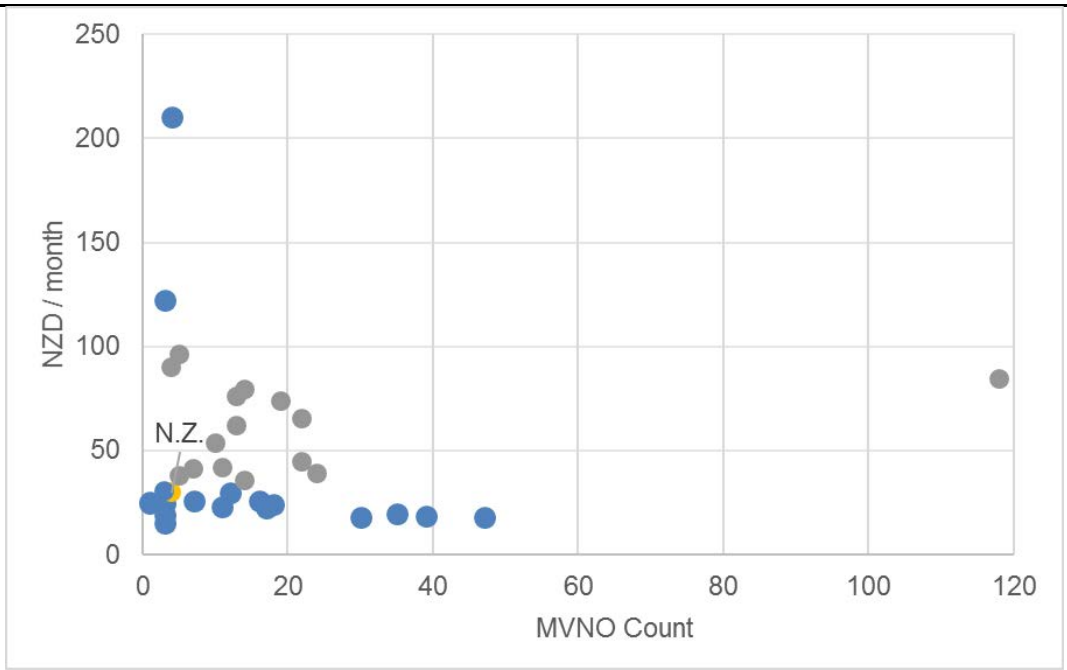
Coef:
0.0061

Std. Err:
0. 3229

P value:
0.9850

R-squared:
0.0000

Number of obs:
35



300 calls, 5 GB.

*Regression of **Price** on **MVNO market share***

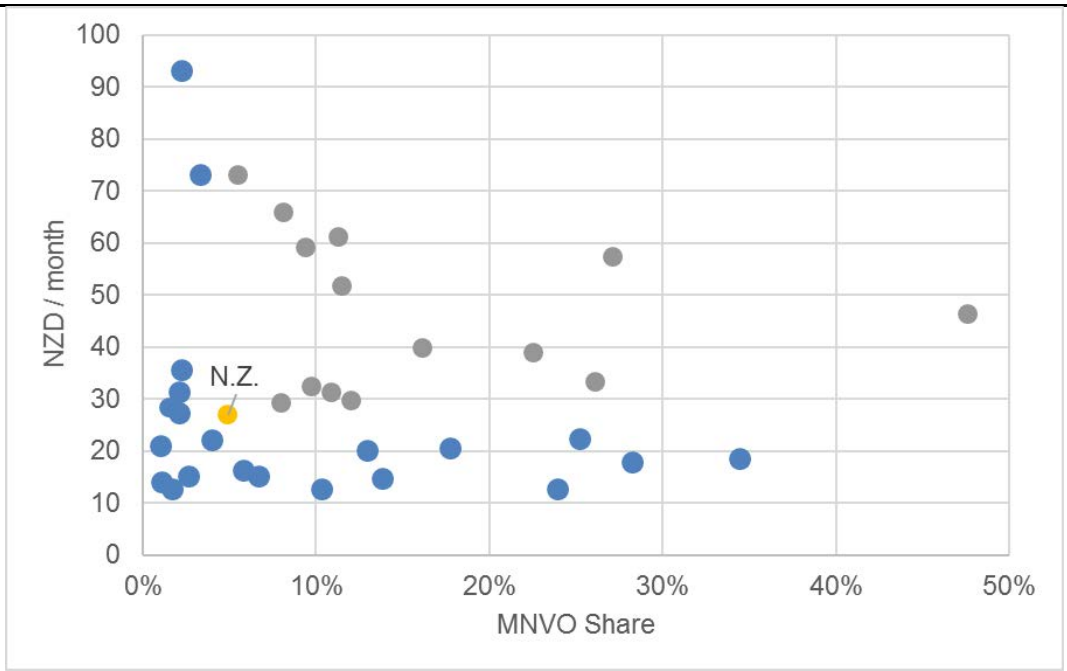
Coef:
-8.4321

Std. Err:
31.9201

P value:
0.7930

R-squared:
0.0020

Number of obs:
36



*Regression of **Price** on **independent MVNO count***

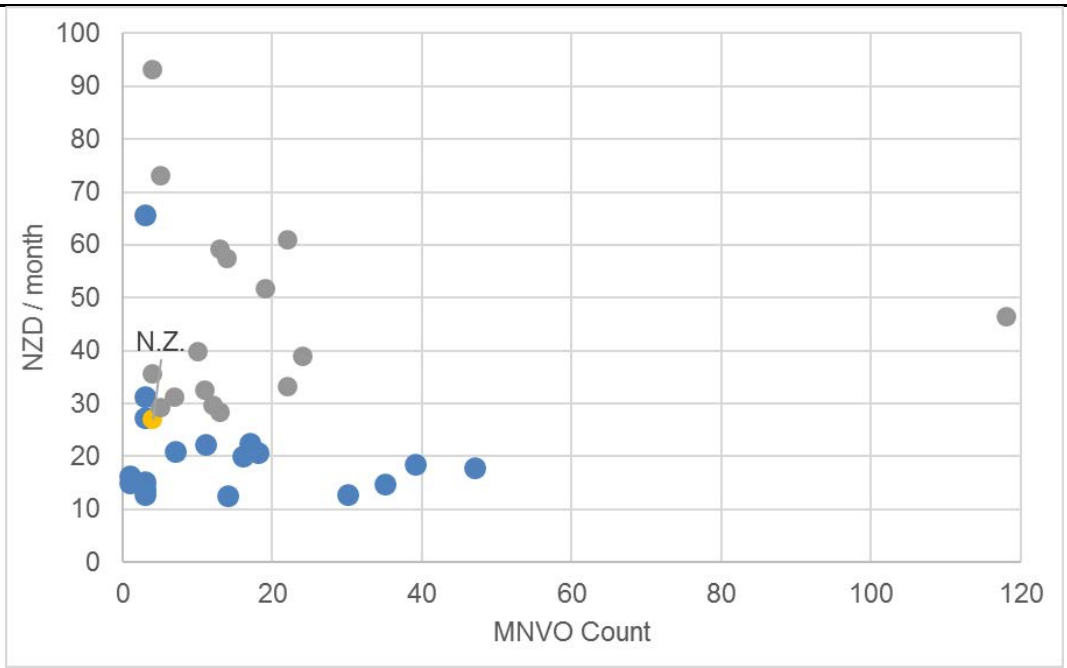
Coef:
0.0068

Std. Err:
0.1623

P value:
0.9660

R-squared:
0.0001

Number of obs:
35



100 calls, 2 GB.

*Regression of **Price** on **MVNO market share***

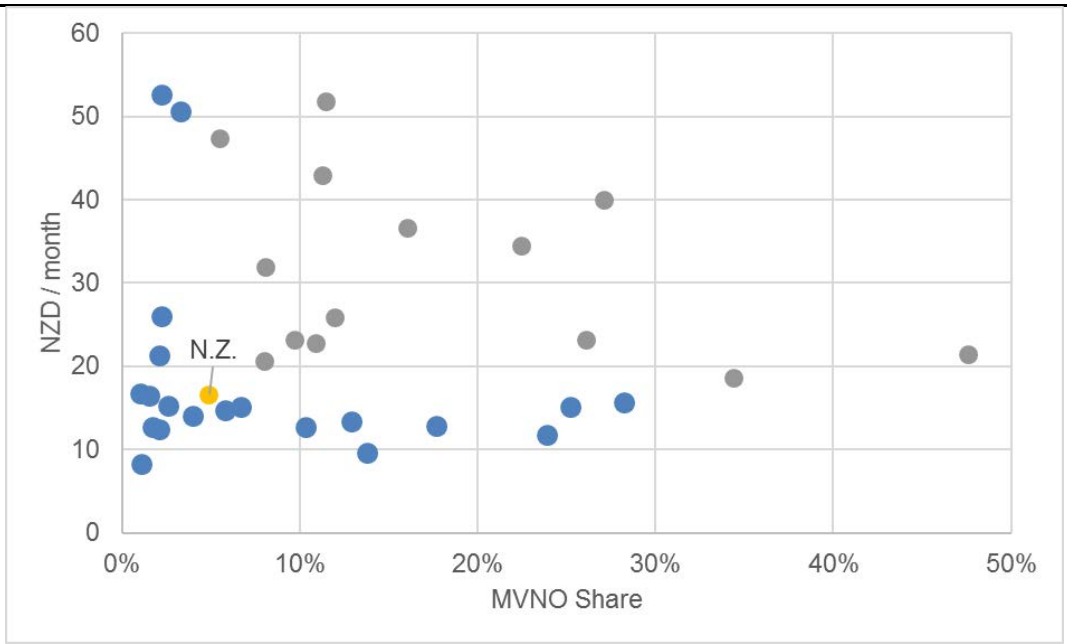
Coef:
-4.7938

Std. Err:
21.6611

P value:
0.8260

R-squared:
0.0014

Number of obs:
36



*Regression of **Price** on **independent MVNO count***

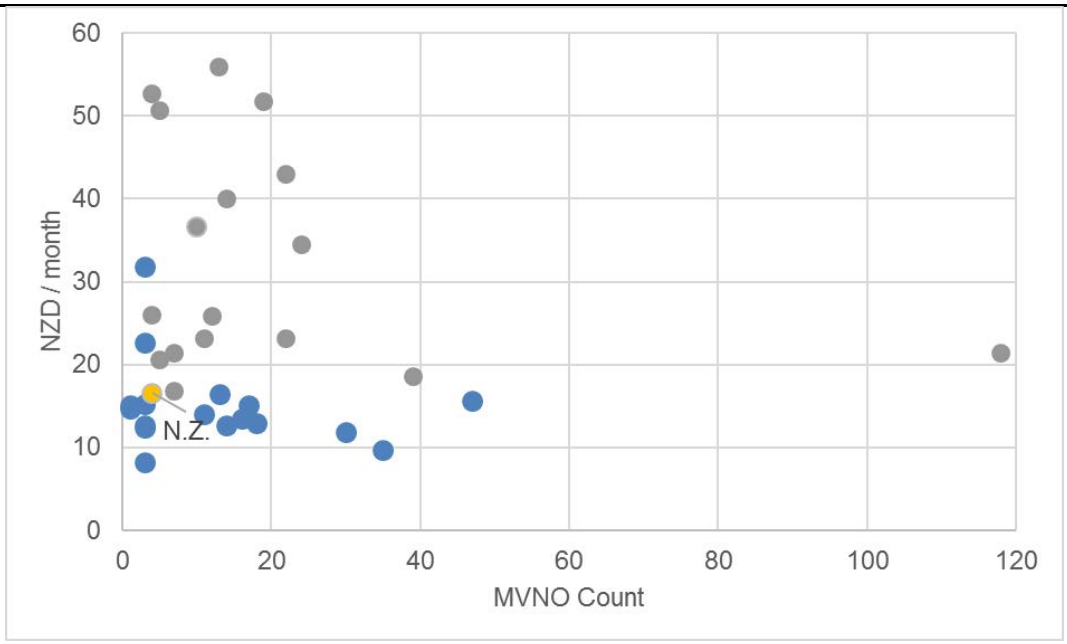
Coef:
-0.0398

Std. Err:
0 .1115

P value:
0.7230

R-squared:
0.0038

Number of obs:
35



900 calls, 2 GB.

*Regression of **Price** on **MVNO market share***

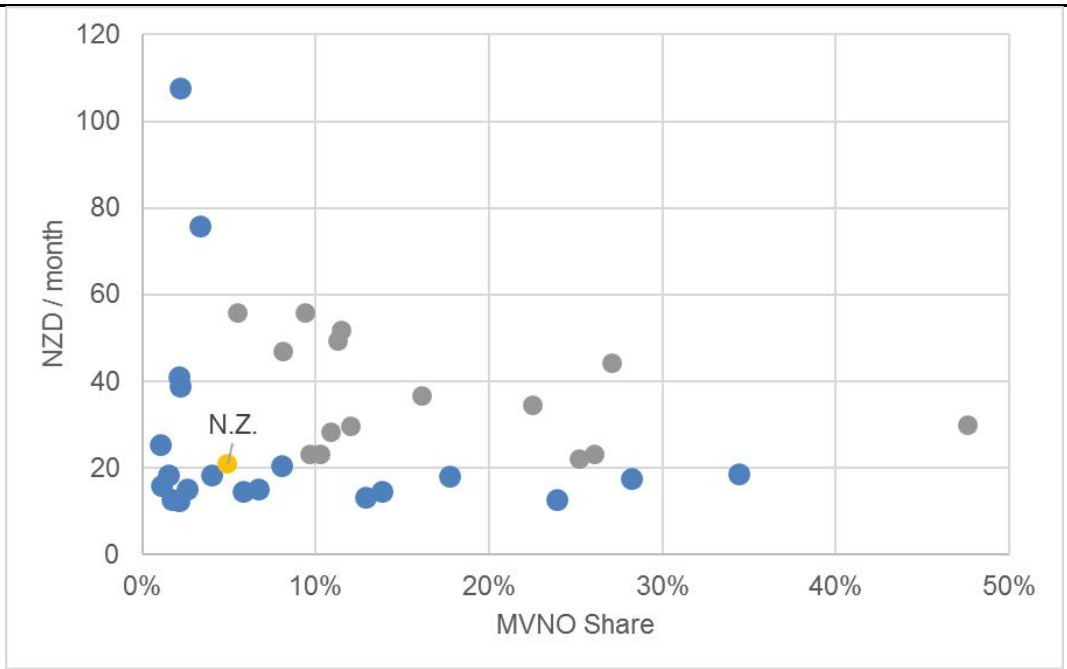
Coef:
-27.2450

Std. Err:
31.3842

P value:
0.3910

R-squared:
0.0217

Number of obs:
36



*Regression of **Price** on **independent MVNO count***

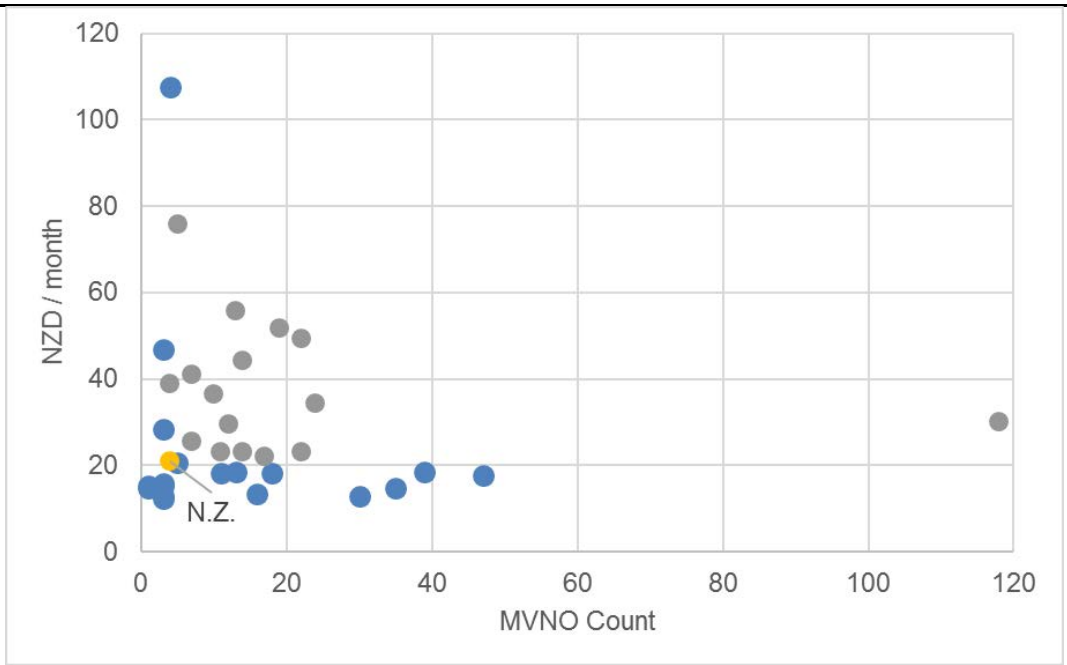
Coef:
-0.0891

Std. Err:
0.1660

P value:
0.5950

R-squared:
0.0087

Number of obs:
35



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