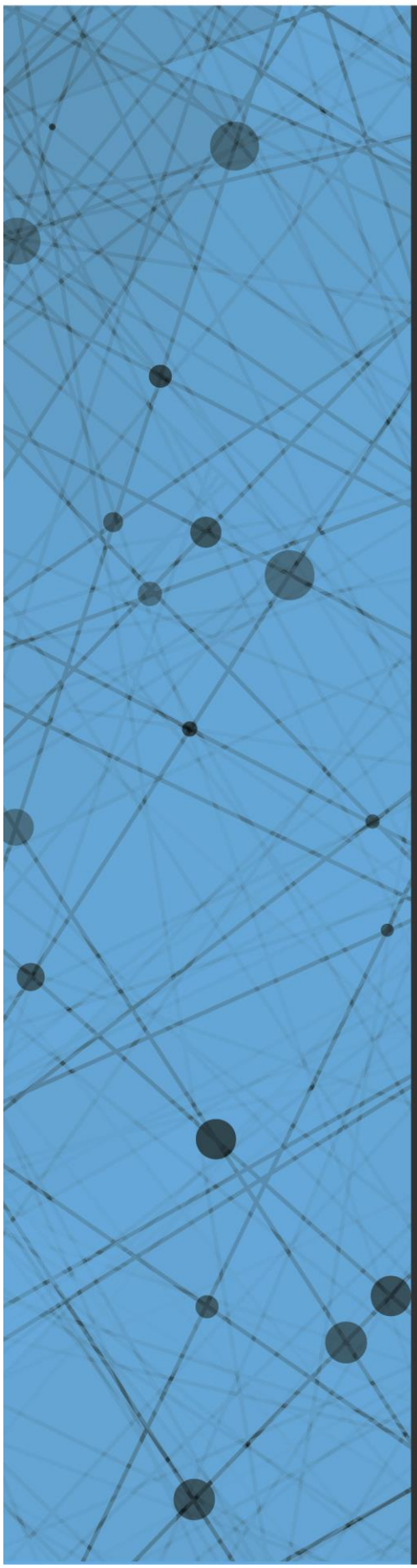

Occupational drift in New Zealand: 1976-2018

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Disclaimer

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Abstract

We measure the rate of occupational change in New Zealand between 1976 and 2018. We use measures of occupational drift reported by Atkinson and Wu (2017) for the United States and by the Australian Office of the Chief Economist (2018) for Australia. This supports the comparison of occupational change between countries as well as over time. We find that occupational change in New Zealand is broadly similar to that in the US or Australia, and that all three countries experienced a slowing in the rate of occupational change over recent decades.

In New Zealand, occupational change was particularly strong between 1986 and 1991 and was historically low between 2006 and 2013, coinciding with the GFC. Current levels of occupational change are similar to those experienced between 1991 and 2006. Employment growth in professional occupations has been particularly strong, growing from 11% of employment in 1976 to 23% in 2018. There has also been pronounced growth and change in the mix of occupations within the 'community and personal services' occupation group and within 'clerical and administrative' occupations.

JEL codes

J01, J24

Keywords

Occupational change, New Zealand

Summary haiku

The jobs that we do
are not those of yesterday.
Each spring, new plants grow.

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Tables and figures

1 Introduction

The nature of work is constantly changing – and always has been. Whether due to new technologies, new work practices, or new goods and services being produced, the mix of jobs evolves over time. In this paper, we trace the changing mix of jobs in New Zealand by measuring changes in the occupational composition of employment over a 42-year period from 1976 to 2018. We calculate measures of occupational 'drift' that is observed as some occupations become a smaller proportion of employment while others increase their share.

We follow the approach of Atkinson and Wu (2017), who examine US patterns, and the Australian Office of the Chief Economist (2018), who examine Australian patterns, to allow international comparisons with New Zealand's rate of occupational drift. These studies use the term 'occupational churn' to describe the changing mix of occupations. We prefer the term 'drift', which better captures the gradual evolution of occupational mix over time. In the context of employment dynamics, the term churn captures the fact that gross flow rates are far in excess of what would be needed to accommodate observed employment growth. Even if there were no change in the level of employment, a lot of people would start new jobs and a lot of people would end jobs. Similarly, a lot of firms, even in the same narrowly defined industry, would grow or start up while others shrink or cease employing. Occupational drift captures something different – the coexistence of growing and declining occupations represents a changing mix of jobs, and not just high rates of turnover, as captured by measures of labour market churn. (Burgess, Lane, & Stevens, 2000; Davis, Haltiwanger, & Schuh, 1998).

2 Measures of occupational drift

In general terms, occupational drift is defined as the sum of jobs gained in growing occupations plus the number of jobs lost in declining occupations, expressed as a proportion of prior period employment. Growth and decline could be measured in absolute terms (growth rates greater or less than zero), or in relative terms, based on whether an occupation's share of total employment is growing or declining.

For clarity, we present measures of occupational drift using the following notation:

National Employment

- E_t=national employment in year t
- $\Delta E_t = (E_t - E_{t-1})$ is the change in employment for occupation i between years.
- $G_t = \frac{\Delta E_t}{E_{t-1}}$=national employment growth rate in year t

Occupation employment

- e_{it}=Employment in occupation i in year t
- $\Delta e_{it} = (e_{it} - e_{it-1})$ is the change in employment for occupation i between years.
- $g_{it} = \frac{\Delta e_{it}}{e_{it-1}}$=occupation employment growth rate in year t

Atkinson and Wu (2017) consider 2 different measures of occupational drift (which they refer to as churn), which differ in their treatment of occupations that grow but grow more slowly than the aggregate employment growth rate. For ease of exposition, we define relative employment change as follows:

- $\widetilde{\Delta} e_{it} = (e_{it} - (1 + G_t) * e_{it-1})$ is the relative change in employment for occupation i between years.

Any occupation that grows more slowly than the national rate (G_t) experiences a decline in their share of total employment and would have a negative relative employment change. Occupations can be categorised into four groups[1], based on their absolute and relative growth

Table 1: Patterns of absolute and relative growth and decline

	Relative decline: $\widetilde{\boldsymbol{\Delta}} \boldsymbol{e_{it}} \leq \mathbf{0}$	Relative growth: $\widetilde{\boldsymbol{\Delta}} \boldsymbol{e_{it}} > \mathbf{0}$
	A: Declining	B1: slower-than-aggregate decline
Absolute decline	Absolute and relative decline	Absolute decline; relative growth
$\boldsymbol{\Delta e_{it}} \leq \mathbf{0}$		Occurs only when $G_t \leq 0$
	B2: slower than aggregate growth	C: Growing
Absolute growth	Relative decline, absolute growth	Absolute and relative growth
$\boldsymbol{\Delta e_{it}} > \mathbf{0}$	Occurs only when $G_t > 0$	

The three sets of occupational drift measures that we consider below differ in their treatment of the different cells of Table 1. For each of the four groups shown in the table above, we define:[2]

- Number of jobs lost or gained

$$D_t^G = \sum_{i \, in \, group \, G} |\Delta e_{it}|$$

- Relative number of jobs lost or gained

$$\widetilde{D}_t^G = \sum_{i \, in \, group \, G} |\widetilde{\Delta} e_{it}|$$

[1] Atkinson and Wu (2017) analyse periods when aggregate growth was positive ($G_t > 0$), so they discuss only three groups – B1 does not occur in their data.
[2] |z| denotes the absolute value of z.

2.1 Main Measure of occupational drift

Atkinson and Wu's first occupational drift measure (2017) sums the relative number of jobs gained and the relative number of jobs lost, expressed as a proportion of initial employment:

$$DRIFT_t^1 = \frac{\left(\widetilde{D}_t^A + \widetilde{D}_t^{B1} + \widetilde{D}_t^{B2} + \widetilde{D}_t^C\right)}{E_{t-1}}$$

This index takes values between 0 (all occupations maintain their share of employment) and 2 (all previous occupations are replaced by a completely new set of occupations).

2.2 Alternative measure of occupational drift

The second occupational drift measure presented by Atkinson and Wu (2017) restricts this measure to gains or losses in occupations that decline both absolutely and relatively, or that grow both absolutely and relatively (groups A and C in the table above):

$$DRIFT_t^2 = \frac{\left(\widetilde{D}_t^A + \widetilde{D}_t^C\right)}{E_{t-1}}$$

When aggregate employment growth is zero, the two measures are identical. With non-zero aggregate growth $DRIFT_t^2$ will generally be less than $DRIFT_t^1$ (the two are equal only if no occupations are in groups B1 or B2). The measure thus depends on the aggregate growth rate – a weakness that the use of relative measures is designed to overcome. For this reason, we prefer the use of $DRIFT_t^1$.

2.3 Gross gains and losses

The third set of measures that we use to capture occupational drift capture the number of jobs lost in declining occupations, or gained in growing occupations, where growth and decline could be defined in absolute or relative terms. These measures are closely related to the measures in the previous section:

- Occupational gain or loss in occupations that declined in absolute size

$$Gain_t = \frac{\left(D_t^{B2} + D_t^C\right)}{E_{t-1}}$$

$$Loss_t = -1 * \frac{\left(D_t^A + D_t^{B1}\right)}{E_{t-1}}$$

- Relative occupational gain (loss) in occupations that grew more rapidly (slowly) than aggregate:

$$\widetilde{Gain_t} = \frac{\left(\widetilde{D}_t^{B2} + \widetilde{D}_t^C\right)}{E_{t-1}}$$

$$\widetilde{Loss_t} = -1 * \frac{\left(\widetilde{D}_t^A + \widetilde{D}_t^{B2}\right)}{E_{t-1}}$$

The loss measures are negative, so $Gain_t + Loss_t = G_t$, the net employment growth rate. By construction, $\widetilde{Gain_t} + \widetilde{Loss_t} = 0$. The main measure of occupational drift ($DRIFT^1$) can be easily derived from the relative measures $\left(DRIFT_t^1 = \widetilde{Gain_t} - \widetilde{Loss_t}\right)$.[3]

3 Data

Detailed occupational data were obtained from eight years of the New Zealand Census of Population and Dwellings (1976, 1981, 1986, 1991, 2001, 2006, and 2013). Census microdata were accessed in the Statistics New Zealand data laboratory.[4] Results derived from the microdata were supplemented outside the datalab by publicly available 2018 census data on employment in level 5 ANZSCO occupations.

The census questionnaires and the coding schedules have varied markedly over the years. Employment counts are based on recoded labour market information to obtain consistent measures of employment across censuses. Similarly, occupations are not coded consistently across censuses. In fact, occupations are coded using 6 different NZSCO or ANZSCO classifications in different years, with 4 census files containing multiple coding using multiple classification schema. Table 2 summarises the available codes.

Table 2: Occupational coding in census files (with number of distinct codes shown in cells)

	Census years								
NZSCO	1976	1981	1986	1991	1996	2001	2006	2013	2018
1968 level 4	1,110	1,110	1,101	1,101	1,069				
1990 level 5				559	560				
1995 level 5					558				
1999 level 5						562	562	562	
2006 level 5							993	1,010	1,023

All occupation codes are mapped to a consistent set of codes. Two consistent sets of coding are derived (harmonised to NZSCO99 and to ANZSCO06). We focus mainly on the data for occupations that have been harmonised to ANZSCO06, since this is the most up-to-date occupational coding. ANZSCO06 estimates are reported for level 1 (1-digit) to level 4 (4-digit) occupations. NZSCO99 estimates are reported for level 3 (3-digit) and level 4 (4-digit) classifications.

[3] Appendix 2 documents the difference between $DRIFT_t^1$ and $(Gain_t - Loss_t)$.

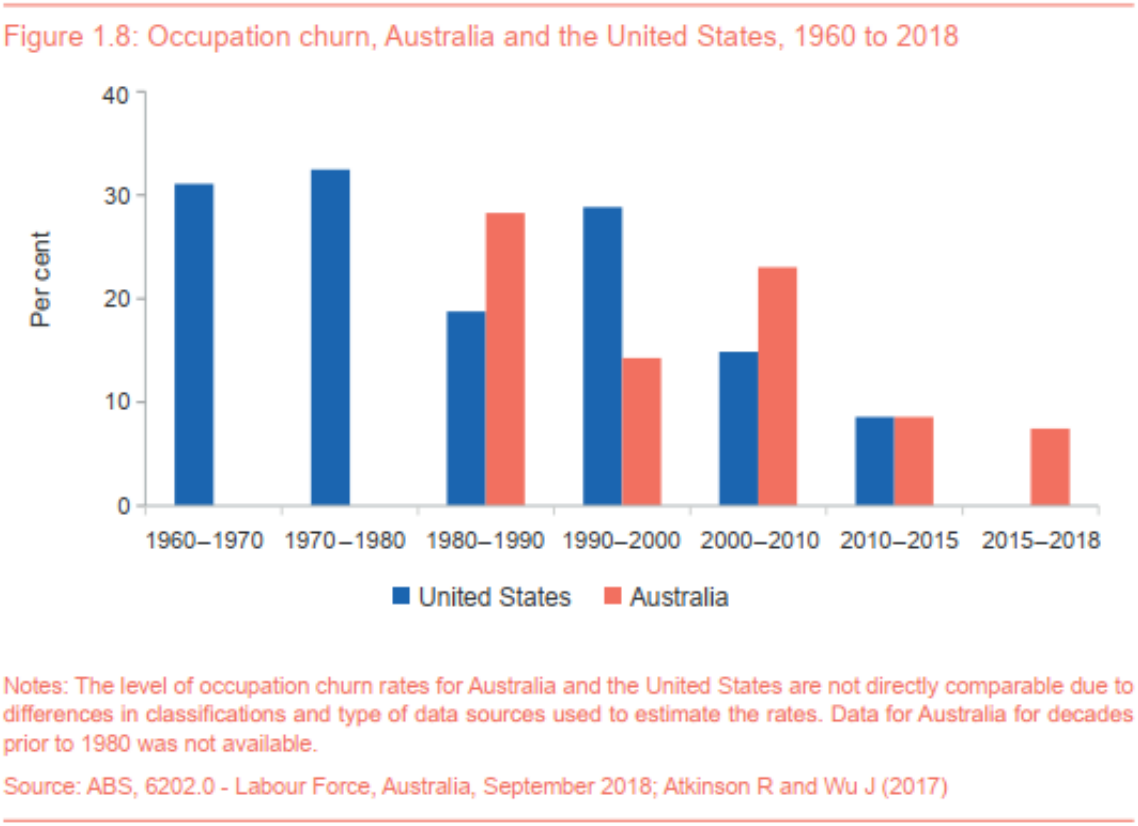
[4] Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Statistics NZ.

The allocation of all data to ANZSCO06 is done using a 'weighted allocation' approach, whereas the allocation to NZSCO99 is done using a 'unique allocation' approach. These methods are outlined in more detail in the Appendix A. The weighted allocation approach is used for ANZSCO06 mapping because of the relatively high potential misallocation that could arise when converting between the differently structured NZSCO99 and ANZSCO06 occupational coding schedules.

3.1 Comparison with International Benchmarks

In the next section, we report summary measures of occupational change in New Zealand. The main focus is on 'occupational drift', as examined for the US by Atkinson and Wu (2017), and for Australia by the Office of the Chief Economist (2018). The choice of measures, timeframes, and definitions has a material effect on the measures. Figure 1 reproduces figure 1.8 from Office of the Chief Economist (2018), which summarises measures for Australia and the United States.

Figure 1. Occupation drift in Australia and the United States



Source: Figure 1.8 from Office of the Chief Economist (2018)

Despite the note at the bottom of the figure cautioning about direct comparability, the authors do not document which method or occupational classifications they used. By comparison with the figures in Atkinson and Wu (2017), it appears that the US measures are based on IPUMS 2010 occupational coding (458 categories) and using method Two (which we refer to as $DRIFT_t^2$).

For the Australian figures, the method is described loosely as "Occupation churn is equal to the absolute value of the sum of jobs created and jobs lost in a particular period as a share of total jobs in the economy in the base period." Our comparisons below assume that this refers to Method One ($DRIFT_t^1$), given that the study aims to compare with the US study, but the description could refer to the sum of gross changes ($Gain_t - Loss_t$). Occupational coding in Australia is based on the ANZSCO schedule but it is not clear whether Office of the Chief Economist (2018) used the most detailed level 5 (level 5) codes (1352 categories) or a less detailed level that would be more comparable with the US coding level (e.g.: Level 4 with 474 categories). It is also not clear whether the estimates for 2010-2015 and 2015-2018, which related to periods shorter than a decade, have been adjusted to be decadal rates for comparison with the other decadal changes. In presenting international comparisons below, we assume that the 2010-2015 and 2015-2018 rates are unadjusted, and the rates have therefore been inflated to be decadal rates (e.g.: the 5-yearly drift between 2010 to 2015 is doubled so that the rate of drift is comparable with other 10-year periods).

The size of estimated drift will also differ depending on the detail of occupational classification, and also on the time period considered. Measures of occupational drift will be higher when more detailed occupational coding is used and will also be higher when measured over a longer period. For that reason, the next section presents the various measures of occupational drift in New Zealand using a range of coding schedules, and for both 5- and 10-year periods.

4 Results

4.1 Occupational drift in New Zealand

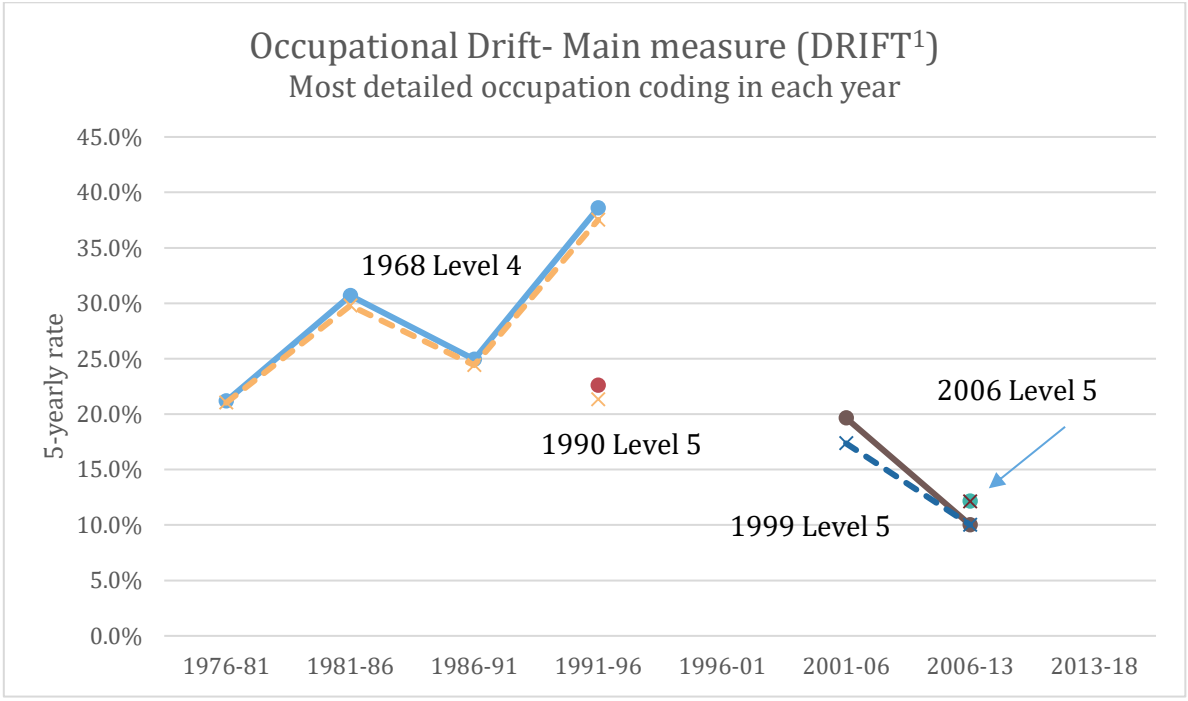
Figure 2 graphs measures of 5-yearly occupational drift based on the most detailed occupation coding available in each census, with the underlying data also tabulated in the first panel of Table 3. Estimates are available for only a subset of years due to changes in occupational coding. A direct comparison of occupational drift using different coding schedules for the same period is available in only two periods – 1991-1996 (using NZSCO68 and NZSCO90) and 2006-2013 (using NZSCO99 and ANZSCO06). For the latter of these periods, the measures are fairly

consistent, showing occupational drift of around 8%. In the former, however, occupational drift was 39% based on NZSCO68 coding, but only 23% based on NZSCO90 coding.

The dotted lines in Figure 2 show estimates of occupational drift using the alternative measure ($DRIFT_t^2$). They are very similar to the main ($DRIFT_t^1$) estimates, so are not displayed on subsequent graphs. The parallel estimates are, however, for completeness, shown in panel (b) of Table 3.

The NZSCO68 coding suggests a decline in occupational drift for the 1986-1991 period, followed by a sharp rise in the following 1991-1996 period. We have not done an exhaustive analysis of these patterns, but it appears that some of this may reflect changing approaches to job titling or classification. Between 1986 and 1991, there appears to be an upgrading of titles in several areas – e.g.: fewer office clerks and more office managers. We are unable to tell whether this reflects actual occupation changes or changes to how occupational titles were coded. Between 1991 and 1996, there appears to be more extensive use of generic occupation codes that are 'general' or 'not elsewhere classified'. The apparent rise in occupational drift between 1991 and 1996 may in part be due to this change in how jobs are allocated to NZSCO68 occupational codes. It may be that the use of more generic codes is inevitable when trying to map job titles from 1996 to occupation codes defined 28 years earlier – in 1968.

Figure 2: Occupational drift – using different coding schedules (Measure $Drift^1$)



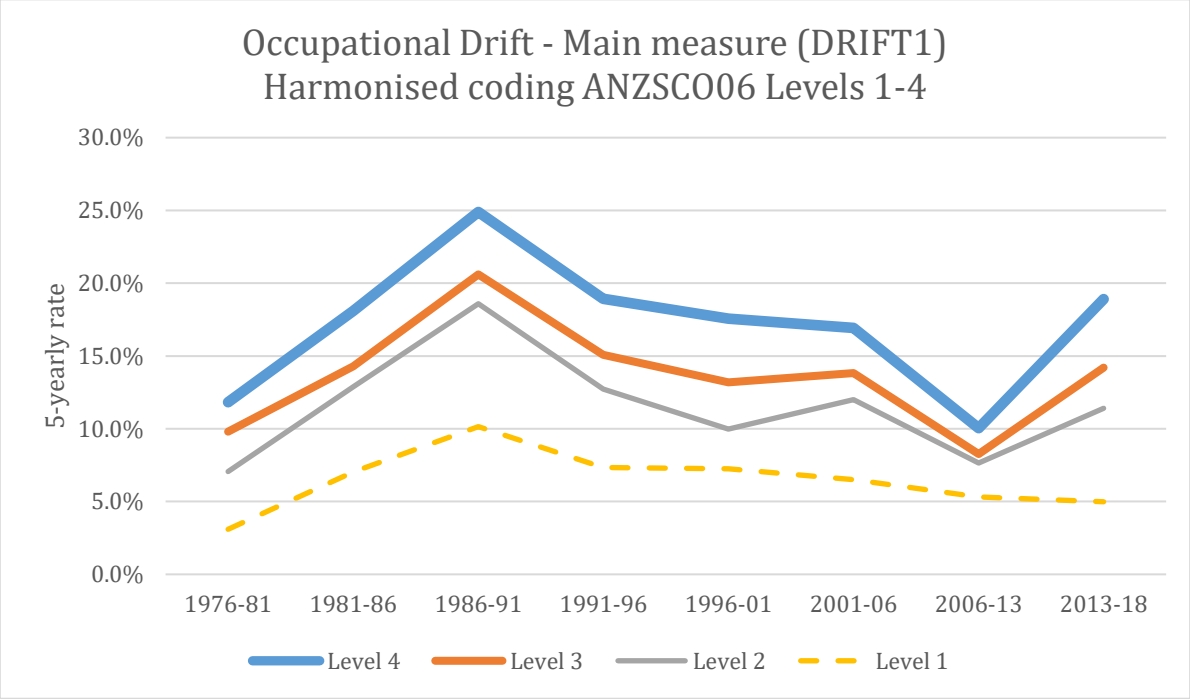
Note: Dotted lines and 'X' symbols show the alternative measure ($DRIFT_t^2$)

Table 3: Occupational Drift – different coding schedules

NZSCO	#codes	1976 - 1981	1981 – 1986	1986-1991	1991 - 1996	1996 - 2001	2001 - 2006	2006 – 2013	2013 - 2018
					Panel A: $DRIFT_t^1$				
1968: Level 4	1,115	21.2%	30.7%	24.9%	38.6%				
1990: Level 5	560				22.6%				
1999: Level 5	558						19.6%	10.0%	
2006: Level 5	1,020							12.1%	
Harmonised coding									
1999: Level 4	257	13.1%	18.4%	28.4%	19.7%	16.3%	15.6%	8.5%	
1999: Level 3	96	9.8%	15.5%	21.1%	14.1%	13.7%	13.2%	7.6%	
2006: Level 4	358	11.8%	18.1%	24.9%	18.9%	17.6%	16.9%	10.0%	18.9%
2006: Level 3	97	9.8%	14.3%	20.6%	15.1%	13.2%	13.8%	8.3%	14.2%
2006: Level 2	43	7.1%	12.9%	18.6%	12.7%	10.0%	12.0%	7.6%	11.4%
2006: Level 1	8	3.1%	7.0%	10.1%	7.3%	7.2%	6.5%	5.3%	5.0%
					Panel B: $DRIFT_t^2$				
1968: Level 4	1,115	21.0%	29.8%	24.4%	37.5%				
1990: Level 5	560				21.3%				
1999: Level 5	558						17.4%	10.0%	
2006: Level 5	1,020							12.1%	
Harmonised coding									
1999: Level 4	257	12.8%	17.6%	28.1%	18.3%	15.6%	13.1%	8.5%	
1999: Level 3	96	9.7%	13.9%	20.7%	11.8%	13.1%	10.8%	7.6%	
2006: Level 4	358	11.5%	17.3%	24.6%	17.7%	17.1%	15.1%	10.0%	13.4%
2006: Level 3	97	9.4%	12.8%	20.3%	13.2%	13.0%	11.7%	8.2%	9.3%
2006: Level 2	43	6.9%	11.3%	18.4%	11.1%	9.6%	9.5%	7.6%	7.5%
2006: Level 1	8	2.5%	5.5%	9.3%	5.6%	5.9%	3.2%	5.3%	2.5%

In any case, such issues highlight the importance of using as consistent a set of occupation codes as possible. Figure 3 presents estimated rates of occupational drift based on having allocated all employment to ANZSCO06 codes – as described in section 3 and in the appendix. The corresponding values are shown in the last 4 rows of panel (a) in Table 3.

Figure 3: Occupational drift– Main measures (using harmonised ANZSCO06)



The rate of occupational drift peaked in the 5-year period from 1986 to 1991. Using the most detailed level of consistent coding (level 4), occupational drift reached 25%. This occurred at a time when employment dropped. Employment, measured as people whose occupation could be coded, declined by 7% between 1986 and 1991. Occupational drift of 25% means that 12.5% of 1986 employment was lost in occupations that contracted by more than the average rate of -7% and that this was balanced by faster-than-average growth (or smaller-than-average declines) in other occupations.

The lowest rate of occupational drift occurred in the 1976-1981 period, when the rate was around half that seen in 1986-1991. Occupations that grew faster than the average rate of 4% added about 6% to the 1976 level of employment and this was balanced by relative losses in occupations that grew by less than 4% or shrank.

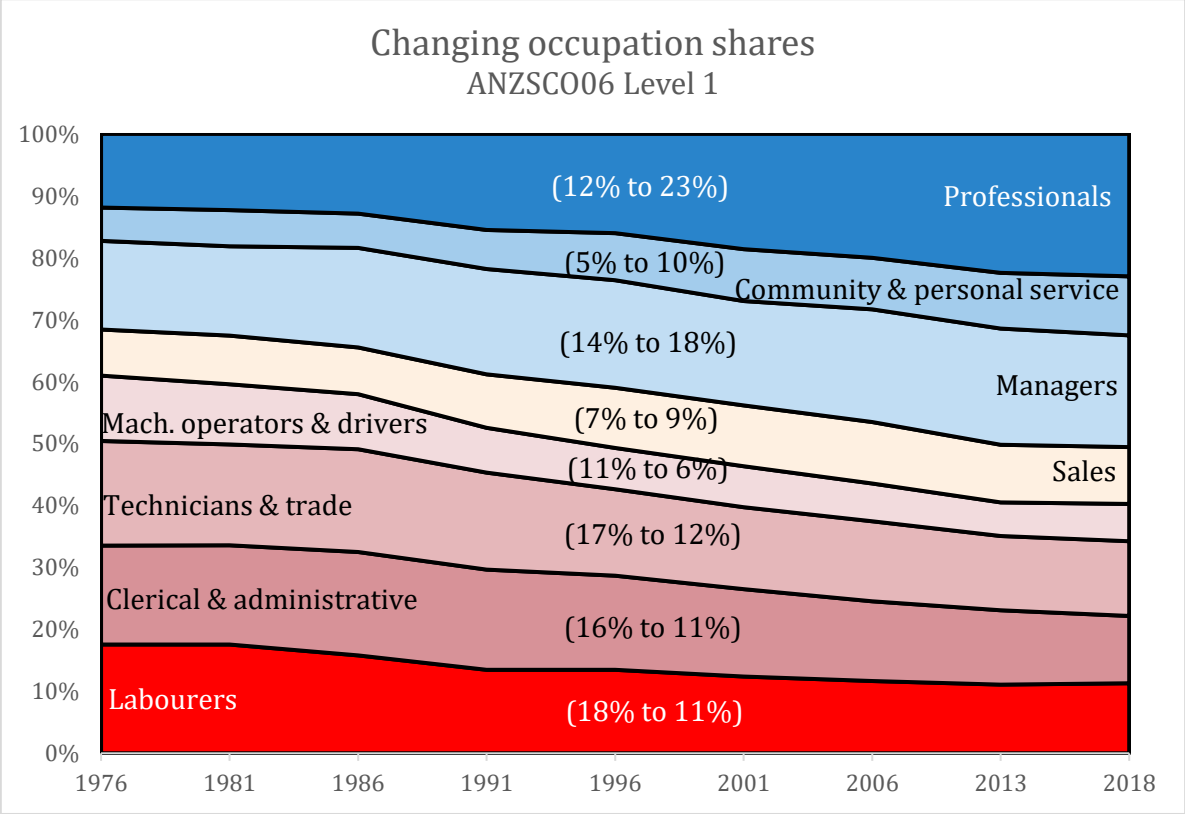
Since 1991, the rate of occupational drift has been relatively stable, apart from a pronounced drop in the rate of drift between 2006 and 2013, when the (5-yearly) rate was only 10%. This period includes the years of the global financial crisis (GFC), which saw not only a drop in employment but also a slowing of gross job and worker flow rates in the labour market

(Maré, 2018). Apart from 2006-2013, the rate of occupational drift in New Zealand since 1991 has been between 17% and 19%.

Figure 3 also presents measures of occupational drift based on more coarsely classified occupations – using level 3, level 2 and level 1 coding. Occupational drift measures based on coarser coding are always smaller than the corresponding more-finely-coded measures because they exclude drift that occurs within the coarse occupation groups. The general pattern over time is, however, similar for the different levels of classification, with the exception that occupational drift based on level 1 occupation data has continued to decline. This implies that the rise in level 2 drift reflects mainly reallocations of employment shares between level 2 occupations within the same level 1 group. There is a similar divergence of level 1 and level 2 occupational drift in 1986-91 and 2001-2006.

Figure 4 summarises the changing occupational composition of employment over 42 years, using ANZSCO06 level 1 coding. Occupations are ordered by growth rate over the period. The growth of professional occupations is clearly evident, growing from 12% of employment in 1976 to 23% of employment in 2018. In contrast, labourers' share of employment declined from 18% to 11%. The impact of these changes on occupational drift measures can be seen in the final row ('2006 level 1') of Panel (a) in Table 3.

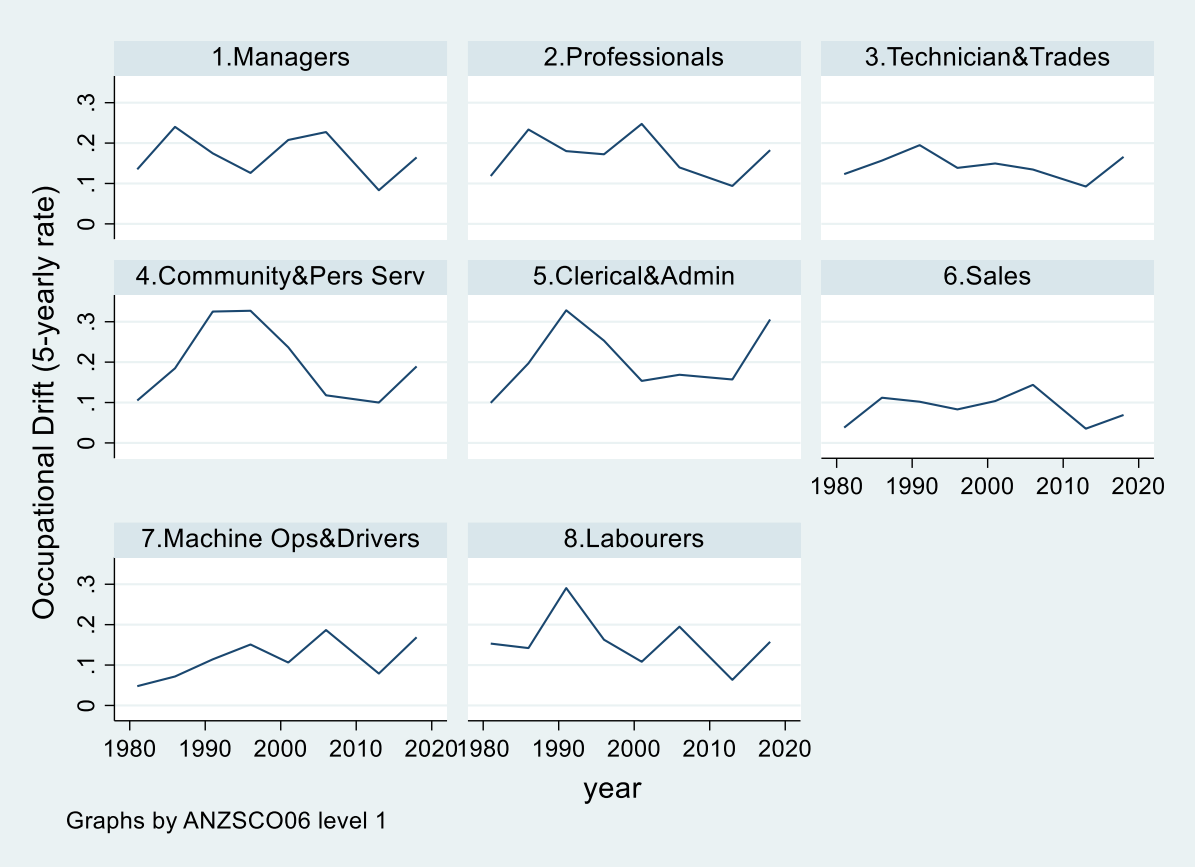
Figure 4: Changing occupational shares: level 1 occupations



Note: Occupations are ordered by change in share of employment.

Occupational drift also occurs within each level 1 occupation. To reveal the nature of occupational drift within occupations, Figure 5 shows the occupational drift within each of the eight level 1 occupation groups. It is clear that the 2013-2018 divergence shown in Figure 3 is due in large part to occupational changes within the 'Clerical and Administrative workers' group ($Drift^1$ =30.6%). Occupational drift within the 'Clerical and Administrative' group was also strong in 1986-91 (32.8%), as it was for the 'Community and Personal Services' group in 1986-91 (32.5%) and 1991-96 (32.7%). We interpret these patterns as indicative of real changes in occupational composition, although different approaches to occupational coding may have also contributed to the changes.

Figure 5: Occupational drift within level 1 occupations



Note: Occupational drift ($DRIFT^1$) based on growth of level 4 occupations within level 1. Calculations use harmonized ANZSCO06 occupational coding

A similar analysis can be done to identify the rate of occupational drift within each of the 43 level 2 occupation groups. Table 4 summarises the pattern of growth and within-occupation drift for each level 2 occupation.

Table 4 lists each level 2 occupation, showing the average employment share over the 1976-2018 period, the mean 5-year growth rate, and the within-occupation drift. It also shows

the number of level 4 occupations included in each level 2 group.[5] Two main patterns are evident in the table.

Table 4: Occupational Drift – within level 2 occupation: 1976-2018

	Level 2 ANZSCO06	Mean Emp share	Mean 5yr growth (76-18)	Within occupation Drift[1]	Num of level 4 occs
11	Chief Executives, General Managers and Legislators	2.9%	21.3%	6.7%	3
12	Farmers and Farm Managers	4.7%	-1.9%	6.0%	4
13	Specialist Managers	5.8%	18.9%	17.5%	20
14	Hospitality, Retail and Service Managers	3.4%	7.8%	9.1%	11
21	Arts and Media Professionals	0.8%	13.3%	10.7%	8
22	Business, Human Resource and Marketing Prof's	3.3%	23.4%	16.6%	20
23	Design, Engineering, Science and Transport Prof's	2.5%	16.7%	15.4%	23
24	Education Professionals	4.6%	9.2%	9.5%	10
25	Health Professionals	3.2%	15.0%	10.8%	23
26	ICT Professionals	1.1%	47.2%	21.8%	7
27	Legal, Social and Welfare Professionals	1.5%	19.5%	12.3%	9
31	Engineering, ICT and Science Technicians	2.1%	5.6%	17.8%	13
32	Automotive and Engineering Trades Workers	3.7%	-2.4%	6.9%	12
33	Construction Trades Workers	2.4%	7.9%	10.7%	9
34	Electrotechnology and Telecomms Trades Workers	1.6%	0.9%	10.1%	5
35	Food Trades Workers	1.4%	13.6%	16.9%	4
36	Skilled Animal and Horticultural Workers	1.1%	12.9%	14.8%	7
39	Other Technicians and Trades Workers	2.2%	-1.0%	14.8%	16
41	Health and Welfare Support Workers	0.9%	9.6%	17.7%	7
42	Carers and Aides	2.3%	26.0%	21.4%	6
43	Hospitality Workers	1.8%	12.7%	8.3%	6
44	Protective Service Workers	1.3%	7.0%	9.5%	5
45	Sports and Personal Service Workers	1.0%	23.2%	17.4%	12
51	Office Managers and Program Administrators	1.9%	24.3%	26.5%	3
52	Personal Assistants and Secretaries	1.6%	-3.1%	3.7%	2
53	General Clerical Workers	3.6%	-6.9%	8.8%	2
54	Inquiry Clerks and Receptionists	1.5%	7.4%	7.9%	3
55	Numerical Clerks	2.8%	0.5%	10.8%	6
56	Clerical and Office Support Workers	1.1%	-3.5%	16.1%	7
59	Other Clerical and Administrative Workers	1.9%	5.0%	14.6%	10
61	Sales Representatives and Agents	2.5%	15.5%	7.4%	4
62	Sales Assistants and Salespersons	5.3%	8.5%	3.7%	8
63	Sales Support Workers	1.1%	10.0%	10.9%	7
71	Machine and Stationary Plant Operators	2.8%	-7.0%	14.0%	12
72	Mobile Plant Operators	1.0%	6.7%	9.8%	4
73	Road and Rail Drivers	2.5%	5.8%	5.0%	5
74	Storepersons	1.2%	2.2%	0.0%	1
81	Cleaners and Laundry Workers	2.4%	5.6%	8.3%	6
82	Construction and Mining Labourers	1.3%	-5.7%	15.6%	8
83	Factory Process Workers	3.4%	-2.7%	8.7%	10
84	Farm, Forestry and Garden Workers	3.1%	2.0%	11.7%	7
85	Food Preparation Assistants	0.7%	18.7%	9.9%	3
89	Other Labourers	2.9%	7.2%	13.2%	10

[5] The rate of occupational drift will generally be lower when there are fewer level 4 occupations. In the extreme case when there is only one level 4 occupation (Level 2 group 74), within occupation drift is zero.s

First, the level 2 occupations with the highest changes in occupational mix, as captured by within-occupation drift, are generally also the occupations that grew most rapidly between 1976 and 2018. These include occupations in the 'professional workers' group (codes 21-27), in 'community and personal services' occupations (codes 41-45), and a subset of management occupations - the single largest level 2 occupation group of 'specialist managers' (code 13), and 'office managers and program administrators' (code 51). The second main pattern is that some of the more routine occupations have declined in size and have experienced only low to moderate levels of occupational drift. These occupations include general clerical workers (code 53), 'machine and stationary plant operators' (code 71) and 'construction and mining labourers' (code 82).

4.1.1 Some examples of occupational drift

In this section we examine changes for specific level 4 occupations. Occupational drift occurs when level 4 occupations grow at different rates, so examining variation in occupational growth provides insights into the mechanisms that give rise to occupational drift. Among the contributing causes are differential industry growth and decline, new technologies, and the changing organisation of work. We discuss examples of each of these factors, as well as examples in which measures of drift based on level 4 data may fail to detect occupational change.

Industry changes

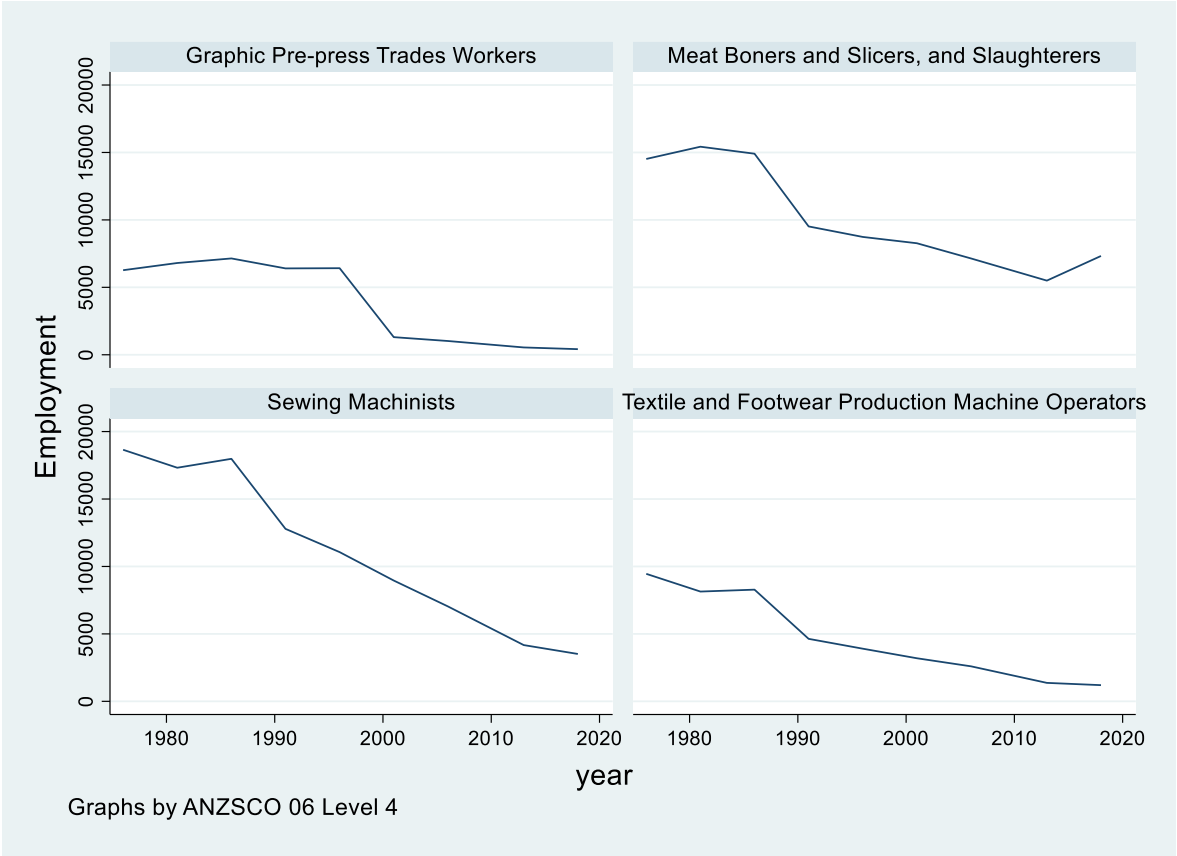
Some occupations are defined in part by the industry in which the occupation is practiced. Consequently, occupational drift may arise because of overall growth or decline in particular industries. Figure 6 shows four examples of occupational decline within industries that have experienced overall employment decline.

Each of the panels of Figure 6 relates to a specific level 4 ANZSCO code, which is the most detailed level of coding used in the harmonised occupational classification. Within each of these occupational groups, there is a range of different occupations included. Furthermore, the way that these contributing occupations is captured has varied over time. It is instructive to see the range of detailed occupations that are associated with a level 4 code has changed over time. The final panel of Figure 6 relates to the level 4 ANZSCO06 code "7117: Textile and Footwear production machine operators". There are 8 level 5 codes associated with this level 4 code, as shown in the left had column of Table 5. The right hand column of Table 5 shows over 50 level 4 NZSCO68 codes that are closely associated with ANZSCO code 7117.[6] The 1968 NZSCO

[6] Not all of the listed NZSCO68 occupations were completely allocated to ANZSCO 7117. In addition, there were other NZSCO 1968 codes that were partly allocated to ANZSCO 7117, including a range of other machinists, designers, and process workers.

occupational coding schedule allowed a much finer disaggregation of related occupations, reflecting the much larger number of people working in these occupations, which together accounted for employment of over 14,000 in 1976 (and more than 16,000 in 1971). Any changes in occupational employment shares among the detailed occupations shown in Table 5 will not be reflected in the level 4 ANZSCO measures of occupational drift because they all appear as a single level 4 occupation in the calculations.

Figure 6: Industry-related occupational decline



Note: Figures are for Level 4 ANZSCO codes 3922, 8312, 7116, and 7117 respectively.

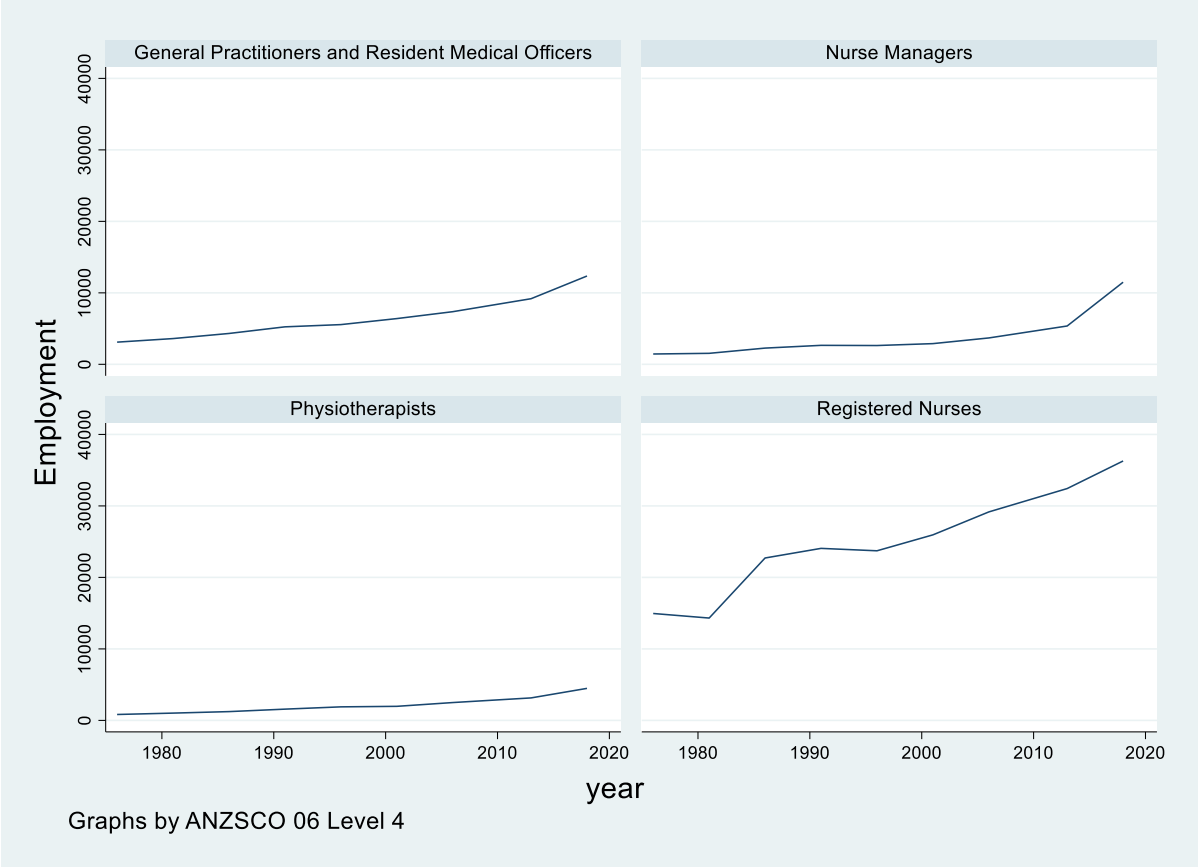
The effects of industry change are also evident for health-related occupations. The health sector has not only expanded since 1976 but has also experienced moderate occupational drift. The level 2 ANZSCO06 group of 'Health Professionals' (code 25) contains 23 occupations at level 4, and 83 at level 5 – many more than the 20 Level 4 occupation codes available in NZSCO68. Figure 7 shows employment changes for four of the level 4 ANZSCO codes that had the largest numeric changes between 1976 and 2018. Measured occupational drift within level 2 occupational groups reflects the impact of differential growth rates across level 4 occupations.

Table 5: ANZSCO 7117: Textile and Footwear production machine operators – contributing occupations

ANZSCO06 level 5		A subset of associated NZSCO68 Level 4 codes	
7117	Textile and Footwear Production Machine Operators • 2018 employment = 1,200 • 1976 employment = 9,453	75	Spinners, weavers, knitters, dyers • 1976 employment = 8,393; • 1971 employment = 10,032
711711	Footwear Production Machine Operator	7511	Wool grader and classer
711712	Hide and Skin Processing Machine Operator	7512	Wool scourer
711713	Knitting Machine Operator	7513	Wool comber, drawer and carder
711714	Textile Dyeing & Finishing Machine Operator	7514	Other wool preparer
711715	Weaving Machine Operator	7515	Fibre preparer other than wool
711716	Yarn Carding & Spinning Machine Operator	7519	Other fibre preparers
711799	Textile & Footwear Prod. Machine Ops nec	7521	Spinner and winder, woollen mills
		7522	Spinner and winder, other fabrics
		7529	Other spinners and winders
		7531	Loom fixer
		7532	Knitting machine setter
		7533	Jacquard machine preparer
		7539	Other weav/knitting mach. Setters, Pattern-Card Preparers
		7541	Beam warper
		7542	Loom threader
		7543	Cloth weaver, except Jacquard weaver
		7544	Jacquard weaver
		7545	Carpet weaver
		7546	Fabric examiner
		7547	Fabric repairer
		7549	Other weavers and related workers
		7551	Knitter, knitting machinist
		7559	Other knitters
		7561	Bleacher and dyer
		7562	Textile washer and shrinker
		7563	Textile waterproofer
		7564	Textile press operator
		7569	Other bleachers, dyers and textile product finishers
		7591	Braidmaker
		7592	Net maker
		7599	Other spinners weavers knitters dyers & related wkrs nec
		76	Tanners, fellmongers and pelt dressers • 1976 employment = 1,081 • 1971 employment = 1,482
		7611	Hide and skin grader
		7612	Fellmonger
		7613	Hide flesher and dehairer
		7614	Hide splitter
		7615	Tanner, currier and dyer
		7619	Other tanners and fellmongers
		7621	Pelt dresser
		7622	Pelt grader
		7629	Other pelt dressers

ANZSCO06 level 5	A subset of associated NZSCO68 Level 4 codes
	80 Shoemakers and leather good makers • 1976 employment = 4,722 • 1971 employment = 5,040
	8011 Shoemaker - bespoke
	8012 Orthopaedic footwear maker
	8013 Shoe repairer (bootmaker)
	8019 Other shoemakers and shoe repairers
	8021 Shoe pattern maker
	8022 Shoe clicker (cutter)
	8023 Bench worker (shoe)
	8024 Shoe sewer and machinist
	8029 Other shoe cutters, lasters, sewers and related workers
	8031 Saddler and harness maker
	8032 Leather goods assembler and worker
	8039 Other leather goods makers

Figure 7: Health related occupations (ANZSCO 25: Health professionals)



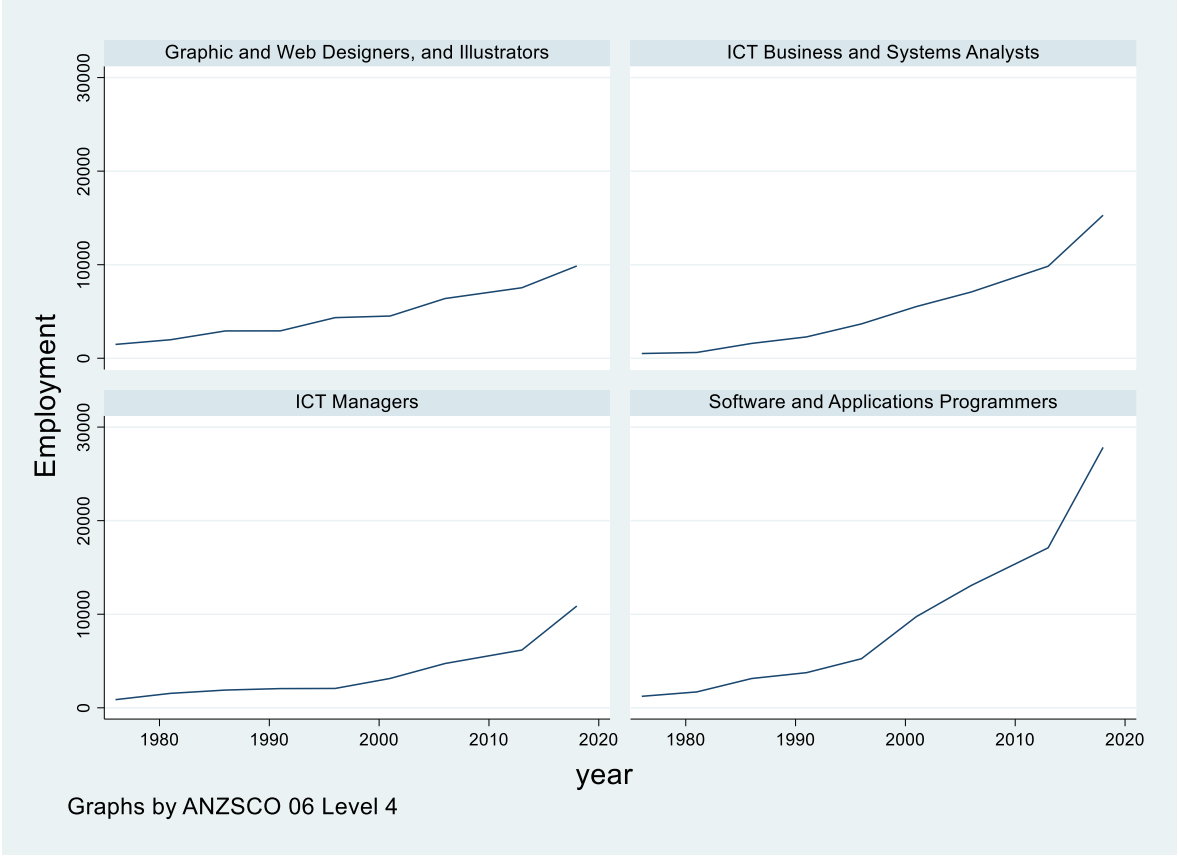
Note: Figures are for Level 4 ANZSCO codes 2531, 2543, 2525, and 2544 respectively.

Computers

Computerisation has also contributed to occupational change. Although the impact of computerisation is widely spread, the occupational impacts are most clearly seen in the increase

in computer-related occupations, and in the changing mix of occupations within offices. Figure 8 shows employment levels from 1976 to 2018 for selected level 4 ANZSCO occupations within the 'ICT Professionals' Level 2 group. The included occupations are those with the largest numeric changes in employment over the period. For the 'ICT Professionals' group as a whole, employment increased from around 2,000 in 1976 to almost 60,000 in 2018 (from 0.2% of employment, to 2.4% of employment). The substantial change in the employment share accounted for by ICT professional employment contributed to measured occupational drift over the period, as did differential growth of occupations within the Level 2 occupation group – which can be seen in the different rates of growth in Figure 8.

Figure 8: Selected computing related occupations



Note: Figures are for Level 4 ANZSCO codes 2324, 2611, 1351, and 2613 respectively.

The growth of employment for ICT professionals is also reflected in changes in occupational coding. The now-larger occupation group is subdivided into 21 Level 5 codes in the ANZSCO06 classification. In contrast, related occupations were captured in NZSCO68 mainly by only four codes, as shown in Table 6.

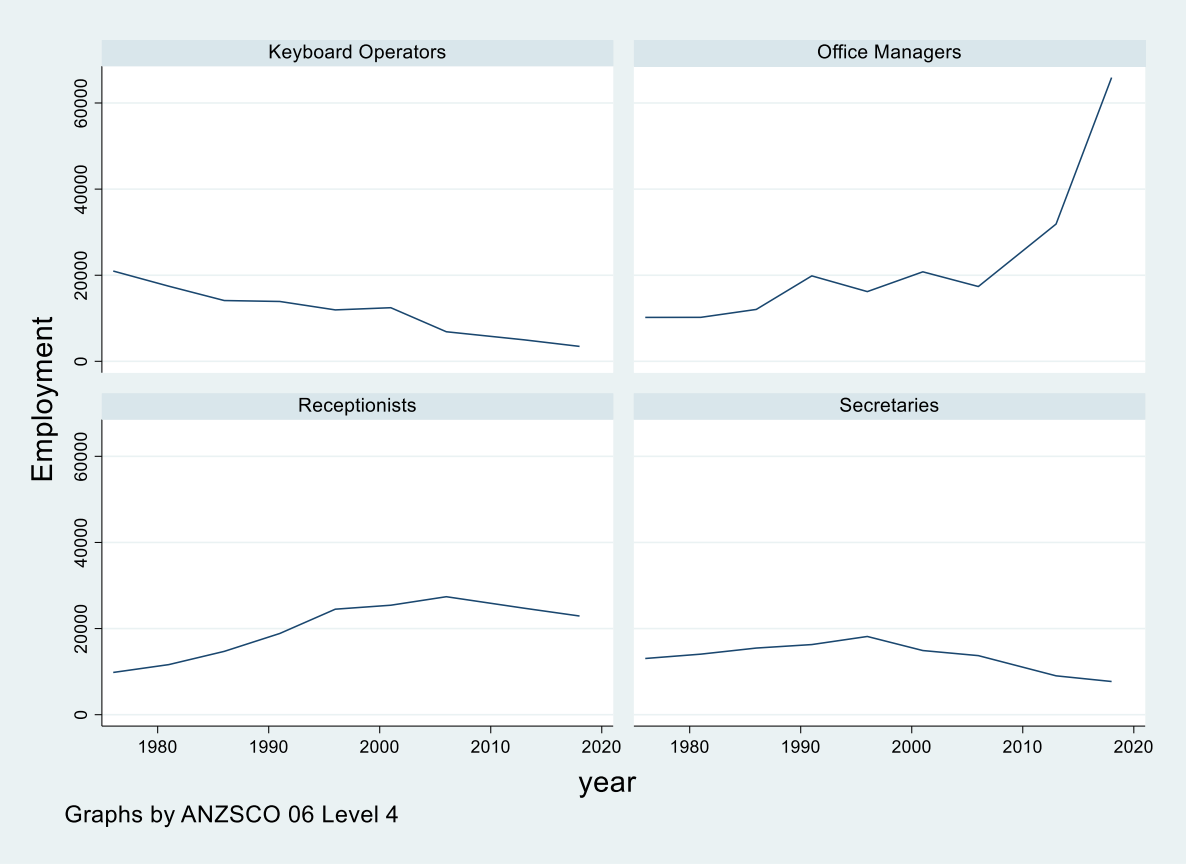
Table 6: ANZSCO 26: ICT professionals – contributing occupations

ANZSCO06 level 5		Associated NZSCO68 Level 4 codes	
26	ICT Professionals • 2018 employment = 58,587 • 1976 employment = 2,283		Various NZSCO codes
261111	ICT Business Analyst	0234	Computer services engineers
261112	Systems Analyst	0830	Systems analysts
261211	Multimedia Specialist	0841	Computer programmer
261212	Web Developer	0849	Other statistical & math technicians
261311	Analyst Programmer		
261312	Developer Programmer		
261313	Software Engineer		
261314	Software Tester		
261399	Software and Applications Programmers nec		
262111	Database Administrator		
262112	ICT Security Specialist		
262113	Systems Administrator		
263111	Computer Network and Systems Engineer		
263112	Network Administrator		
263113	Network Analyst		
263211	ICT Quality Assurance Engineer		
263212	ICT Support Engineer		
263213	ICT Systems Test Engineer		
263299	ICT Support and Test Engineers nec		
263311	Telecommunications Engineer		
263312	Telecommunications Network Engineer		

Office jobs

Computers have also had a substantial impact on the organisation of office work, which is reflected in the employment levels within 'Clerical and administrative worker' occupations (ANZSCO06 Level 1 occupation group 5). Employment levels for selected occupations are shown in Figure 9. The clerical and administrative occupation that has grown most strongly is 'office manager', which has increased from 10,000 in 1976 to 32,000 in 2018. This occupation combines a range of duties that were previously carried out by more specialised occupations. In many workplaces, the functions of receptionists and secretaries have also been combined with other duties, which may explain the slowing growth of employment in these occupations. Similarly, the functions performed by keyboard operators have in part been incorporated into other clerical and administrative occupations, as the use of computers has become an integral part of almost all forms of office work rather than a specialised occupation in its own right. The changing nature of 'keyboard operators', which declined from 21,000 in 1976 to 3,500 in 2018, is reflected in the changing list of related occupations in NZSCO68 compared with ANZSCO06. This is shown in Table 7, with 11 NZSCO68 level 4 occupations associated with only 3 ANZSCO06 Level 5 occupations.

Figure 9: Selected clerical and administrative workers occupations (ANZSCO06 Level 1 group 5)



Note: Figures are for Level 4 ANZSCO codes 5321, 5121, 5421, and 5212 respectively.

Table 7: ANZSCO 5321: Keyboard operators – contributing occupations

ANZSCO06 level 5		Associated NZSCO68 Level 4 codes	
5321	Keyboard operators • 2018 employment = 3,471 • 1976 employment = 20,973	32 34	Stenographers, Typists and Card and Tape Punching Machine Operators Computing Machine Operators
532111	Data Entry Operator	3211	Shorthand and dictaphone typist
532112	Machine Shorthand Reporter	3212	Secretary-Typist
532113	Word Processing Operator	3213	General typist
		3214	Verbatim reporter including Hansard
		3215	Teletypist
		3216	Varitypist
		3219	Other stenographers & typists
		3220	Card and tape punching machine operators
		3421	Computer operator (incl peripheral machine)
		3422	Punch card machine operator
		3429	Other automatic data processing machine operator

The growth of management

More generally, the changing organisation of work is reflected in the relatively rapid growth of management occupations, as was shown in Figure 9 for office managers. The number of managers (level 1 ANZSCO06 group 1) grew from 14% of employment to 18% of employment between 1976 and 2018 – an increase in employment from 186,000 to 441,000. Figure 10 shows employment levels for a selection of level 4 occupations that experienced particularly large numerical increases.

Figure 10: Selected management occupations (ANZSCO06 Level 1 group 1)

Note: Figures are for Level 4 ANZSCO codes 1311, 1111, 1112, and 1324 respectively.

Changing occupation titles

Changes in occupational titles can reflect changes in the organisation of work and the degree of task specialization across occupations. The NZSCO68 coding schedule has 14 codes for 'production supervisors' (codes 7010-7099), which differ only according to which industry they are in. The 2006 ANZSCO codes do not include 'production supervisor' as an occupation title. While industry-related occupation names are still used in the 'technicians and trades workers' classification (ANZSCO06 level 1 group 3), for Machine operators (level 3 group 711), and for

Labourers (level 1 group 8), the role of 'supervisor' appears only for retail supervisors (Level 4 code 6215).

A further example of occupational classifications changing to reflect the changing nature of work is the classification of 'government and local body official' (NZSCO68 level 4 code 3101). The NZSCO90 coding schedule retained the generic sector-based naming for senior central government officials (11211) and senior local government officials (11212), but these no longer appear in the ANZSCO06 codes. Instead, senior officials are categorised functionally, in occupations such as 'corporate services manager (132111), 'finance manager' (132211), 'human resources manager' (132311) or 'policy and planning manager' (132411)

A final change in the nature of work and the classification of jobs that is evident from occupational classifications is the removal of explicitly gendered occupation titles. Some examples of this are included in Table 8.

Table 8: Examples of gendered occupation titles that have been superseded

ANZSCO06 level 3/4/5		Associated NZSCO68 Level 4 codes	
3122	Civil Engineering Draftspersons and Technicians	0327	Draughtsman (general)
3123	Electrical Engineering Draftspersons and Technicians		
3124	Electronic Engineering Draftspersons and Technicians		
3125	Mechanical Engineering Draftspersons & Technicians		
133611	Supply and Distribution Manager	3315	Post Office counter clerk including Postmistress
561411	Mail Clerk	3520	Postmasters
6217	Street Vendors and Related Salespersons	4525	Milkman
732	Delivery Drivers		
441212	Fire Fighter	5811	Fireman
899212	Fishing Hand	6411	Fisherman
231211	Master Fisher		
831212	Slaughterer	7731	Slaughterman
8991	Caretakers	9592	Building maintenance man
591116	Warehouse Administrator	9715	Warehouseman, storeman
721914	Railway Track Plant Operator	9909	Railway ballastman, trackman, ganger, navvy
821611	Railway Track Worker		

4.1.2 Long run occupational drift

The strength of measured occupational drift depends on the period over which drift is measured. If a change in occupational shares were reversed in consecutive 5-year periods, this would result in positive drift in both 5-year periods, but no drift across the decade. In Table 9, we show rates of occupational drift for 10-year periods rather than for intercensal periods as in Table 3. We measure change between non-consecutive censuses (e.g.: change between 1976 and 1986). We calculate decadal occupational drift for all available decades, with the result that our measures cover overlapping periods (e.g.: changes between 1981 and 1986 are reflected in the 1976-1986 and the 1981-1991 measures of drift. The rates for 2001-2013 and 2006-2018 are converted to decadal rates by multiplying them by 10/12.

Table 9: Occupational drift – Decadal rates and long-run drift: 1976-2018

								1976-2018	
ANZSCO 06	1976-1986	1981-1991	1986-1996	1991-2001	1996-2006	2001-2013	2006-2018	Drift over 42 years	As a decadal rate
Level 4	24.9%	34.5%	34.4%	31.5%	30.4%	22.6%	24.2%	135.3%	32.2%
Level 3	20.3%	29.8%	27.5%	24.8%	23.9%	19.4%	19.3%	115.6%	27.5%
Level 2	18.3%	26.4%	25.0%	21.7%	20.6%	18.8%	18.2%	106.0%	25.2%
Level 1	8.6%	14.7%	18.2%	15.0%	13.8%	12.3%	9.1%	78.1%	18.6%

Note: Rates for 2013-18 have been converted to decadal rates. Rates in the final column are not decadal rates – they are rates of occupational drift over 37 years.

The decadal rates of drift in Table 9 are higher than the 5-year rates in Table 3, but in general are slightly less than the sum of the two corresponding 5-year rates.[7] Although some of the 5-yearly occupational changes are reversed in the following period, the dominant pattern is one of occupational growth trends that are sustained over time – occupations that increase their share of employment in one period are more likely to do so in the following period as well.

The final columns of Table 9 summarise occupational drift over the entire 1976-2018 period, comparing employment patterns in 2018 with those in 1976. Using level 4 ANZSC06 coding, the long run rate of drift is 135.3%. About half of this (two thirds as many people as were employed in 1976) is due to growth in occupations that increased their share of employment. An equal amount is due to occupations with declining shares. The final column of the table converts this into a decadal equivalent (by dividing by 42 and multiplying by 10). The resulting rate is of a similar size to the average of the decadal rates, suggesting that occupational

[7] In the presence of employment growth, the sum of 5-year rates could be smaller than the decadal rate because the second 5-year period is measured as a proportion of the larger mid-decade employment. The difference is also affected by the correlation of growth rates and employment shares, as documented in Appendix 2.

drift is largely cumulative, and that occupational drift in one period is reinforced rather than reversed by subsequent drift.

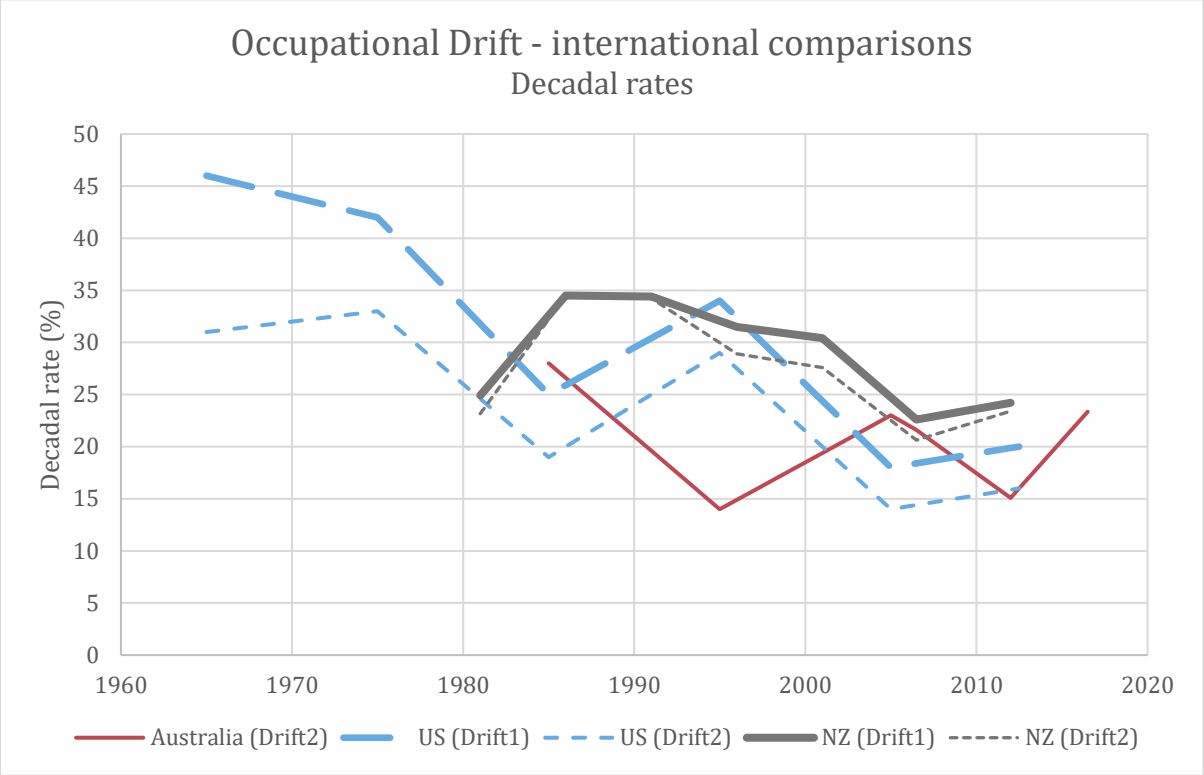
4.1.3 International Comparisons of occupational drift

The availability of occupational drift measures for Australia and the United States enables us to gauge, to some extent, whether New Zealand rates of occupational drift are high or low compared with rates in these other countries. Some caution is needed making these comparisons due to the different occupational codings used. For instance, as noted in section 3.1, we cannot be certain of the number of occupation groups used. For the purposes of comparison, we measure occupational drift based on level 4 ANZSCO06 coding (358 categories used) to most closely align with the assumed number of categories used by Atkinson and Wu (2017) and Office of the Chief Economist (2018).

The international measures are based on changes over 10-year periods, apart from recent periods of less than 10 years, which we convert to decadal rates. We base the comparison with New Zealand rates on the decadal rates reported in Table 9. The comparison is shown in Figure 11, combining Australian, United States and New Zealand measures, and with each measure plotted against the middle year of the period over which occupational drift is measured.

The general pattern of decline that Atkinson and Wu (2017) report for the United States is evident using the main measure of drift (DRIFT_t^1) and, to a lesser extent, using the alternative measure (DRIFT_t^2). For Australia, the pattern is less clear, but also shows the highest rate of drift in the earliest (1980-1990) decade. Occupational drift in New Zealand is at a similar rate to that in the United States, except for in the peak period of 1981-1991 period. Since then, decadal occupational drift has been declining in New Zealand, matching the general trend in the other countries.

Figure 11: Occupational drift– International comparisons



Note: Rates for all periods have been converted to decadal (10-year) rates. Points are plotted against the year that is mid-way through the period over which drift is measured. For instance, drift between 1981 and 1991 is plotted as year 1986. New Zealand data are presented for overlapping 10-year periods. For instance, 1981-1991 (plotted as year=1986) is included as well as 1986-1996 (plotted as year=1991).

4.2 Occupational gains and losses

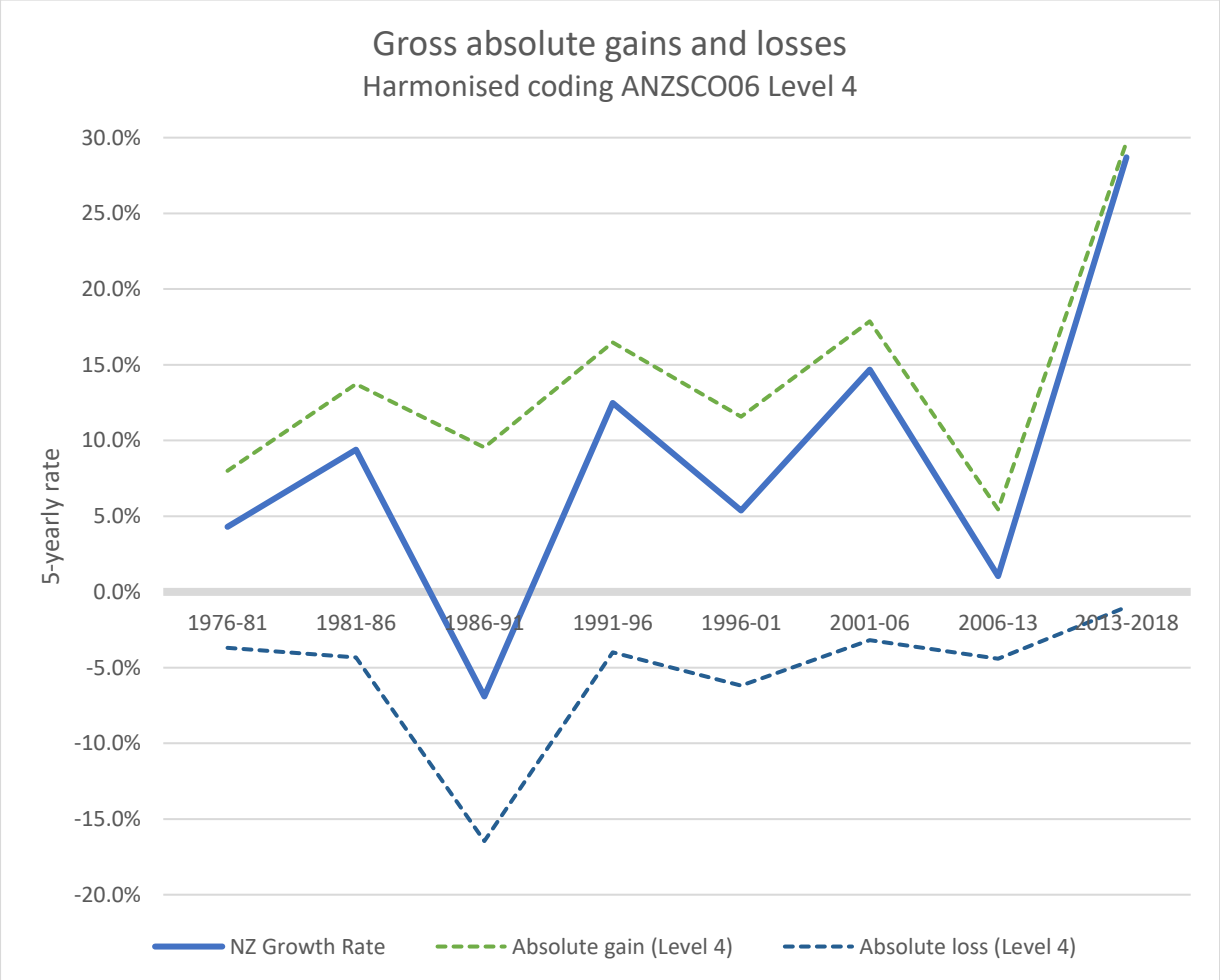
The final indicator of occupational drift that we report is the rate of gross gain or loss, as documented in section 2.3. Figure 12 presents estimates of absolute gains and losses, which separately identify employment reductions in occupations that shrank, and employment increases in occupations that grew. These measures are highly influenced by the overall rate of growth and as such are a less meaningful measure of occupational drift *per se*. In a period of high overall growth, there may be few occupations that decline in absolute numbers, even though the mix of occupations could be changing markedly. Similarly, in periods of overall employment reduction, there may be large absolute losses even without any change in the occupational mix.

The solid line in Figure 12 is the employment growth rate, as captured by the count of people who were employed in each census and reported an identifiable occupation. The reported growth rate thus captures patterns of non-response and imputation as well as actual employment growth. The growth rates are, however, very similar to the corresponding estimates obtained from the Household Labour Force Survey, apart from in the 2013-2018

period. In this period, the census data show a higher growth rate (28.7%) than the HLFS (19.1%). This may reflect the lower rate of missing responses due to greater use of administrative and imputed data in the 2018 census.

The dotted lines show the total employment growth in growing occupations (positive line) and the total employment losses in occupations that contracted. The rate of employment loss is relatively stable over time, at around -5% of total employment, apart from the 1986-91 period, when there were losses of around -15% in declining occupations. Apart from 1986-91, the rate of employment gains in expanding occupations mirrors the overall growth pattern. We conclude from these relationships that absolute gains and losses are individually weak indicators of occupational drift, and that measures based on relative growth, as defined in section 2, are more informative.

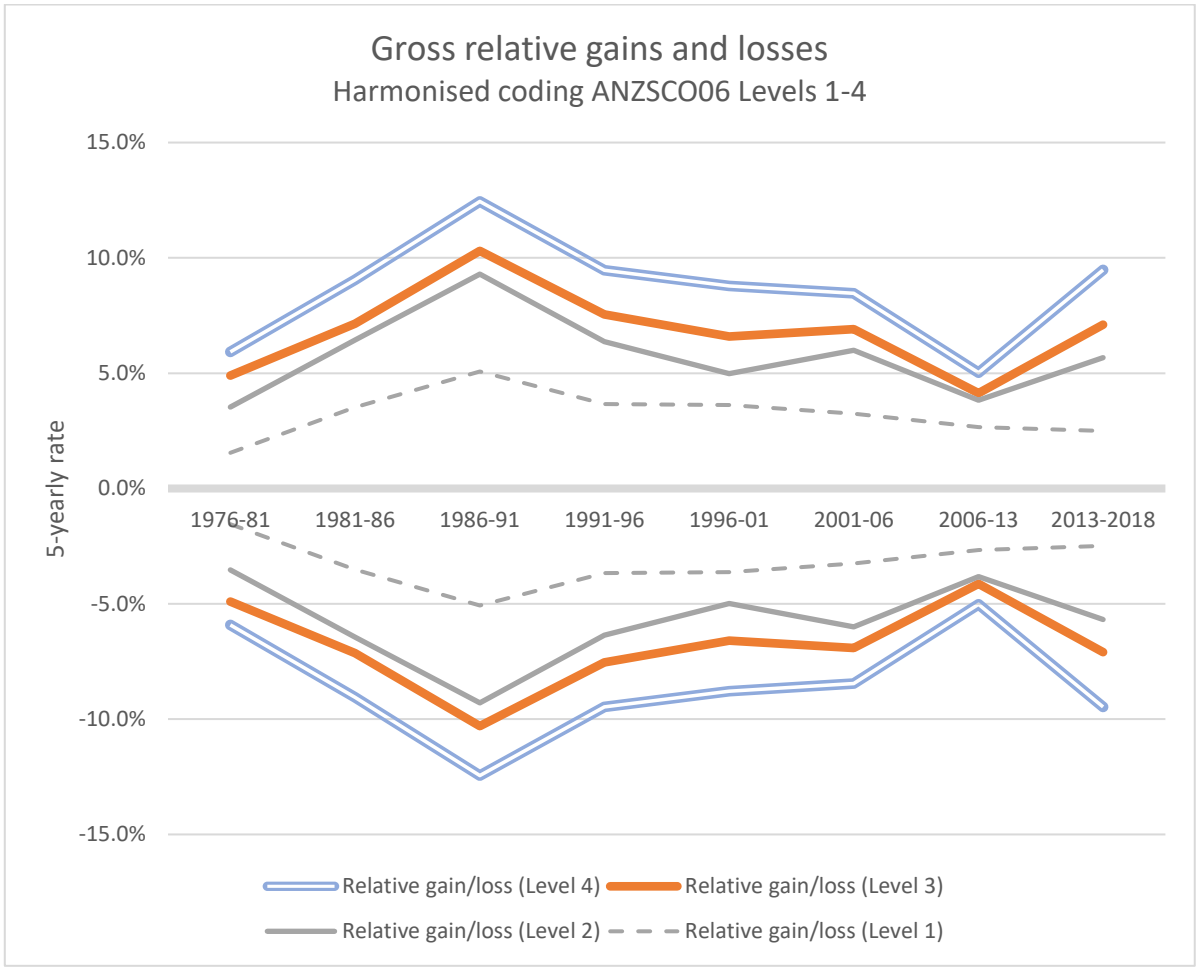
Figure 12: Gross occupational absolute losses



Note: Absolute gain is the increase in employment resulting from growing occupations. Absolute loss is the decrease occurring in contracting occupations. Both are measured as a proportion of aggregate employment at the start of the period over which growth is measured.

Relative gains and losses are presented in Figure 13, for each of the four levels for which we have harmonised ANZSCO06 coding. The gains and losses are symmetric (by construction), and $DRIFT_t^1$ is the vertical distance between pairs of relative gain and relative loss lines. The similarity of the shape of the gross relative gains lines and the occupation drift lines in Figure 3 is not coincidental. As a result of symmetry, $DRIFT_t^1 = 2 * Gross\ relative\ gain$. Figure 13 thus illustrates the interpretation of $DRIFT_t^1$. In the 2006-13 period, for instance, level 4 occupations that grew faster than average added 5% to total employment. This was balanced by slower than average growth in other industries, leading to a 'shortfall' in those industries equivalent to 5% of employment. The interpretation of the pattern for 1986-91 is analogous, though in that period overall employment declined. The gross relative loss is therefore the loss of employment in occupations that declined more strongly than overall employment. This was balanced by relative gains in other occupations, where declining more slowly than the average decline counts as a relative gain.

Figure 13: Gross occupational relative gains and losses

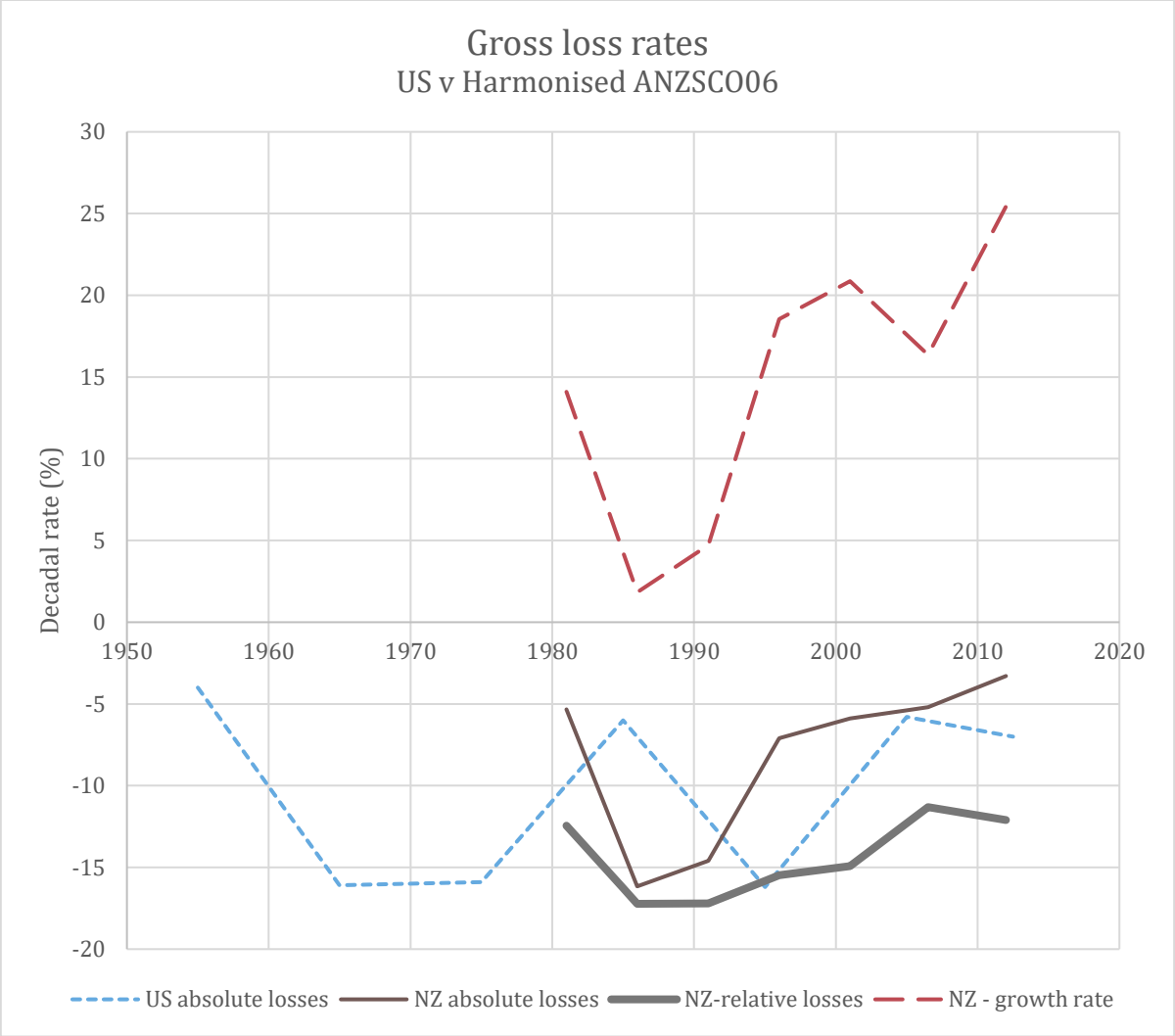


4.2.1 International Comparison

Atkinson and Wu (2017) report absolute losses, by decade, for the United States. In Figure 14, we reproduce the estimates from their Figure 14, together with corresponding decadal loss rates for New Zealand, calculated for overlapping decadal periods. As in Figure 11, measures are plotted against the year that is the midpoint of the period to which the measure relates.

Without information on gross gains or net growth for the United States, it is hard to interpret the US absolute losses. For New Zealand, the decadal absolute loss rate reflects the overall growth rate even more strongly than in Figure 12, where 5-yearly rates were used. This demonstrates clearly the difficulty of interpreting absolute losses as an indicator of occupational change. The New Zealand relative losses, shown as the darkest line in Figure 14 provides a more meaningful indicator of occupational drift. As discussed above, it is a mirror image of the occupational drift shown in Figure 11 and exactly half as large.

Figure 14: Absolute and relative gross occupational losses – international comparison



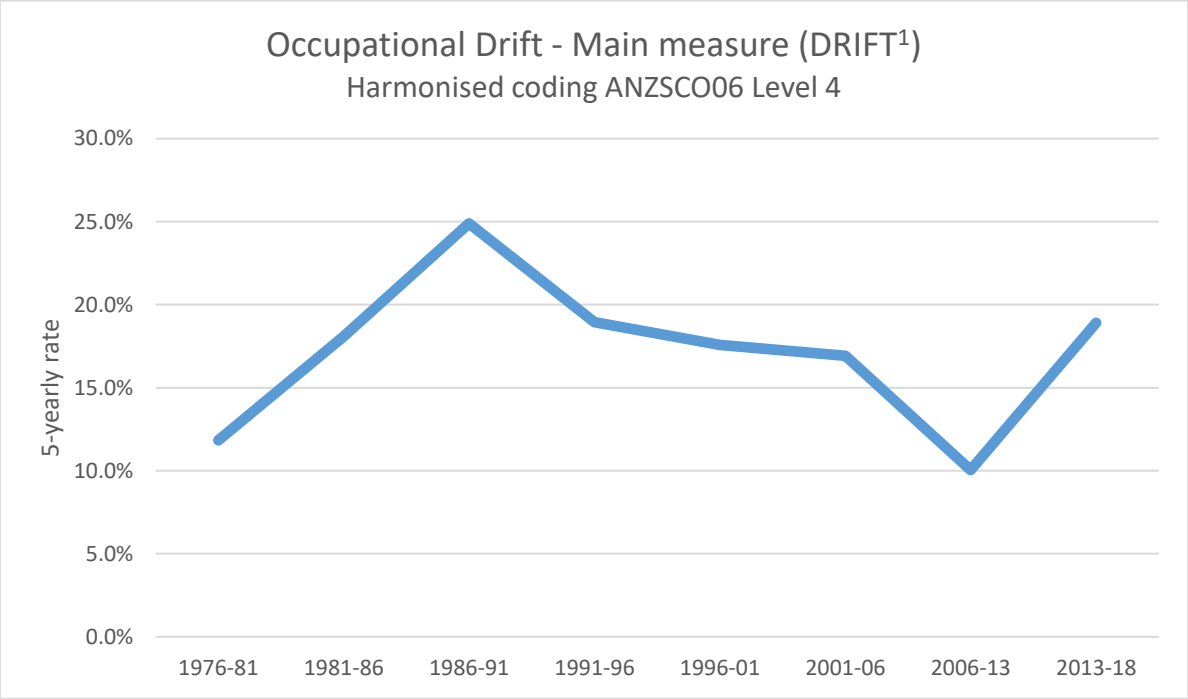
Note: Rates for all periods have been converted to decadal (10-year) rates. Points are plotted against the year that is mid-way through the period over which drift is measured. For instance, drift between 1981 and 1991 is plotted as year 1986. New Zealand data are presented for overlapping 10-year periods. For instance, 1981-1991 (plotted as year=1986) is included as well as 1986-1996 (plotted as year=1991).

5 Summary

The occupational structure of employment in New Zealand has been changing throughout the 42-year period we examine. At the broadest level (ANZSCO06 level 1), the employment of 'professionals' has increased from 12% of employment in 1976 to 23% of employment in 2018. In contrast, the share of labourers has declined from 18% to 11% (Figure 4). Occupational change is also evident within broad occupation groups – particularly for 'clerical and administrative' and 'community and personal services' occupations (Figure 5).

By harmonising occupational coding over a 42-year period, we have been able to track the pace of occupational change. We use a measure of 'occupational drift' that captures the strength of reallocation that occurs as some occupations increase their share of employment while others decrease theirs. The rate of occupational drift was strongest in the 1986 to 1991 period ($Drift^1$ =24.9%), at a time when overall employment declined. Since then, the rate has dropped to around 17% to 19%, apart from the 2006-2013 period ($Drift^1$ =10.0%), which includes the years around the *GFC*. The decline of employment around the GFC was quite different from the declines of the late 1980s. In particular, 2006-2013 was a period of relative occupational stability, in contrast to the high rate of change in 1986-91.

Figure 15: Occupational drift in New Zealand: 1976-2018



New Zealand rates of occupational drift are similar to those reported for Australia and the United States, although differences in occupational coding make a precise comparison difficult. A decline in the rate of occupational drift since the 1980s or early 1990s is evident in all three countries.

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Appendix 1: Occupational Coding

Appendix Table 1: Coding Schedules

Coding schedule	Number of distinct occupations			
United States				
• IPUMS 1950	284			
• IPUMS 1990	389			
• IPUMS 2010	458			
ANZSCO	**V1 (2006)**		**V1.2 or V1.3 (2013)**	
• level 5	1326		1352	
• level 4	474		474	
• level 3	134		134	
• level 2	51		51	
• level 1	8		8	
NZSCO	**1968**	**1990_v1**	**1995_v1**	**1999_v1**
• level 5	n/a	564	579	607
• level 4	1116	263	260	263
• level 3	307	101	96	99
• level 2	82	27	23	25
• level 1	10	10	8	9

Appendix Table 2: Number of distinct occupation codes used in census data

	Census years								
NZSCO	**1976**	**1981**	**1986**	**1991**	**1996**	**2001**	**2006**	**2013**	**2018**
NZSCO 1968	Level 4: 1,110 Level 3: 304 Level 2: 83 Level 1: 10	Level 4: 1,110 Level 3: 303 Level 2: 82 Level 1: 10	Level 4: 1,101 Level 3: 303 Level 2: 82 Level 1: 10	Level 4: 1,101 Level 3: 303 Level 2: 82 Level 1: 10	Level 4: 1,069 Level 3: 301 Level 2: 82 Level 1: 10				
NZSCO 1990				Level 5: 559 Level 4: 258 Level 3: 97 Level 2: 24 Level 1: 10	Level 5: 560 Level 4: 259 Level 3: 97 Level 2: 24 Level 1: 10				
NZSCO 1995					Level 5: 558 Level 4: 258 Level 3: 96 Level 2: 23 Level 1: 9				
NZSCO 1999						Level 5: 562 Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 9	Level 5: 562 Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 9	Level 5: 562 Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 9	
ANZSCO 2006							Level 5: 993 Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8	Level 5: 1,010 Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8	Level 5: 1023 Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8
Harmonised NZSCO 1999	Level 4: 247 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 247 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 247 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 255 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 8	Level 4: 257 Level 3: 96 Level 2: 23 Level 1: 8	
Harmonised ANZSCO 2006	Level 4: 356 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 356 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 356 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 355 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 356 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8	Level 4: 358 Level 3: 97 Level 2: 43 Level 1: 8

More or less consistent occupational coding

We use two different approaches to deriving consistent occupational coding across censuses. We rely on 'dual coding' of occupations that exist in the 1991, 1996, 2006 and 2013 censuses. The approaches differ in their treatment of occupation coding schedules in cases when a source coding is split between two or more target coding occupations.

- For the mapping of all years to NZSCO99 codes, we use the unique allocation approach
- For the mapping of all years to ANZSCO06 codes, we use the weighted allocation approach

The following example is hypothetical and illustrates the allocation approaches. It highlights a case where the resulting allocation depends on the approach. In practice, many occupations are a one-to-one mapping, for which the choice of approach is irrelevant.

Appendix Table 3: Hypothetical data from a year when occupations are dual coded to both the source and target classifications:

Source code	Target code	Employment count in dual-coded year
1111	2221	50
1111	2222	50
1111	3333	75
2221	2221	20

Appendix Table 4: Unique allocation approach

Source code	Allocated to level 4	Allocated to level 3
1111	100% allocated to 3333 • the single largest level 4 target code • potential misallocation = 100/175	100% allocated to 222 • the single largest level 3 target code • potential misallocation = 75/175
2221	100% allocated to 2221	100% allocated to 222

Appendix Table 5: Weighted allocation approach

Source code	Allocated to level 4	Allocated to level 3
1111	50/175 allocated to 2221	100/175 allocated to 222
	50/175 allocated to 2222	75/175 allocated to 333
	75/175 allocated to 3333	
2221	100% allocated to 2221	100% allocated to 222

Appendix Table 6: Summary of final allocations to target codes

Source code	Employment in a year where dual coding is not available	Unique allocation to target code	Weighted allocation to target code
		To level 4 target codes	
1111	1,750	3333: Emp=1,750	2221: Emp=500 2222: Emp=500 3333: Emp=750
2221	1,000	2221: Emp=1,000	2221: Emp=1,000
		To level 3 target codes	
1111	1,750	222: Emp=1,750	222: Emp=1,000 333: Emp=750
2221	1,000	222: Emp=1,000	222: Emp=1,000

Appendix Table 7: Summary of allocations

Target occupation code	Unique allocation to target code	Weighted allocation to target code
level 4		
• 2221	1,000	1,500
• 2222	0	500
• 3333	1,750	750
level 3		
• 222	2,750	2,000
• 333	0	750

'Weighted allocation' approach used for allocation to ANZSCO06 codes

1976 to 1986 Censi: Use NZSCO68 (level 4) codes

- Weighted allocation of NZSCO68 (level 4) to NZSCO95 (level 5) based on the dual coding in the 1996 census (with manual allocation of a small number of NZSCO68 codes that do not appear in the 1976 census data)
- Convert NZSCO95 (level 5) to NZSCO99 (mostly level 5, with a few codes linked to level 4 only) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)
- Weighted allocation of NZSCO99 (Level 4/ 5) to ANZSCO06, using dual coding in 2006 and 2013.

1991 Census: Use NZSCO90 (level 5) codes

- Weighted allocation of NZSCO90 (level 5) to NZSCO95 (level 5) based on the dual coding in the 1996 census
- Convert NZSCO95 (level 5) to NZSCO99 (mostly level 5, with a few codes linked to level 4 only) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)
- Weighted allocation of NZSCO99 (Level 4/ 5) to ANZSCO06, using dual coding in 2006 and 2013.

1996 Census: Use NZSCO95 (level 5) codes

- Convert NZSCO95 (level 5) to NZSCO99 (mostly level 5, with a few codes linked to level 4 only) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)
- Weighted allocation of NZSCO99 (Level 4/ 5) to ANZSCO06, using dual coding in 2006 and 2013.

'Unique allocation' approach used for allocation to NZSCO99 codes

1976 to 1986 Censi: Use NZSCO68 (level 4) codes

- Unique allocation of NZSCO68 (level 4) to NZSCO95 (level 5) based on the dual coding in the 1996 census
- Convert NZSCO95 (level 5) to NZSCO99 (mostly level 5, with a few codes linked to level 4 only) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)

1991 Census: Use NZSCO90 (level 5) codes

- Unique allocation of NZSCO90 (level 5) to NZSCO95 (level 5) based on the dual coding in the 1996 census
- Convert NZSCO95 (level 5) to NZSCO99 (level 4) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)

1996 Census: Use NZSCO95 (level 5) codes

- Convert NZSCO95 (level 5) to NZSCO99 (level 4) using concordance tables obtained from Statistics New Zealand (aria.stats.govt.nz)

2001-2013 Censi: Use NZSCO99 codes (level 3)

Unique allocation potentially misallocates some proportion of total employment. The following tables summarise the potential misallocation rates for various possible conversions

Appendix Table 8: Potential misallocation rates from unique allocation

occ68 to occ99: for 1976-1986 census data

	occ99: Lvl 1	occ99: Lvl 2	occ99: Lvl 3	occ99: Lvl 4
occ68: Level 1	27.8%	43.3%	65.4%	70.5%
occ68: Level 2	10.6%	18.4%	31.0%	41.0%
occ68: Level 3	5.6%	8.8%	11.4%	15.8%
occ68: Level 4	1.9%	3.3%	4.0%	5.0%

occ90 to occ99: for 1991 census data

	occ99: Lvl 1	occ99: Lvl 2	occ99: Lvl 3	occ99: Lvl 4
occ90: Level 1	0.5%	36.8%	60.7%	70.8%
occ90: Level 2	0.5%	0.5%	41.2%	56.4%
occ90: Level 3	0.4%	0.4%	0.4%	25.9%
occ90: Level 4	0.4%	0.4%	0.4%	1.0%
occ90: Level 5	0.4%	0.4%	0.4%	0.5%

occ99 to occ06: Not used - could be used for 1991-2006 census

	occ06: Lvl 1	occ06: Lvl 2	occ06: Lvl 3	occ06: Lvl 4	occ06: Lvl 5
occ99: Level 1	16.0%	31.4%	34.9%	37.6%	38.2%
occ99: Level 2	10.6%	21.8%	27.8%	31.9%	33.1%
occ99: Level 3	7.8%	12.2%	17.1%	22.8%	24.9%
occ99: Level 4	5.1%	7.0%	9.0%	13.4%	16.5%
occ99: Level 5	3.1%	4.0%	4.6%	7.1%	9.2%

Note: occ68, occ90 and occ99 refer to NZSCO coding. Occ06 refers to ANZSCO coding.

Appendix 2: Comparison of Drift[1] and gross gains and losses

This appendix documents the difference between occupational drift and the sum of gross gains and gross losses.

Let:

- g_i = employment growth rate in industry *i*
- G = aggregate employment growth rate
- λ_0 = industry *i* share of total employment in previous period
- λ_G = group *G* share of total employment in previous period (G ∈{A,B,C})

Case 1: Positive aggregate growth

- Group A: $g_i < 0$
- Group B: $0 < g_i < G$
- Group C: $G < g_i$
- $Drift^1 = -\sum_A \lambda_0(g_i - G) - \sum_B \lambda_0(g_i - G) + \sum_C \lambda_0(g_i - G)$
- $Gross\ Gain = \sum_B \lambda_0 g_i + \sum_C \lambda_0 g_i$

$$Gross\ Loss = -\sum_A \lambda_0 g_i$$

$$Drift^1 = Gross\ Gain + Gross\ Loss + (\lambda_A - \lambda_C)G - \sum_B \lambda_0(2|g_i| - |G|)$$

Case 2: Negative aggregate growth

- Group A: $g_i < G$
- Group B: $G < g_i < 0$
- Group C: $0 < g_i$

$$Drift^1 = -\sum_A \lambda_0(g_i - G) + \sum_B \lambda_0(g_i - G) + \sum_C \lambda_0(g_i - G)$$

$$Gross\ Gain = \sum_B \lambda_0 g_i + \sum_C \lambda_0 g_i$$

$$Gross\ Loss = -\sum_A \lambda_0 g_i$$

$$Drift^1 = Gross\ Gain + Gross\ Loss + (\lambda_A - \lambda_C)G - \sum_B \lambda_0(2|g_i| - |G|)$$

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