Simulating the Welfare Impacts of Improving Access to Māori Medium Education using Logit School Demand

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Introduction

- What is the social value of improving school access to students with "non-mainstream" schooling needs or preferences? Consider, e.g.:
  - Disabled students, or students from religious families; or
  - Students who wish to learn in their native language, or in accordance with traditional philosophies?
- Particularly relevant for Māori whānau/families wanting their children to learn in te reo Māori, and to be immersed in other aspects of Māori culture.

Language Mediums in Education

- English Medium Education (EME) is the dominant schooling mode in New Zealand – children taught exclusively or predominantly in English:
  - Māori Medium Education (MME) – teaching students exclusively or predominantly in te reo Māori – has (re)emerged only since the 1980s.
- MME schools have largely grown in parallel with EME schools, and not enjoyed the same level of support or development:
  - Means that Māori students either have no local MME schools, or must travel greater distances, and with fewer subsidised transport options, than EME students.

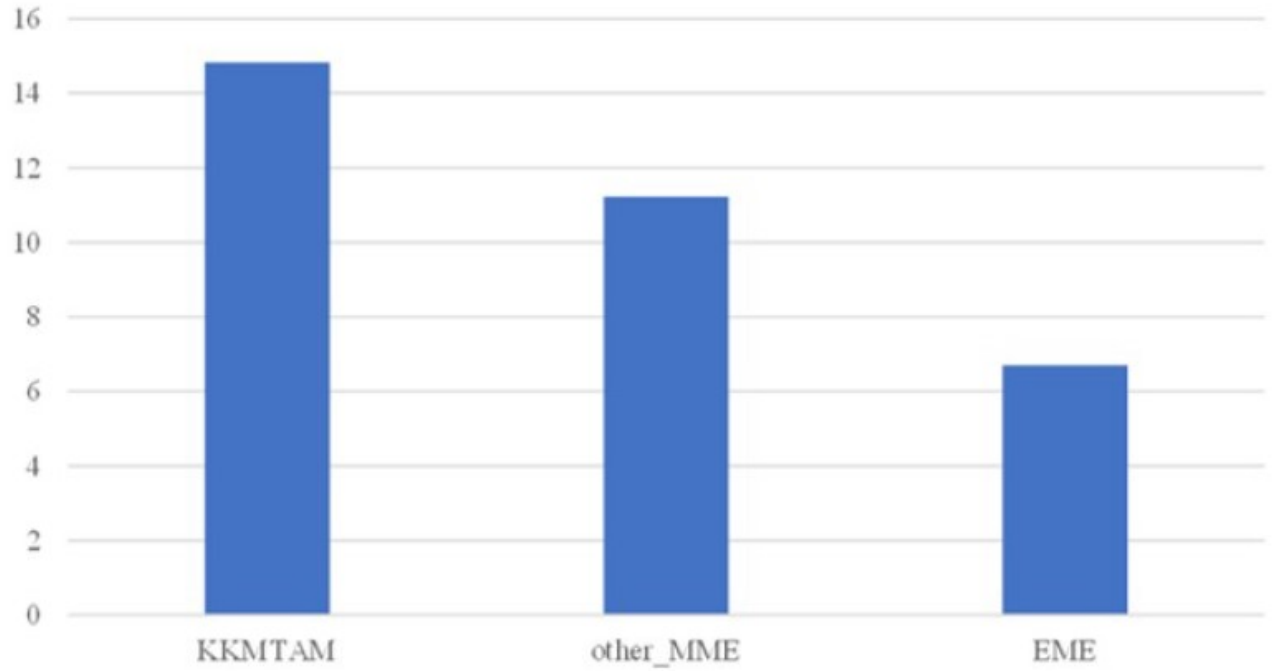
Māori Medium Access Barriers

- Distances between Māori students and their preferred schools represent access barriers in terms of both travel distances and "distances in preference space".
- Such access barriers are acknowledged, and considered to be socially important (Tomorrow's Schools Independent Taskforce (2019, p. 50)):

> *"[a]ccess to te reo Māori for all learners/ākonga is ... not easily available. Without this, te reo Māori cannot function as one of this country's official languages, or part of our everyday life."*

Average Travel Distances by School Language Medium

Figure 1: Average Student Travel Distances by School Type (km)



Grounds for Improving MME Schooling Access

- MME schooling is associated with *improved educational outcomes* for Māori students, including:
  - Staying longer in secondary education;
  - More likely to leave high school with advanced qualifications;
  - Greater chance of enrolling in tertiary education.
- Better MME schooling *enables government to better discharge its Treaty and international obligations*:
  - Important to invest in language immersion education, especially school-age learning, to ensure te reo's survival (Barrett-Walker et al. (2020)).

Grounds for Improving MME Schooling Access (cont'd)

- Improving MME accessibility can provide *other social benefits*:
  - Thriving minority languages are associated with student gains in both cognitive skills and abilities in dominant languages (Council of Europe (2020, p. 16));
  - Protecting minority languages helps to maintain and develop cultural wealth (Council of Europe (1992)).
- Indeed, abilities of Māori in te reo, and groundedness in Māori culture more generally, are common wellbeing indicators used in New Zealand (Dalziel et al. (2019)).

This Paper

- This paper explores the welfare implications of improving access to a particular class of MME schools:
  - *Kura Kaupapa Māori* schools which, unlike other MME schools, teach in accordance with a philosophy known as Te Aho Matua (KKMTAM schools).
- Estimate a multinomial logit (MNL) model of school choice by Māori primary school-age students' families:
  - Using aggregate school market share (i.e. ward-level roll share) and other school-level data for 2016-2020 available from administrative sources.
- School's are assumed differentiated in terms of price and non-price school attributes, with *price measured as travel cost*.

Contributions

- Add to international literatures on school choice and cultural valuation:
  - First to estimate school choice model for New Zealand;
  - First to estimate preferences for KKMTAM and other MME schools (relative to EME schools).
- Show how much KKMTAM and other MME schools are valued by Māori families relative to EME schools:
  - Also show that KKMTAM schools are valued more highly than other MME schools.
- **Policy simulation:** *estimate consumer surplus gain to Māori families from improved KKMTAM accessibility – i.e. from their travel costs being no worse than those of local EME schools*.

Indirect Utility and Choice Probabilities

- Indirect utility of Māori years 1 to 8 student/family i (i.e. "consumer i"), in ward-year t (i.e. "market t"), from enrolling at public school j (i.e. "product j", $j = 0 \dots J_t$), is:

$$u_{ijt} = \delta_{jt} + \varepsilon_{ijt}$$

  where δ_{jt} is mean utility, and ε_{ijt} is assumed *iid* Type I Extreme Value (captures random taste variation across students).

- From standard results (e.g. Berry (1994)), the resulting probability that students in market t choose school j (i.e. estimated school market share) is:

$$s_{jt} = \frac{exp(\delta_{jt})}{\sum_{k=0}^{J_t} exp(\delta_{kt})}$$

Indirect Utility (cont'd)

- Following Girotti and Meade (2017, p. 8), mean utility from students choosing school j in market t, δ_{jt}, is:

$$\delta_{jt} \equiv \beta_{TC} TC_{jt} + \beta_{KKM} KKM_{jt} + \beta_{MME} MME_{jt} + x_j \beta + \xi_{jt}$$

  where TC_{jt} is average travel cost of students attending school j in market t.
- KKM_{jt} is dummy equalling 1 if school j in market t is KKMTAM, and MME_{jt} is a dummy equalling 1 if it is other MME – measure mean utility of non-EME schools (relative to EME schools) not otherwise captured.
- x_{jt} is other observed school attributes, and β's are mean student "taste" (i.e. preference) parameters.

Estimation

- Choice probabilities depend on *relative* utilities, so we have a degree of freedom:
  - Conventionally resolve this by choosing an "outside option" ($j = 0$) and normalising $\delta_{jt} \equiv 0$ (Berry (1994)).
  - W.l.o.g., choose largest EME school in market t to be the outside option (cf Neilson (2017)).
- Last term in indirect utility, ξ_{jt}, measures students' mean valuation of remaining unobserved school attributes.
- Berry (1994) shows that the following transformation means taste parameters can be recovered from a linear regression, with ξ_{jt} playing the role of error term:

$$ln(s_{jt}) - ln(s_{0t}) = \beta_{TC} TC_{jt} + \beta_{KKM} KKM_{jt} + \beta_{MME} MME_{jt} + x_j \beta + \xi_{jt}$$

Data – Non-Price School Attributes

- School-level data for 2016-2020 on *non-price* school attributes was mainly sourced from the Ministry of Education's *Education Counts* website:
  - Some school-level attributes data – e.g. property details, FTTEs, and Māori immersion levels – were sourced from the Ministry directly (many thanks!);
  - Details of which schools were KKMTAM schools were provided by the national body representing those schools (Te Rūnanga Nui o Ngā Kura Kaupapa Māori o Aotearoa).

Data – Price School Attributes

- School-level *prices* (i.e. average student travel costs) combine direct travel costs and travel time costs:
  - Average school-level travel distances sourced directly from the Ministry;
  - Student travel modes, and average travel speeds by mode, sourced from Ministry of Transport;
  - Vehicle running costs based on IRD allowances; and
  - Following Lupi et al. (2020), hourly travel time cost measured as 33% of regional average Māori earnings (sourced from SNZ).

Demand Model Results (Extract)

Table 2: Results of Multinomial Logit School Choice Model

	Dependent variable: $ln(s_{jt}) - ln(S_{0t})$			
	(1)	(2)	(3)	(4)
tot_annual_TC	-0.0001*	-0.0001*	-0.0001***	-0.0001*
	(0.00003)	(0.00003)	(0.00002)	(0.00003)
KKMTAM	0.274**	0.276**	1.311***	0.281**
	(0.139)	(0.134)	(0.134)	(0.138)
other_MME	0.122	0.116	1.067***	0.126
	(0.123)	(0.120)	(0.130)	(0.122)
roll_total	0.003***	0.003***	0.002***	0.003***
	(0.0004)	(0.0003)	(0.0004)	(0.0004)
roll_maori_share_2022	2.303***	2.296***		2.254***
	(0.204)	(0.196)		(0.155)
var_funds_per_stud	-0.0001***	-0.0001***	-0.00005***	-0.0001***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)

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Willingness to Pay

Table 3: Estimated Willingness to Pay for Māori Medium School Attendance

	$/Student/Year (Dec-22 $)
WTP_{KKMTAM}	19,234
$WTP_{other\ MME}$	15,665

Policy Simulation

- Given KKMTAM students face higher average travel distances (and hence travel costs) than EME schools, what would be the welfare (i.e. consumer surplus) impact of "improving KKMTAM access":
  - Specifically, so that travel costs of KKMTAM students' families are no worse than the average of those for those attending local EME schools?
- Can answer this at KKMTAM student/family level using estimated demand parameters, by calculating change in expected consumer surplus resulting from change in assumed travel costs.

Welfare Measure

- Following Train (2009), use standard measure of change in consumer surplus for MNL models:

$$\Delta E\left(CS_{it}\right) = -\frac{1}{\hat{\beta}_{TC}}\left\{ln\left(\sum_{j=0}^{J_t} exp\left(\hat{\delta}_{jt}^{1}\right)\right) - ln\left(\sum_{j=0}^{J_t} exp\left(\hat{\delta}_{jt}^{0}\right)\right)\right\}$$

where:

$$\hat{\delta}_{jt}^{1} = \hat{\beta}_{TC}\, TC_{jt}^{1} + \hat{\beta}_{KKM} KKM_{jt} + \hat{\beta}_{MME}\, MME_{jt} + x_j\hat{\beta}$$

$$\hat{\delta}_{jt}^{0} = \hat{\beta}_{TC}\, TC_{jt}^{0} + \hat{\beta}_{KKM} KKM_{jt} + \hat{\beta}_{MME}\, MME_{jt} + x_j\hat{\beta}$$

Policy Simulation Results

Table 4: Results of Policy Simulation

$\Delta E\left(\bar{CS}_{it}\right)$	357	\$/Student/Year (Dec-22 \$)
Mean increase in KKMTAM rolls	7.1%	For all KKMTAM schools
Mean increase in KKMTAM rolls	10%	For KKMTAM schools enjoying reduction in annual travel costs

Discussion

- This study illustrates how it is possible to quantify the welfare impacts of an assumed policy change – here, affecting travel costs – in monetary terms (e.g. for use in CBAs, RISs, etc):
  - Using a model of school choice that can be estimated using administrative data.
- Along the way, the model's estimates shed light on the relevant drivers of school choice:
  - Coefficients estimate the relative marginal utilities of price and non-price school attributes;
  - Trade-offs between attributes can be assessed – including WTP.

Discussion (cont'd)

- Study is illustrative, in the sense MNL models are the most basic type of demand model, with known limitations:
  - Among other things, all decision-makers are assumed to have the same taste parameters, even if they are making choices over differentiated schools.
- With the available data, a more general approach would be to fit a random coefficient logit (RCL) model – e.g. Berry et al. (1995):
  - Allows for taste variation across decision-makers, and can be estimated using aggregate market share data;
  - Left to future work ...

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