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Te Kōmihana Whai Hua o Aotearoa

Productivity measurement case study: early childhood education

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The New Zealand Productivity Commission Research Note 2017/05: Productivity measurement case study: early childhood educationeducation

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The Commission – an independent Crown entity – completes in depth inquiry reports on topics selected by the Government, carries out productivity related research and promotes understanding of productivity issues. The Commission aims to provide insightful, well –formed and accessible advice that leads to the best possible improvement in the wellbeing of New Zealanders. The New Zealand Productivity Commission Act 2010 guides and binds the Commission.

Information on the Productivity Commission can be found on www.productivity.govt.nz or by contacting +64 4 903 5150.

[1] The Commission that pursues abundance for New Zealand

Abstract

- The ability to assess productivity change in early childhood education (ECE) is limited by incomplete or inconsistent data. Available data suggest that:
  - Basic labour productivity grew by an annual average of 0.4% between 2004/05 and 2012/13.
  - When adjusted for changes in the qualifications of the teaching workforce, labour productivity in the teacher-led ECE sector between 2000/01 and 2012/13 was either flat or fell by an average of 2.8% per annum.
- When using Government funding as the input, ECE multifactor productivity on average fell by 3.4% per annum between 2001/02 and 2014/15. However, this result needs to be treated with caution, given the significant role that parental financial contributions play.
- A range of data improvements are needed to gain a better understanding of ECE productivity. Key areas of improvement include:
  - consistent data in monetary terms on average hourly parent financial contributions to ECE,
  - teaching staff data on a full-time equivalent or 'actual hours worked' basis, rather than simple headcounts, and
- Understanding the impact of ECE on children and parents is also important for fully assessing productivity changes in the sector. Assessments of child development or measures of parental employment are potential indicators that could be used to quality-adjust ECE outputs.

Box 1 **Productivity measurement case studies**

This case study supplements the New Zealand Productivity Commission's draft inquiry report *Measuring and improving state sector productivity*. The terms of reference for the inquiry ask the Productivity Commission to provide guidance and recommendations on:

- how to measure productivity in "core" public services (health, education, justice, social support) at the sector and service level;
- what role productivity measures should play in public sector performance frameworks; and
- how to develop the culture, capability and systems needed within government agencies to measure, understand and improve productivity.

This paper is one of a series of case studies illustrating how to measure state sector productivity and how to overcome measurement difficulties. The Commission's website provides access to the full suite of case studies.

Readers should not view any of the case studies as a definitive description of productivity in the relevant state sector agency. Rather, the case studies aim to demonstrate different aspects of productivity measurement. The Commission hopes the results of the studies will stimulate further discussion about what is driving the identified productivity trends, how productivity measurement could be improved, and how productivity measures could be incorporated into the wider performance frameworks of state sector organisations.

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Key points

- The ability to assess productivity change in early childhood education is limited by incomplete or inconsistent data. Available data suggest that:
  - Basic labour productivity grew by an annual average of 0.4% between 2004/05 and 2012/13.
  - When adjusted for changes in the qualifications of the teaching workforce, labour productivity in the teacher-led ECE sector between 2000/01 and 2012/13 was either flat or fell by an average of 2.8% per annum.
- When using Government funding as the input, ECE multifactor productivity on average fell by 3.4% per annum between 2001/02 and 2014/15. However, this result needs to be treated with caution, given the significant role that parental financial contributions play.
- A range of data improvements are needed to gain a better understanding of ECE productivity. Key areas of improvement include:
  - consistent data in monetary terms on average hourly parent financial contributions to ECE,
  - teaching staff data on a full-time equivalent or 'actual hours worked' basis, rather than simple headcounts, and
- Understanding the impact of ECE on children and parents is also important for fully assessing productivity changes in the sector. Assessments of child development or measures of parental employment are potential indicators that could be used to quality-adjust ECE outputs.

1.1 Introduction

This note looks at options for measuring productivity in early childhood education (ECE). Drawing off the work of Gemmell et al (2017), it

- uses publicly-available information to construct measures of productivity in the ECE sector; and
- discusses options for quality-adjusting ECE outputs to provide a more accurate and complete picture of changes in early childhood productivity.

1.2 Productivity measures

Productivity measurement in education

There are a variety of ways in which productivity can be measured in education. Gemmell et al explored a number of possible productivity measures for the school system (Table 1.1).

Table 1.1 Productivity measures for schooling and their results

Measure	Data	Results
Basic labour productivity (Total Student Places / Teacher FTEs)	Total student places based on data for student roll by school type. Excludes students in private schools. FTE teachers (headcount for 2001 and earlier) in	Declined by 1.0% on average between 2002 and 2014, with

Measure	Data	Results
	state and state integrated schools based on Education Counts data. Teaching staff includes principal, management, teacher, resource teachers, community education, guidance and therapists	the fastest decline between 2002 and 2008.
Basic multifactor productivity (Total Student Places / School Revenue)	Total student places as above. School revenue based on Core Crown Expenditure from Treasury Budget documents and percentage of non-government revenue from Ministry of Education. Core Crown Expenditure covers roll-based operations funding to schools, teacher and management salaries, support costs and supplementary funding programmes. Indexation is based on the full CPI.	Declined by 1.7% on average between 2002 and 2014, also with the fastest decline between 2002 and 2008
Labour productivity based on adjusted labour input (Total Student Places / Teacher Salaries)	Total student places as above. Expenditure on teacher salaries (primary and secondary) in state and state integrated schools from Education Counts. Indexation is based on the full CPI.	Declined by an average of 2.0% between 2002 and 2014, although grew by an average of 0.2% between 2008-2014
Labour productivity based on adjusted output (pupil attainment) (Aggregate PISA Points / Teacher FTEs)	Total student places (primary and secondary) weighted by attainment in unweighted average of the reading, mathematics and science PISA scores. Primary and secondary teacher FTEs.	1.1% average decline between 2003 and 2015 (if using only secondary students and FTE teachers the decline was 1.0%)
Labour productivity based on adjusted output (pupil attainment) (Students Achieving Domestic Standard / Teacher FTEs)	Total student places (primary and secondary) weighted by share of students leaving school with NCEA level 2 (or equivalent) or more. Primary and secondary teacher FTEs.	0.8% average increase between 2002 and 2014
Multifactor productivity based on adjusted output (pupil attainment) (Students Achieving Domestic Standard / School Revenue)	Total student places (primary and secondary) weighted by share of students leaving school with NCEA level 2 (or equivalent) or more. School revenue based on Core Crown Expenditure from Treasury Budget documents and percentage of non-government revenue from Ministry of Education. Core Crown Expenditure covers roll-based operations funding to schools, teacher and management salaries, support costs and supplementary funding programmes. Indexation is based on the full CPI.	0.5% average decrease between 2002 and 2014.
Labour productivity based on adjusted output (earnings) (Total Student Places Weighted by Average Real Expected Income / Teacher FTEs)	Data on school leavers by three categories of attainment, average weekly incomes for people over 15 in employment for each category from New Zealand Income Survey, average unemployment rate for each category for June year. Primary and secondary teacher FTEs.	0.2% average decline between 2002 and 2014 (if only using secondary FTEs the decline was 0.7%)
Labour productivity based on adjusted output (earnings) (Total Student Places Weighted by Average	Data on school leavers by three categories of attainment, average weekly incomes for people over 15 in employment for each category from New Zealand Income Survey, average unemployment rate for each category for June year. Total	Declined by an average of 1.1% between 2002 and 2014

Measure	Data	Results
Real Expected Income / Teacher Salaries)	(secondary and primary) teacher salaries. Indexation based on the full CPI.	
Multifactor productivity based on adjusted output (earnings) (Total Student Places Weighted by Average Real Expected Income / School Revenue)	Weighted average real income as above. Wage indexation based on full CPI. School revenue based on Core Crown Expenditure from Treasury Budget documents and percentage of non-government revenue from Ministry of Education. Core Crown Expenditure covers roll-based operations funding to schools, teacher and management salaries, support costs and supplementary funding programmes. Indexation is based on the full CPI.	Declined by an average of 0.9% between 2002 and 2014

Source: Gemmell et al, 2017

That so many variants on productivity could be explored for the schooling system reflects the nature of schooling and the state's involvement in the system. For example, the Ministry of Education collectively bargains with teachers regarding pay and conditions and funds schools, in part, in the form of teacher staffing places. There is therefore consistent and long-term data on teacher salary expenses. Similarly, almost all secondary students participate in assessment and examination schemes such as the National Certificate of Educational Achievement (NCEA), providing information on intermediate outcomes which can be used to quality-adjusted outputs.

By comparison, information on early childhood education is more limited, which constrains the type of productivity measurement that can be conducted. In part, this limited information reflects the nature of education in ECE and the different role of the state. For example,

- Whereas most schools in the New Zealand system are owned by the state, ECE is delivered through non-government providers.
- While schools are resourced through a combination of funding and staffing entitlements, ECE services are resourced through bulk financial grants, based mainly on child participation.
- Parental financial contributions make up a larger share of total revenue in ECE than in schooling.
- ECE services employ their own teachers and can set their own terms and conditions (although many centres participate in collective agreements).
- There is no nationally-consistent assessment or examination in early childhood education.

Available data on early childhood education

Outputs

Output information is readily-available and is in the form considered most appropriate for early childhood – pupil hours (OECD, 2017a; Statistics New Zealand, 2010). ECE in New Zealand is funded by the government on the basis of 'child hours', and public data on funded child hours is available starting from the 2001/02 year to 2014/15 (Table 1.2)

Table 1.2 Funded child hours by service type, 2001/02 - 2014/15

Year	Education & care	Kindergarten	Home-based	Playcentre	Kōhanga reo	TOTAL
2001/02	52 735 460	22 789 173	7 112 748	3 237 396	8 246 582	94 121 359
2002/03	56 091 576	23 210 802	7 413 283	3 331 643	12 823 258	102 870 562

2003/04	59 612 259	23 826 949	7 963 117	3 389 929	12 546 092	107 338 346
2004/05	62 973 908	23 581 858	8 430 793	3 256 751	12 071 919	110 315 229
2005/06	66 719 352	23 865 594	8 638 862	3 327 112	11 763 676	114 314 596
2006/07	70 741 584	23 475 503	9 090 734	3 177 093	11 078 006	117 562 920
2007/08	80 585 039	23 535 049	10 880 497	3 122 620	10 935 254	129 058 459
2008/09	87 843 637	23 436 849	12 453 935	3 169 946	11 141 416	138 045 783
2009/10	95 267 853	23 343 682	14 017 626	3 177 389	11 268 330	147 074 880
2010/11	102 415 632	23 859 076	15 541 741	3 146 315	11 602 158	156 564 922
2011/12	107 359 714	23 843 906	16 169 767	3 010 751	11 524 020	161 908 158
2012/13	114 065 959	24 223 657	16 809 313	2 813 943	11 361 768	169 274 640
2013/14	123 024 575	24 947 758	17 824 221	2 759 700	11 261 420	179 817 674
2014/15	130 607 779	25 437 274	20 170 348	2 710 502	11 106 068	190 031 971
% change 2001/02 – 2014/15	148	12	184	-16	35	102

Source: Ministry of Education

Inputs

Labour

Data on ECE inputs is incomplete or not always comparable, and its quality varies depending on sector. The Ministry of Education publishes information on teaching staff in the teacher-led ECE sector (education & care centres and kindergartens), including their qualification levels, registration, and part time/full time status. However, only headcount numbers are available and changes to the collection method means that more recent data (2013/14 onwards) is not comparable with earlier results.

Table 1.3 Number of ECE teaching staff in licensed teacher-led services with child contact

Year ending June…	Full-time	Part-time	Total
2002	9 007	3 230	12 237
2003	9 508	3 529	13 037
2004	9 923	3 582	13 505
2005	10 538	3 232	13 770
2006	11 008	3 351	14 359
2007	11 819	3 404	15 223
2008	13 375	3 486	16 861
2009	14 607	3 790	18 397
2010	14 553	5 354	19 907
2011	14 299	6 347	20 646

Year ending June…	Full-time	Part-time	Total
2012	14 861	6 620	21 481
2013	15 610	6 585	22 195
2014	*15 512*	*9 772*	*25 284*
2015	*15 361*	*12 869*	*28 230*
Change in total staff numbers, June 2002 – June 2013			81.4%

Source: Ministry of Education

Notes: 2014 and 2015 results not comparable with earlier data, due to change in collection method. 'Full time' defined as working 25 hours or more a week

ECE is also provided through playcentres and te kōhanga reo (both of which rely predominantly on volunteers), and home-based services. Headcount and average weekly hours of duty are available for playcentres (Table 1.4), and headcount and part time/full time status is available for home-based services from 2005 (Table 1.5). No information is currently publicly available for te kōhanga reo teachers.

Table 1.4 Number of playcentre adults on duty and average hours of duty, 2002-15

Year ending June…	Number of on-duty adults	Average weekly hours of duty
2002	7 212	4.2
2003	7 223	4.4
2004	7 268	4.6
2005	7 065	4.7
2006	7 097	4.5
2007	6 765	4.5
2008	6 650	4.6
2009	6 960	4.8
2010	7 063	4.6
2011	7 314	4.6
2012	6 871	4.6
2013	6 337	4.6
2014	6 379	4.6
2015	5 734	4.7

Source: Ministry of Education

Table 1.5 Numbers of home-based educators by full-time / part time status, 2005-2014

Year ending June…	Full-time	Part-time
2005	2 882	791
2006	2 945	692
2007	3 267	886
2008	3 710	985
2009	4 043	1 316
2010	4 495	1 426
2011	4 665	1 526
2012	4 896	1 425
2013	5 108	1 378
2014	*5 383*	*1 701*

Source: Ministry of Education

Note: 2014 results not directly comparable to earlier data, because of a change in the collection method

Funding

The Ministry publishes information on Government expenditure on ECE, which includes:

- Vote Education subsidy and equity funding, professional development and support and family participation support programmes
- Evaluations of ECE centres (funded through Vote Education Review Office); and
- Other ECE payments made through Vote Social Development.

Table 1.6 Government funding of early childhood education, 2001/02 – 2014/15

	Vote Education	Vote Education Review Office	Vote Social Development	Total
2001/02	$358 832 000	$3 049 000	$52 696 000	$414 577 000
2002/03	$384 471 000	$3 557 000	$53 096 000	$441 124 000
2003/04	$401 030 000	$5 828 000	$55 383 000	$462 241 000
2004/05	$453 310 000	$6 646 000	$74 371 000	$534 327 000
2005/06	$564 884 000	$8 320 000	$100 501 000	$673 705 000
2006/07	$627 656 000	$8 287 000	$125 564 000	$761 507 000
2007/08	$870 832 000	$8 672 000	$130 684 000	$1 010 188 000
2008/09	$1 041 837 000	$9 463 000	$134 255 000	$1 185 555 000
2009/10	$1 193 214 000	$9 193 000	$149 990 000	$1 352 397 000
2010/11	$1 350 381 000	$9 708 000	$156 847 000	$1 516 936 000

	Vote Education	Vote Education Review Office	Vote Social Development	Total
2011/12	$1 363 077 000	$9 820 000	$154 426 000	$1 527 323 000
2012/13	$1 445 725 000	$9 610 000	$148 087 000	$1 603 422 000
2013/14	$1 565 696 000	$9 481 000	$145 764 000	$1 720 941 000
2014/15	$1 653 725 000	$9 721 000	$140 486 000	$1 803 932 000
% change 2001/02 – 14/15	360.9	218.8	166.6	335.1

Source: Ministry of Education

Information on monetary contributions made by parents to early childhood is not consistently collected by the Ministry of Education. A biennial survey of ECE services collects information on their revenue and expenditure, but has only provided information on fees for 2011 and 2013 to date (Table 1.7).

Table 1.7 Average hourly ECE fees paid by service type, 2011 and 2013

Service type		2011	2013	% change
Education & care	0 – 1 year old	$5.55	$5.80	4.5%
	2 - 5 years old	$5.25	$5.50	4.8%
Kindergarten	0 – 1 year old	na	na	na
	2 - 5 years old	$3.15	$3.60	14.3%
Home-based	0 – 1 year old	$5.75	$5.60	-2.6%
	2 - 5 years old	$5.75	$5.55	-3.5%
Playcentre	0 – 1 year old	$0.35	$0.45	28.6%
	2 - 5 years old	$0.45	$0.50	11.1%

Source: Ministry of Education, 2015

Statistics New Zealand has been collecting information on household ECE payments as part of the Consumer Price Index since 1988. This information is presented as an index, rather than a monetary figure, which means that it would be necessary to chain weight and combine this data with Government expenditure numbers to establish a time series of total per child hour costs.

Potential measures

Labour and multifactor productivity analysis can be conducted for early childhood education, albeit with some caveats and limitations.

Basic labour productivity

Labour productivity measures capture changes in the ratio of output to labour inputs. The mix of different teacher headcount numbers collected by the Ministry complicate the analysis somewhat, in that they:

- only provide a crude 'full time / part time' distinction for staff in teacher-led services and home-based educators rather than a more accurate Full-Time Equivalent or 'actual hours worked' numbers, and

- do not provide any numbers at all for educators in te kōhanga reo.

Only using the total teacher numbers would overstate the effective teaching resource being deployed, so some sort of adjustment needs to be made to the part-time numbers. For the purposes of this report,

- part time staff numbers for home-based and teacher-led services were multiplied by 0.5 to construct a 'weighted staff numbers' index,
- playcentre adults numbers were multiplied by their average weekly hours of duty, divided by 35 (to provide a weekly fraction) and added to the weighted staff numbers figure,
- te kōhanga reo funded child hours were excluded from the analysis (as there are no staff input numbers), and
- analysis commenced from the 2004/05 year, as that was the first point at which there were corresponding staff data for the home-based sector (Table 1.8).

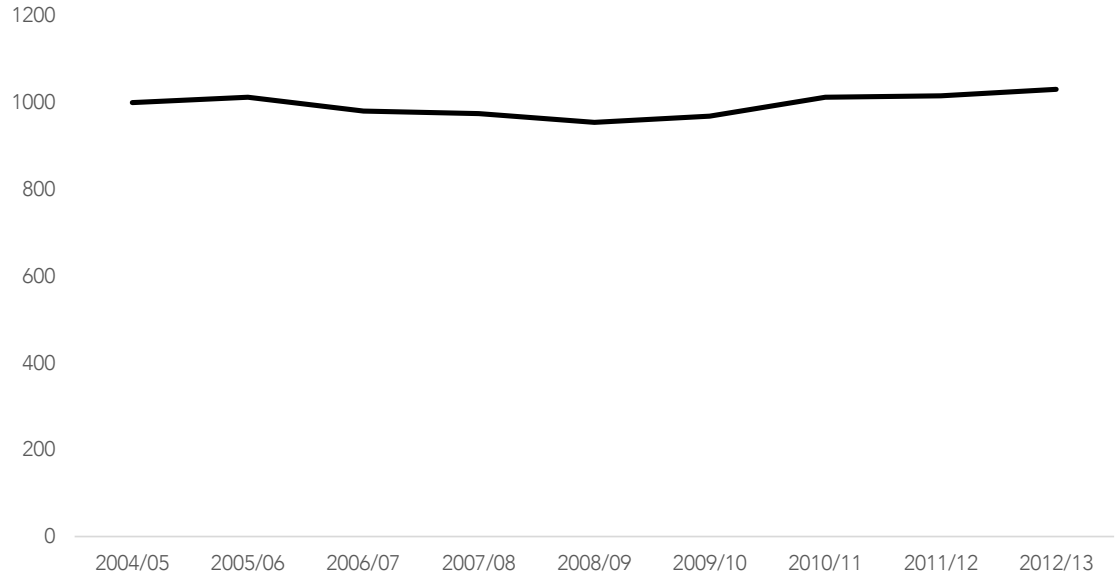
Table 1.8 ECE labour productivity statistics, 2004/05 - 2012/13

Year	Funded child hours (FCH)	Weighted staff numbers	FCH / weighted staff	Index	% change
2004/05	98 243 310	16 380	5997.7	1000	
2005/06	102 550 920	16 887	6072.8	1012.5	1.3%
2006/07	106 484 914	18 101	5882.9	980.9	-3.1%
2007/08	118 123 205	20 195	5849.3	975.3	-0.6%
2008/09	126 904 367	22 158	5727.4	954.9	-2.1%
2009/10	135 806 550	23 366	5812.1	969.1	1.5%
2010/11	144 962 764	23 862	6075.1	1012.9	4.5%
2011/12	150 384 138	24 683	6092.7	1015.8	0.3%
2012/13	157 912 872	25 532	6184.8	1031.2	1.5%

Source: Productivity Commission analysis of Ministry of Education data

Based on this analysis, labour productivity in the early childhood sector seems broadly flat, growing at an annual average of 0.4% (Figure 1.1)

Figure 1.1 ECE labour productivity, 2004/05 to 2012/13



Source: Productivity Commission analysis of Ministry of Education data

Different weights for the part-time staff numbers in teacher-led and home-based services change the results somewhat, but not hugely (Table 1.9).

Table 1.9 ECE labour productivity trends, with different part-time weights, 2004/05 - 2012/13

	Part time staff weighted 0.25		PT staff weighted 0.5		PT staff weighted 0.75	
	Index	% change	Index	% change	Index	% change
2004/05	1000		1000		1000	
2005/06	1010.9	1.1%	1012.5	1.3%	1014.0	1.4%
2006/07	978.6	-3.2%	980.9	-3.1%	982.9	-3.1%
2007/08	969.0	-1.0%	975.3	-0.6%	980.8	-0.2%
2008/09	951.1	-1.8%	954.9	-2.1%	958.4	-2.3%
2009/10	980.7	3.1%	969.1	1.5%	959.0	0.1%
2010/11	1036.2	5.7%	1012.9	4.5%	993.2	3.6%
2011/12	1038.1	0.2%	1015.8	0.3%	997.0	0.4%
2012/13	1049.7	1.1%	1031.2	1.5%	1015.4	1.8%
Annual average % change	0.6%		0.4%		0.2%	

Source: Productivity Commission analysis of Ministry of Education data

Adjusted labour productivity

Another measure of labour productivity takes into account changes in the composition of the teaching workforce, such as changes in the proportion of teachers who are qualified or registered. Better-qualified staff might be expected to produce more, or better, outputs. The Ministry publishes

comparable data on staff in teacher-led services (education & care centres and kindergartens) both for the 2002-2013 June years (Table 1.10).

Table 1.10 ECE teaching staff in teacher-led services by qualification or registration status

Year ending June	Qualification status		Registration status	
	Qualified	Not qualified	Registered	Not registered
2002	5 953	6 284	4 242	7 995
2003	6 432	6 605	4 544	8 493
2004	6 857	6 648	5 040	8 465
2005	7 468	6 302	7 159	6 611
2006	8 187	6 172	8 092	6 267
2007	9 122	6 101	9 087	6 136
2008	10 305	6 556	10 320	6 541
2009	11 780	6 617	11 773	6 624
2010	13 298	6 609	13 415	6 492
2011	14 785	5 861	14 619	6 027
2012	15 870	5 611	15 681	5 800
2013	16 917	5 278	16 746	5 449

Source: Productivity Commission analysis of Education Ministry data

Adjusting the teaching workforce to reflect changes in the qualification or registration status raises the question of what weight to use. One proxy could be to use wage rates from the sector. The 2016-2017 Early Childhood Education Collective Agreement of Aotearoa New Zealand sets out hourly rates for short-term reliever teachers, based on their qualification levels (Table 1.11).

Table 1.11 Short-term ECE teaching reliever wage rates

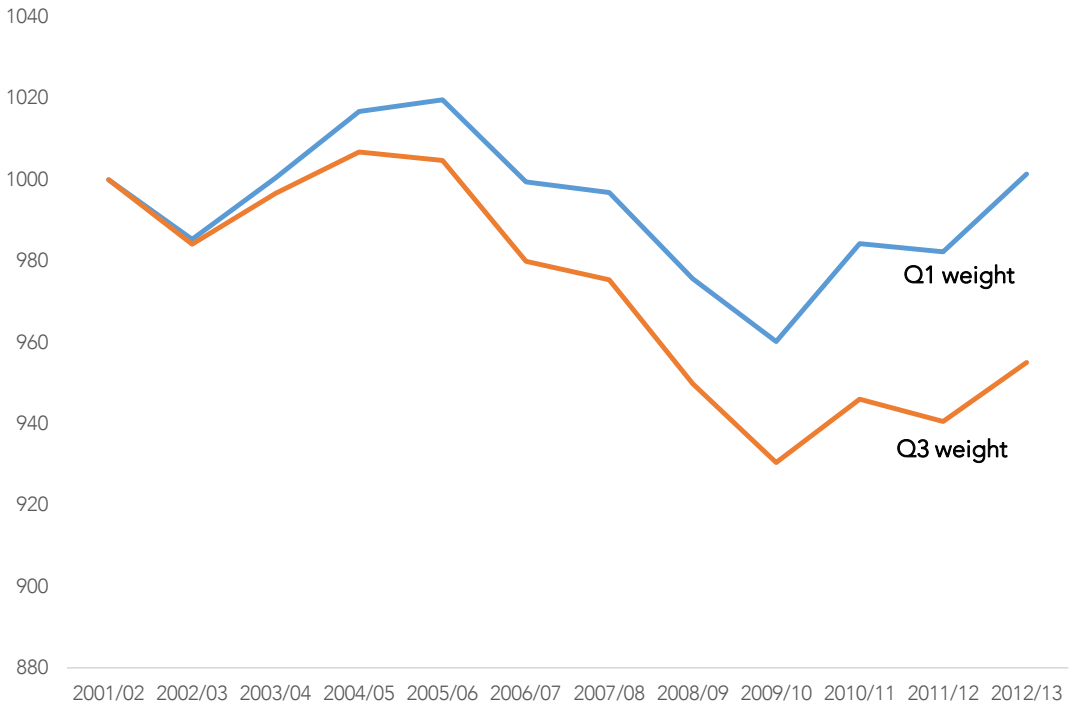
Teacher qualification	Hourly rate, effective 1 July 2017
Unqualified, 1 year of service or less	$15.33
Entry rate, Q1 (Diploma of Teaching ECE or equivalent)	$15.76
Entry rate, Q2 (Diploma of Teaching ECE and 2/3 of a degree, or Higher Diploma of Teaching ECE)	$16.97
Entry rate, Q3 (3 year ECE teaching degree, advanced Diploma of Teaching ECE, or Diploma of Teaching ECE and attested fluency in te reo and knowledge of tikanga Māori)	$18.83

Source: NZEI, 2016

This implies a wage premium for qualified teachers of between 3% (for Q1) and 23% (for Q3). When assessed against funded child hours for education and care centres and kindergartens, adjusting the labour inputs by these two premia leads to a flat or slightly negative productivity trend for the teacher-

led sectors – no overall decline using the Q1 weight (annual average of 0.0%) or an average decline of 0.4% with the Q3 weight (Table 1.12).

Table 1.12 Labour productivity in the teacher-led ECE sectors, adjusted for wage premia for qualifications



Source: Productivity Commission

Because of the difficulties in finding an appropriate weight to reflect the relative values of qualifications, an alternative way to adjust the labour inputs is to use changes in salaries as a proxy. The Ministry of Education does not collect regular data on ECE teacher salaries. However, Statistics New Zealand publishes quarterly information on mean and median salaries in the 'preschool education' sector from its Linked Employer-Employee Dataset. Using this data, adjusted labour productivity has declined on average by 2.8% a year (Table 1.13).

Table 1.13 Labour productivity in the teacher-led ECE sector, adjusted for staff earnings

Year	Funded child hours	ECE teaching staff	Real mean ECE annual earnings	Staff * mean earnings	Index – FCH / staff earnings
2001/02	75 524 633	12 237	$22 622	$276,828,133	1000
2002/03	79 302 378	13 037	$23 198	$302,435,553	961.1
2003/04	83 439 208	13 505	$23 893	$322,675,615	947.8
2004/05	86 555 766	13 770	$24 761	$340,957,796	930.5
2005/06	90 584 946	14 359	$25 530	$366,585,270	905.7
2006/07	94 217 087	15 223	$26 941	$410,125,529	842.0
2007/08	104 120 088	16 861	$27 964	$471,504,119	809.4
2008/09	111 280 486	18 397	$30 555	$562,121,101	725.6
2009/10	118 611 535	19 907	$31 365	$624,380,610	696.3

Year	Funded child hours	ECE teaching staff	Real mean ECE annual earnings	Staff * mean earnings	Index – FCH / staff earnings
2010/11	126 274 708	20 646	$30 942	$638,830,424	724.5
2011/12	131 203 620	21 481	$31 541	$677,534,281	709.8
2012/13	138 289 616	22 195	$31 420	$697,368,410	726.8
Average annual % change				-2.8%	

Sources: Ministry of Education; Statistics New Zealand

Note: real mean annual earnings are in constant 2006 terms using the full CPI, and are the sum of June-June quarterly results. Teaching staff numbers are unweighted, because the mean annual earnings figures should more accurately capture changes in average workloads.

Multifactor productivity

Multifactor productivity measures capture changes in the ratio of output to all inputs. Total ECE revenue would be an appropriate indicator of inputs, but as noted earlier, consistent and long-term monetary data on parental fees is not available.

Based on the most recent survey of ECE centres, Government funding made up the majority of ECE centre revenue, ranging between 58% (for home-based services) and 93% (for kōhanga reo). One option, therefore, would be to use Government funding as the input for productivity analysis. Using Government funding as the input yields an annual average decline in ECE multifactor productivity of 3.4%.

Table 1.14 ECE multifactor productivity, using Government expenditure as inputs

Year	Funded child hours (FCH)	Real total Government ECE $	Index – FCH / total Government $	% change
2001/02	94 121 359	$552 666 778	1000	
2002/03	102 870 562	$579 487 531	1042.4	4.2%
2003/04	107 338 346	$593 181 589	1062.5	1.9%
2004/05	110 315 229	$666 706 945	971.6	-8.6%
2005/06	114 314 596	$808 445 523	830.3	-14.5%
2006/07	117 562 920	$895 889 874	770.5	-7.2%
2007/08	129 058 459	$1 142 531 548	663.3	-13.9%
2008/09	138 045 783	$1 316 064 602	615.9	-7.1%
2009/10	147 074 880	$1 476 684 853	584.8	-5.0%
2010/11	156 564 922	$1 573 313 572	584.3	-0.1%
2011/12	161 908 158	$1 569 167 196	605.9	3.7%
2012/13	169 274 640	$1 636 145 271	607.5	0.3%
2013/14	179 817 674	$1 728 141 589	611.0	0.6%
2014/15	190 031 971	$1 803 932 000	618.6	1.2%

Year	Funded child hours (FCH)	Real total Government ECE $	Index – FCH / total Government $	% change
Annual average % change			-3.4%	

Source: Productivity Commission analysis of Education Ministry data

Note: real total Government ECE $ are in constant June 2015 dollars, and includes ECE expenses from Vote Education, Vote Education Review and Vote Social Development.

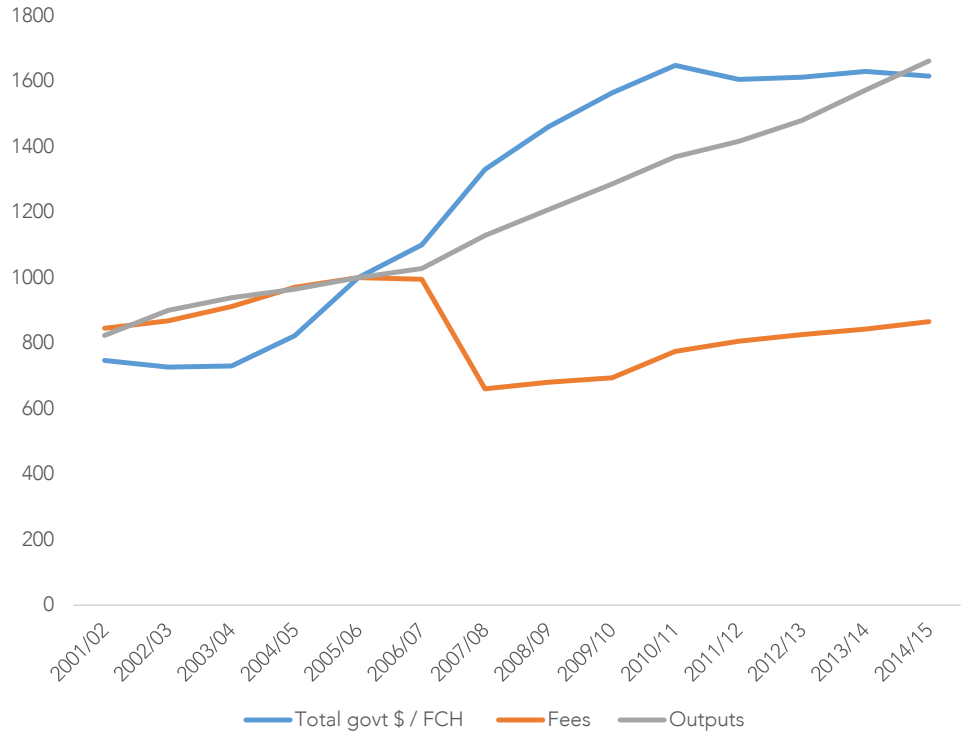
The risk with measurement based solely on Government revenue as the input is that cost-shifting to parents through increased fees may be misrepresented as a productivity gain. Available evidence suggests that cost-shifting may partly explain the apparent improvement in early childhood MFP from 2011/12 onwards, with parental fees rising from that point, while Government funding stabilised (Table 1.15 and Figure 1.2)

Table 1.15 Indices of total government funding per child hour, fees and outputs

Year	Total government funding per FCH (nominal)	Fees	Funded child hours (outputs)
2001/02	747.4	845.5	823.4
2002/03	727	868.2	899.9
2003/04	730.4	912.2	939.0
2004/05	822.5	970.7	965.0
2005/06	1000	1000	1000
2006/07	1100.7	995	1028.4
2007/08	1331.1	661	1129.0
2008/09	1460.8	681	1207.6
2009/10	1564.8	694	1286.6
2010/11	1648.5	775	1369.6
2011/12	1605.8	806	1416.3
2012/13	1612.6	826	1480.8
2013/14	1629.7	843	1573.0
2014/15	1616	866	1662.4
Annual average % change	6.4%	0.8%	5.6%

Sources: Productivity Commission analysis of Ministry of Education and Statistics New Zealand data

Figure 1.2 Changes in parental fees, outputs and per child hour Government funding, 2001/02 to 2014/15



Sources: Productivity Commission analysis of Ministry of Education and Statistics New Zealand data

However, in the most recent survey of ECE provider income, expenditure and fees, centres reported average per child hour costs rising at a faster rate than income (Table 1.16). This suggests that centres are absorbing some cost increases, creating efficiency gains.

Table 1.16 Average cost and income by provider type, 2011 and 2013

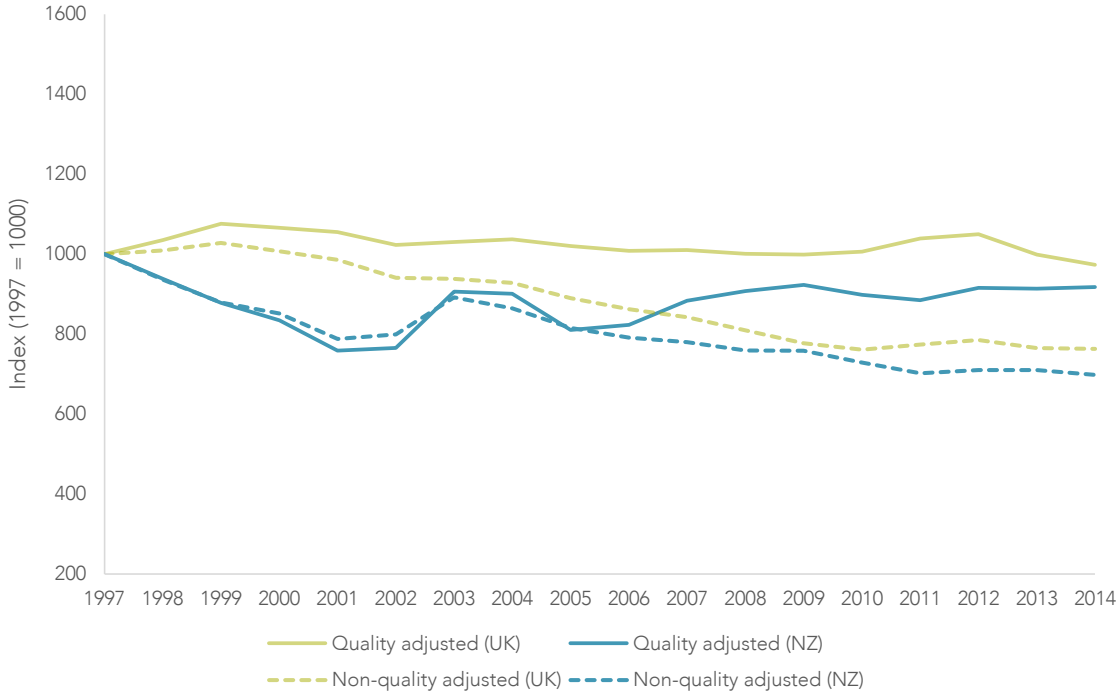
		2011	2013	% change
Education & care	Average income	$10.15	$10.60	6%
	Average cost	$9.20	$10.20	11%
Kindergarten	Average income	$9.95	$10.10	2%
	Average cost	$9.10	$9.70	6%
Home-based	Average income	$8.75	$8.95	2%
	Average cost	$8.10	$8.90	9%
Playcentre	Average income	$6.15	$6.15	0%
	Average cost	$5.70	$5.80	1%
Kōhanga Reo	Average income	na	$7.50	na
	Average cost	na	$7.40	na

Source: Ministry of Education, 2015

1.3 Quality-adjusting ECE outputs

The productivity results presented above only present part of the picture. As Te Rito Maioha comment in their submission to the Commission, an important part of productivity analysis is to "consider how changes in quality or effectiveness are captured in efficiency measures." (sub.2, p.1) After all, productivity gains are not just about increases in the *volume* of output per input, but also about increases in the *quality* of output. Including changes in quality or effectiveness can have quite significant impacts on assessed productivity trends, as can be seen in the difference between the adjusted and unadjusted results from Gemmell et al's schooling productivity analysis (Figure 1.3)

Figure 1.3 Adjusted and unadjusted schooling productivity, UK and New Zealand



Source: Gemmel et al, 2017

So what could be used to quality adjust ECE outputs? Any quality adjustment should have a close causal and empirically-demonstrated link to early childhood activities, be relevant to the entire sector,[2] and avoid overlaps with other parts of the education system (eg, by measuring gains to longer-term life outcomes, where it may be difficult to distinguish the impact of ECE participation from the impact of schooling).

Two possible candidates for quality adjustment are child development and increased parental employment resulting from ECE participation.

Child development

There is a broad range of studies which links ECE participation to positive child development. Mitchell et al's (2008) literature review found evidence of "positive outcomes (cognitive, learning dispositions, and social-emotional) of ECE participation for learners in the short and long term." (p.7) Cognitive outcomes associated with ECE participation included "gains in mathematics and literacy, school achievement, intelligence tests, and also school readiness, reduced grade retention, and reduced special education placement", and the learning dispositions included "attitudes of perseverance, curiosity, confidence, and social competence such as the ability to work with others." (p.2)

In New Zealand, the *Competent Children, Competent Learners* longitudinal study found evidence of continued positive impacts from ECE participation on young people's educational performance at ages

[2] Some studies cite benefits from early childhood participation that are specific to particular types of ECE. For example, Mitchell et al (2008) note studies which report improvements in parenting practices following participation in ECE with intensive levels of parental involvement

14 and 16 (Wylie et al, 2006; Hodgen, 2008). These impacts included improved numeracy and logical problem-solving competencies and social abilities. However, studies in other jurisdictions suggest that the academic benefits from ECE participation may be low or "fade out" relatively quickly. (Lefebvre & Merrigan, 2002; Kay & Pennucci, 2014)

One approach therefore would be to collect information on children's cognitive, attitudinal and social competencies either during their participation in early childhood, or after their entry into school. Relative changes in competency levels in those who attended ECE (compared to those who didn't) could then be used to adjust the funded child hour outputs. Something similar was proposed by Te Rito Maioha, who noted in their submission that to

> ascertain the quality of the outputs – that is the quality of the ECE services that 96.7% of children attended or the quality of the educational experience of that cohort – would require measures for assessing such things as children's self-regulation and school readiness. (sub.2, p.2)

Such information could potentially be based on the national early childhood curriculum document, Te Whāriki, which includes a number of learning outcomes, such as:

- Showing respect for kaupapa, rules and the rights of others | te mahi whakaute
- Recognising mathematical symbols and concepts and using them with enjoyment, meaning and purpose | he korero pāngarau
- Using a range of strategies for reasoning and problem solving | te hīraurau hopanga (Ministry of Education, 2017)

However, the learning outcomes in Te Whāriki are provided for guidance only, and early childhood centres have flexibility in the degree to which their local curricula reflect these outcomes. Using Te Whāriki as the basis for learner competencies would most likely require changing the legal status of the learning outcomes to make them mandatory.

Alternatively, New Zealand could look to join international studies of early learning, which would provide comparable data with other countries. The OECD is currently in the process of trialling an International Early Learning and Child Well-being Study, which would collect "robust empirical data on children's early learning through a broad scope of domains that comprise cognitive and social and emotional development." (OECD, 2017b, p.6) The OECD study has the benefit of being sample-based, and hence potentially lower cost than a broad-based assessment model. Although New Zealand has chosen not to participate in the International Early Learning and Child Well-being pilot, it could join at a later stage, if the study becomes an established OECD tool.

Parental employment

Another possible impact of higher ECE participation is increased parental (especially maternal) participation in the labour force, which may in turn generate social benefits in the form of higher tax revenue, reduced welfare expenses and improved social engagement. A number of studies has found positive impacts on female participation from decreases in the cost of ECE (due to Government subsidies) in Quebec, Canada, Argentina and several US states (discussed in Mitchell et al. 2008).

There does not appear to be much detailed New Zealand evidence on female labour supply response to ECE costs. A "selective review of the evidence" on the labour participation response of mothers to changes in early childhood education costs prepared for the Ministry of Women's Affairs argued that while

> there was a sharp drop in ECE costs in 2007, due to the introduce of the '20 hours ECE' policy, the publicly available data shows no associated detectable increase in labour force participation. However, this does not mean that there was no effect, as a number of other factors influenced employment at this time. In particular, the economic downturn may have masked any effects of '20 hours ECE.' (Knox, 2012, p.3)

On the other hand, Chapple (2012) attributes the lack of a labour supply response to the design of ECE policy:

> …there is little evidence that [20 hours free early childhood education for three and four year old children) has made a big difference to secondary earner employment, probably because the intervention was poorly targeted and designed for the purposes of expanding paid employment of low skilled, largely female parents. (p.31)

An indicator would need to link a child's ECE participation with the employment status of their primary caregiver. This would probably require data-matching or the use of shared data platforms such as the IDI. Relative changes in parental employment (compared to parents whose children either did not attend ECE or participated at lower levels) could be used to quality-adjust outputs.

1.4 Conclusion

Early childhood education has been one of the fastest-growing areas of public education expenditure, and an increasingly universal experience for young New Zealanders. This note explored options for measuring productivity change in ECE using publicly-available data. In doing so, it sought to provide guidance on how to conduct simple productivity analysis and highlight how that analysis could be improved in future.

Publicly-available data provides mixed productivity results, depending on the measure used and adjustment made. Basic labour productivity is largely flat, or negative when adjusted for labour quality. Multifactor productivity also appears to have declined substantially, although the absence of robust and consistent information about parental financial contributions means that this finding needs to be treated with caution.

The ability to analysis ECE productivity would be improved with better input and output data, namely collecting and publishing

- teaching staff data on a full-time equivalent or 'actual hours worked' basis, rather than simple headcounts, and
- data, in monetary terms, on average hourly parental financial contributions (to match the data available average hourly government subsidy rates).

In order to capture changes in the quality of ECE, output information could be adjusted. Measures used for quality adjustment should have a close causal and empirically-demonstrated link to early childhood activities, be relevant to the entire sector, and avoid overlaps with other parts of the education system. Two possible candidates for quality adjustment are child development and increased parental employment resulting from ECE participation. Child development measures would require the introduction of some form of assessment of children's cognitive, attitudinal and social competencies, either before or after their entry to school. A parental employment measure would need to link a child's ECE participation to the employment status of their primary caregiver, and require data-matching or the use of shared data platforms.

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