Safety in numbers? Firm size and injury risk

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Abstract

The relationship between firm size and injury risk is an important consideration for policymakers as they seek to reduce regulatory burden for small firms while simultaneously improving workplace health and safety outcomes. The literature has produced mixed results with some research finding a negative linear relationship between firm size and injury rates while others find medium-sized firms have the highest rates. Data matching in recent years has improved our ability to empirically explore this question, although limitations still exist. The results indicate that there is no clear relationship between entitlement claim rates and enterprise size overall in New Zealand. The relationship varies by industry, suggesting that factors other than firm size are important in explaining health and safety outcomes. Investigation into the role of firm dynamics would be a promising area for further research. It is clear from the literature that one size does not fit all when it comes to occupational health and safety. Interventions should be targeted to meet the needs of different sized firms.

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Disclaimer

The results in this paper are not official statistics They have been created for research purposes from the Integrated Data Infrastructure (IDI), managed by Statistics New Zealand. The opinions, findings, recommendations, and conclusions expressed in this paper are those of the author(s), not Statistics NZ, the Accident Compensation Corporation or WorkSafe New Zealand.

Access to the anonymised data used in this study was provided by Statistics NZ under the security and confidentiality provisions of the Statistics Act 1975. Only people authorised by the Statistics Act 1975 are allowed to see data about a particular person, household, business, or organisation, and the results in this [report, paper] have been confidentialised to protect these groups from identification and to keep their data safe. Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

1. Introduction

The question of whether small and medium sized enterprises (SMEs) have a higher work-related injury rate than large enterprises arises recurrently as policymakers seek to achieve a health and safe work environment while reducing the burden of regulations. The need for a regulatory approach that is proportionate to the risks faced by SMEs was highlighted by the Independent Taskforce on Workplace Health and Safety (Independent Taskforce on Workplace Health and Safety, 2013) and more recently in the debate over whether small 'low-risk' workplaces should be excluded from health and safety representative requirements in the new Health and Safety at Work Act (Davison & Trevett, 2015) .

There are many reasons why we might expect to see a negative relationship between firm size and injury risk. Large firms benefit from better access to expertise and resources, stronger incentives for injury prevention, lower levels of risk exposure and formal management practices. However, SMEs also have characteristics that may be considered protective including a close social working environment and informal communication channels.

Previous attempts to determine the relationship between work-related injury and firm size in New Zealand have suffered from a lack of reliable data. However, with the linking of ACC claims to the Statistics New Zealand Integrated Data Infrastructure, we can answer this question with greater confidence. The paper is structured as follows. Section 2 reviews the literature on why we might expect SMEs to have higher injury rates than large enterprises, what has been found in other countries, and what results have previously been produced for New Zealand. Section 3 discusses the data and methods used here. Section 4 outlines the results and section 5 concludes with implications for policy makers and next steps for this research.

2. The literature

2.1. How are SMEs different from large enterprises?

One of the main distinctions between SMEs and large firms in the health and safety literature is the informal, social working style of small firms relative to the formal management structures in large firms (Legg et al., 2009; MacEachen et al., 2010). Visible commitment to health and safety, worker participation, and regular external health and safety audits are some of the characteristics strongly associated with safer work environments (Institute for Work & Health, 2011). These management practices likely to be more common in large firms, which have been found to have better management practices overall (Agarwal, Green, Brown, Tan, & Randhawa, 2013).

Accidents are rare occurrences in small firms, but when they happen the close social relations between owners and workers may act as a barrier to learning from the accident. Owners of small firms tend to attribute serious accidents as being unpreventable or the fault of the employee, possibly because the alternative is seen to be accepting responsibility or blame (Hasle, Kines, & Andersen, 2009). This possibly also explains why small firms are more likely to consider occupational health and safety regulation to be excessive (Micheli & Cagno, 2010).

SMEs generally find it harder to access resources and expertise for occupational health and safety relative to large enterprises. They tend to have tight profit margins, high risk of closure, lack economies of scale, and find it harder to access specialist occupational health and safety expertise (Lamm & Walters, 2004; MacEachen et al., 2010). These factors increase the marginal cost of injury prevention for small firms.

Large firms face stronger incentives for injury prevention. They are more commonly targeted with financial incentives through workers insurance levy reductions because their claims history is a more reliable predictor of injury risk; and they face a greater likelihood of inspection by the regulator because they are more visible (MacEachen et al., 2010). These factors reduce the marginal benefit of injury prevention for small firms.

Employees in small firms have higher ergonomic and chemical risk exposure than those in large firms (Sørensen, Hasle, & Bach, 2007). Small firms tend to be concentrated in hazardous industries such as Agriculture, Forestry and Fishing and Construction. Within industries, large firms may face less risk through factors such as better hazard management; a higher proportion of employees working in low-risk in-house administrative occupations; and contracting-out high-risk activities.

2.2. Different definitions for small and large

There is large variation in how small and large firms are defined in the literature. 'Small' firms can range in size from less than one FTE (McVittie, Banikin, & Brocklebank, 1997) to less than 100 employees (reference); while 'large' firms range from 20+ employees to 2,500+ employees. The way in which firm size is categorised has an effect on research results (Micheli & Cagno, 2010). A greater consistency in definitions would improve comparability of study results.

2.3. Estimates in the literature

Large firms have been found to have higher fatality rates than small firms (Fabiano, Currò, & Pastorino, 2004; Mendeloff, Nelson, Ko, & Haviland, 2006), higher major injury rates (Kines & Mikkelsen, 2003; Nichols, Dennis, & Guy, 1995), and higher lost-time injury rates (McVittie et al., 1997).

McVittie et al. (1997) looked at firm size and lost time injury claim rates per million hours worked in the Construction Industry in Ontario. The authors used eight categories of firm size ranging from fewer than one FTE through to more than 100 FTE employees. They found that injury rates monotonically decrease with injury size. Similarly Micheli and Cagno (2010) found that small firms (less than 10 employees) have a higher injury rate than large firms (250+ employees). In looking at firm perspectives of health and safety, the authors find that large firms are more likely to invest in safety technology, medium firms in safety management practices and staff training, while small enterprises are more likely to see health and safety as a regulatory burden.

Fabiano et al. (2004) find a negative linear relationship between firm size and fatal and permanent disability injury rates, and number of days of lost time injury in Italy. They find a stronger relationship in industries that have a higher concentration of workers in large firms (more than 30 percent of workers in firms of 250 or more employees).

Kines and Mikkelsen (2003) use injury data reported to the health and safety regulator to show that large firms (20 or more employees) have lower rates of major fall-from-height injury in Construction than small firms (less than 20 employees). Major injuries are lost time injuries resulting in amputations, bone fractures, or multi-trauma injuries, while minor injuries are all other lost time injuries. Said, Halim, and Said (2012) use a continuous measure of firm size and find that injury claim rates decrease as the number of employees per Manufacturing establishment increases.

The ownership structure of the firm appears to play an important role in the relationship between firm size and injury risk. While the relationship is generally found to be negative for both establishments (single-geographic unit) and enterprises (single point of ownership, but may geographically dispersed), results differ for small establishments depending on their ownership structure. Small singe-establishment enterprises have lower fatality and major injury rates than small establishments that are part of a large enterprises, possibly because they have more control over their work environment (Mendeloff et al., 2006; Nichols et al., 1995). However, the reverse relationship appears to apply for ergonomic hazards; higher levels of exposure have been found in small single-establishment enterprises (1-4 employees) compared to small establishments that are part of larger enterprises (Sørensen et al., 2007).

There are a few exceptions to the finding that large firms are safer. Leigh (1989) uses data on injuries reported the Department of Labor and finds that small firms (1-19 employees) and large firms (1,000+ employees) in Manufacturing have lower injury rates than medium firms. The author suggests this may be a result of under-reporting of injury in the small firms. The same conclusion is reached by Kines and Mikkelsen (2003) on finding that large firms have higher rates of minor fall-from-height

Construction injury notified to the regulator. They estimate that about 50 percent of injuries go unreported, with better reporting rates for major injury than minor injury.

A study less subject to under-reporting is Pedersen, Hannerz, and Christensen (2012). They use linked administrative data on hospital injuries among a cohort of manual Construction workers in Denmark. This includes work and leisure injuries (work-relatedness of injury is not identifiable in the data). They find a positive relationship between firm size and injury rates. Large firms were defined as having 20 or more employees. This is a lower threshold for large firms than is usually found in the literature, but it is in this study because large firms in Denmark are smaller than those found elsewhere. Workers were assigned to a firm size category based on the number of people employed by the firm, however the numerator and denominator for the injury rates were based on manual construction workers only. This study design suggests the firm size relationship in previous studies may have been driven in part by large firms having more workers engaged in low-risk occupations than small firms.

New Zealand has a similar proportion of small firms to those found in other developed countries but, like Denmark, the average size of large firms is smaller (Mills & Timmins, 2004). Consistent with most of the literature, New Zealand studies have found a negative relationship between firm size and work-related injury claim rates (Legg et al., 2013; Safe Work Australia, 2015). Research undertaken more recently by the New Zealand Council of Trade Unions indicates that while injury rates generally decrease with firm size, there is variation by industry (Rosenberg, 2016). For example, Manufacturing is positively associated with injury risk (particularly food manufacturing), and Construction and Transport, Postal and Warehousing the relationship has an inverted-U shape with medium-sized firms having the highest risk.

The New Zealand studies are limited by a lack of data on number of employees. Instead they use liable earnings as a proxy for firm size (liable earnings are used by the Accident Compensation Corporation to apply levy rates to the firm). I extend the literature by using newly available data on the number of employees in a firm to look at injury rates by firm size.

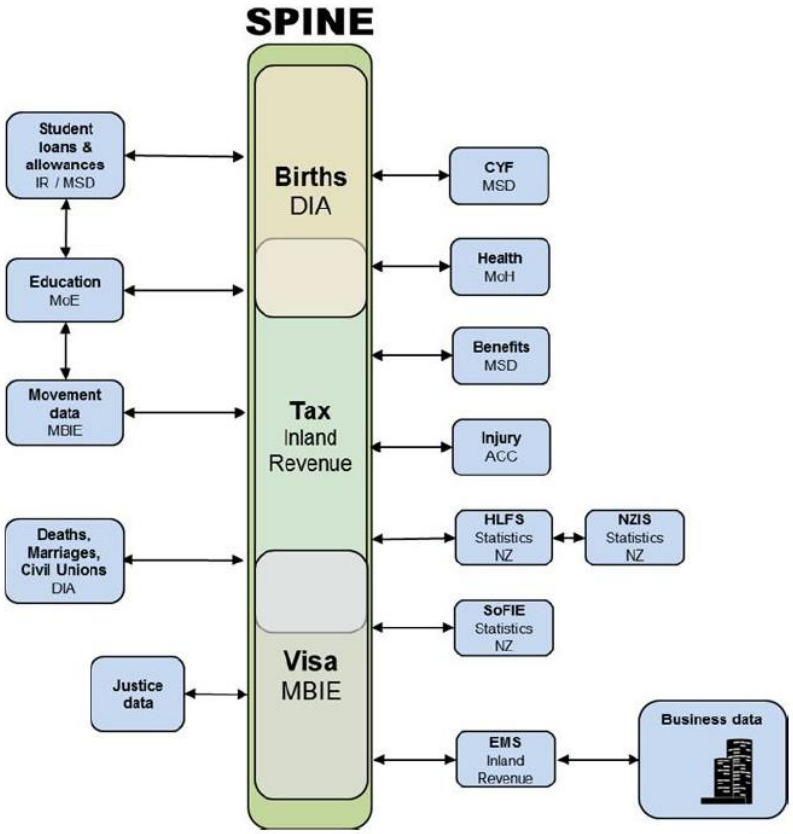
3. Data

I investigate injury rates by enterprise size using the Integrated Data Infrastructure. I use enterprise-level data on ACC claims linked to enterprise size based on the number of employees reported in the Employer Monthly Schedule (EMS). I then look for evidence of under-reporting of injury using linked IDI data on ACC claims, enterprise size from EMS, and self-reported injury from the Survey of Family, Income and Employment. I finish by looking at leading indicators of occupational health and safety using data from the WorkSafe New Zealand Health and Safety Attitudes and Behaviours Survey of Employers. Each of these datasets are described in this section.

3.1. Integrated Data Infrastructure

I use linked data from the Statistics New Zealand Integrated Data Infrastructure (IDI). The IDI is updated quarterly; this study is based on the October 2016 refresh. The IDI is made up of a series of datasets from different source agencies that have been integrated using deterministic and probabilistic linking (see Figure 1). The main structure of the IDI, the spine, is based on three linked data sources: IRD numbers issued by Inland Revenue, births registered in New Zealand since 1920, all visas granted to migrants from 1997 (excluding visitor and transit visas). People present in at least one of these three data sources will be included in the spine (Gibb, Bycroft, & Matheson-Dunning, 2016). ACC claims data has also been linked to the IDI spine by Statistics New Zealand.

Figure 1: Structure of the Integrated Data Infrastructure in May 2015



Source: Gibb, S, Bycroft, C, Matheson-Dunning, N (2016, figure 1, p10). Identifying the New Zealand resident population in the Integrated Data Infrastructure (IDI). Retrieved from www.stats.govt.nz.

3.2. Linked Employer-Employee Data (LEED)

Information on the number of employees in each enterprise is derived from the LEED data. LEED links employee tax numbers to employer tax numbers through the Employer Monthly Schedule (EMS). This information is then aggregated to the enterprise level using the Business Register. For a more detailed description of the LEED data, see Fabling and Maré (2015).

I transform the monthly data into financial years, using the average number of employees in the year ending March. The focus of this study is on employers so I exclude companies with no employees. The EMS includes information on wages and salaries. I estimate ACC liable earnings based on gross earnings minus 'earnings not liable for ACC levies' (a variable in EMS). The ACC website states that

'earnings not liable for ACC levies' includes an individual earnings cap and some types of earnings such as redundancy payments.[1]

I use nine categories of enterprise size to improve comparability with the literature. Most employers are small enterprises with five or fewer employees, although most employees work in large enterprises.

Table 1: Average number of employers and employees by enterprise size, annual average 2002/03-2014/15

Enterprise size	Number of employing enterprises	Number of employees
1-5	126,648	259,700
6-19	34,680	345,000
20-49	8,572	255,000
50-249	3,821	371,700
250-499	398	136,600
500-999	189	130,500
1,000-1,499	54	65,300
1,500-2,499	36	69,500
2,500+	52	269,800

Source: IDI (confidentiality rules were applied to the annual data; averages are displayed here)

The data used here is slightly different to the Business Demography data published by Statistics New Zealand. I use the average number of employees in a year, rather than the number of employees in the month of February. A comparison to the 2015 Business Demography data is provided in Table 2. The data in this study has a slightly larger number of employer enterprises, all of which are concentrated in the smallest employer size. The total numbers of employees in each of the firm size categories are broadly consistent with those reported in the Business Demography data.

Table 2: Comparison of employee and employer numbers by firm size and dataset

	Business Demography, Feb 2015		IDI, Year ending March 2015	
Employer Size	Enterprises	Employees	Enterprises	Employees
1-5 employees	97,293	227,850	124,029	258,600
6-19 employees	37,239	372,030	35,772	357,000
20-49 employees	9,459	280,240	9,126	271,900
50+ employees	5,109	1,165,510	5,022	1,145,200
Total	**149,100**	**2,045,610**	**173,949**	**2,032,700**

Source: Statistics New Zealand (2015) New Zealand Business Demography: At February 2015, Table 1 (columns 2&3); IDI Source: IDI (confidentiality rules have been applied; columns 4&5).

[1] www.acc.co.nz/for-business/tax-agents-accountants-and-advisors/levies-and-invoicing/BUS00085#P17_1320

3.3. Accident Compensation Claims

When a person in New Zealand seeks treatment for injury, an approved health professional helps them to complete an Accident Compensation Corporation (ACC) form and sends the claim to ACC to cover the insured component of treatment costs. The form collects information about the accident, whether it occurred at work, employment details, personal details, diagnosis, and what affect the injury has on ability to work (the health professional completes these last two pieces of information). All people in New Zealand are insured for injuries under the ACC scheme – private health insurance companies will not cover injuries that are covered by ACC.[2]

Some employers manage their workers' work-related claims instead of ACC. This is known as the Accredited Employer Programme (AEP).

ACC categorises claims based on the funding account. Injuries from a motor vehicle accident on a public road are funded by the Motor Vehicle Account – this includes work-related injuries. Injuries to employees at work are funded through the Work Account. AEP claims are also captured in the Work Account. Injuries to employees when they are not working are funded by the Earners Account. There is also a Non-Earners Account and a Treatment Account. This paper uses the Work Account and Earners Account claims - it excludes motor vehicle accidents. The claims data used here covers the March financial years 2002/03 to 2014/15.

I look at all claims and a subset called 'entitlement claims'. Entitlement claims are ones where an entitlement is paid in addition to medical fee compensation (e.g. loss of earnings compensation). Entitlement claims tend to be more serious than medical fee only claims. I calculate claim rates as the number of claims per 1,000 employees at the enterprise size category level. This is done by summing the total number of claims and dividing it by the total number of employees for each year and enterprise size category.

3.4. Survey of Family, Income and Employment

The Survey of Family, Income and Employment (SoFIE) is a longitudinal survey that was run by Statistics New Zealand from October 2002 to September 2010. The target population is the usually resident population of New Zealand living in permanent dwellings. At wave one 15,100 households

[2] Although private insurance companies will not cover what is covered by ACC they may offer top-up compensation. E.g. ACC covers 80% of earnings for time off work from injury, private insurance schemes may cover the extra 20%.

were randomly selected to take part. Survey responses were obtained through face-to-face interviews with 22,200 eligible adults and 7,500 children (under 15 years) living in 11,500 households (a response rate of 81 percent). The survey was repeated annually (Statistics New Zealand, 2011) and has been linked into the IDI.

Every two years (waves three, five and seven) adult respondents were asked a series of health questions. The data from these three waves are used in this research. The retention rate was reasonably high. Relative to 100 percent at wave one, it was 85 percent for wave three, 80 percent for wave five and 74 percent for wave seven.

The injury question in the survey is:

> *"In the last 12 months, have you had an injury that stopped you from doing your usual activities for more than a week? An injury includes burns, near drownings, and poisoning."*

There is a follow-up question that asks where the injury occurred (at home, at work, somewhere else).

3.5. Health and Safety Attitudes and Behaviours Survey of Employers

I use data from the 2014 WorkSafe New Zealand Survey of Attitudes and Behaviours Survey of Employers. Employers were selected from ACC's Levy Payers' database.[3] Employers in Agriculture, Forestry, Fisheries, Construction and Manufacturing were over-sampled. Employers who had been surveyed by ACC in the previous six months were excluded, as were employers in ACC's Accredited Employers Programme. Employer letters were addressed to the health and safety representative. Questionnaires were self-completed, either online or a paper copy. Letters were sent to 6,751 employers and responses were received from 1,903, while 450 were identified as ineligible (generally returned as 'gone, no address'). This meant the final response rate was 29 percent. The responses have been weighted, see the technical report for more detail (Nielsen, 2015).

The survey includes the eight questions from the Monash University and WorkSafe Victoria Organisational Performance Metric. The original tool was developed in Ontario, Canada (OPM) and was later refined by Monash University and WorkSafe Victoria in Australia (OPM-MU).[4] It is a simple eight-item questionnaire that has been shown to be a good predictor of occupational health and safety performance (De Cieri, Shea, Cooper, Sheehan, & Donohue, 2016; Institute for Work & Health, 2011).

[3] Some additional sample for the Forestry and Fishing sectors was sourced from databases provided by WorkSafe NZ and Maritime NZ.

[4] The OPM-MU is licensed under Creative Commons (CC BY-NC-ND 4.0).

Although the testing of the tool in Australia focused on large firms, the Ontario study found that the tool worked well for small and large firms (Institute for Work & Health, 2011). The questions in the tool appear to align well with research on injury prevention in small businesses (Cagno, Micheli, Jacinto, & Masi, 2014).

Respondents were asked to rate eight statements on a scale from one to five, where one represents 'Strongly Disagree' and five represents 'Strongly Agree'. The results are added to form an overall score ranging from eight (strongly disagree with all eight statements) to 40 (strongly agree with all eight statements).

The eight statements that make-up the OPM-MU are:

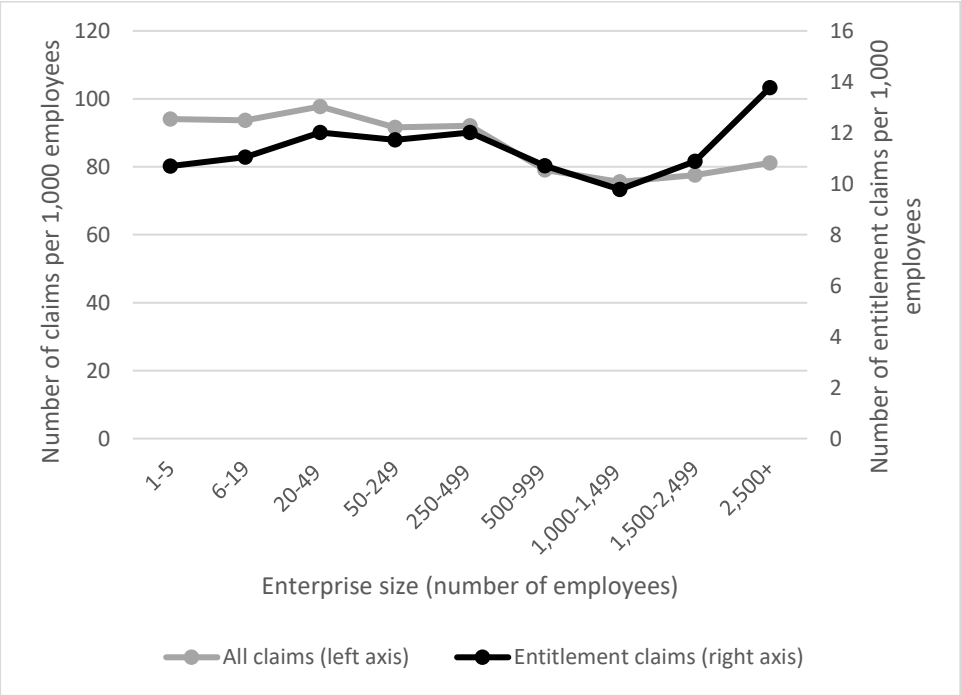
1. Formal safety audits at regular intervals are a normal part of our business
2. Everyone at this business values ongoing safety improvements in this business
3. This workplace considers health and safety at least as important as production and quality in the way work is done
4. Workers and supervisors have the information they need to work safely
5. Workers are always involved in decisions affecting their health and safety
6. Those in charge of safety have the authority to make the changes they have identified as necessary.
7. Those who act safely receive positive recognition
8. Everyone has the tools and/or equipment they need to complete their work safely

4. Results

4.1. Claim rates and enterprise size

Figure 2 displays average injury rates by enterprise size for the period 2001/02 to 2014/15. Enterprise size is on the x-axis, claim rate per 1,000 employees is on the left-hand y-axis and the entitlement claim rate per 1,000 employees is on the right-hand y-axis. Enterprises with less than 500 employees have a higher total claim rate than those with 500 or more employees. The pattern is less clear for the more serious entitlement claims. Enterprises with 1,000 to 1,499 employees have the lowest entitlement claim rate and the largest enterprises (2,500+) have the highest entitlement claim rate. Among enterprises with less than 500 employees, the smallest enterprise size (1-5 employees) has the lowest entitlement claim rate.

Figure 2: Average work account claim rate per 1,000 employees by enterprise size, 2001/02-2014/15



Source: IDI (confidentiality rules applied).

4.2. Claim rates by enterprise size and industry

The relationship between enterprises and work account entitlement claim rates varies by industry. I look at three hazardous industries– Agriculture, Forestry & Fishing, Construction and Manufacturing. The first two industries are primarily made-up of small enterprises (about 80% of enterprises have 5 or fewer employees), while the Manufacturing industry has more large enterprises (only about half of enterprises have 5 or fewer employees).

In Agriculture, Forestry and Fishing, large enterprises have the lowest entitlement claim rates, with little difference between the other size categories. In Manufacturing, entitlement claim rates increase with enterprise size – the largest enterprises have the highest entitlement claim rates. In Construction, small and large enterprises have the lowest claim rates, with medium-sized enterprises (20-49 employees) having the highest entitlement claim rate.

Table 3: Average work account entitlement claim rates per 1,000 employees, 2001/02-2014/15

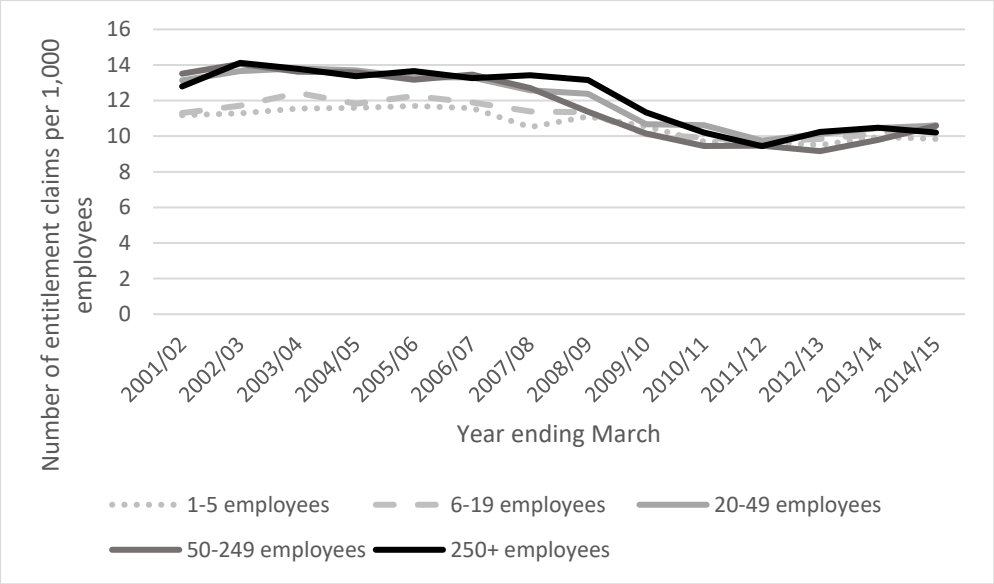
Enterprise size	Agriculture, Forestry & Fishing	Manufacturing	Construction	All industries
1-5 employees	20.6	12.6	21.5	10.7
6-19 employees	20.8	17.9	27.6	11.0
20-49 employees	20.1	20.3	32.3	12.0
50-249 employees	19.1	20.5	27.9	11.7
250+ employees	17.7	28.2	17.0	12.1
All Employers	**19.7**	**19.9**	**25.3**	**11.5**

Source: IDI (confidentiality rules have been applied)

4.3. Claim rates by enterprise size over time

The relationship between enterprise size and work account entitlement claim rates has changed over time. Figure 3 displays the time trend for five enterprise size categories. In 2001/02 entitlement claim rates were highest in the three larger enterprise sizes. In the period through to 2009/10 claim rates fell faster among these larger enterprises, resulting in a convergence of claim rates by enterprise size. This pattern was consistent across industries, with greater reductions in injury rates among the larger enterprises. By 2014/15 claim rates were very similar across the enterprise size categories with the lowest injury rate in enterprises with one to five employees (9.85 per 1,000 employees) and the highest in enterprises with six to 19 employees (10.65 per 1,000 employees).

Figure 3: Work account entitlement claim rate by enterprise size and financial year



Source: IDI (confidentiality rules have been applied)

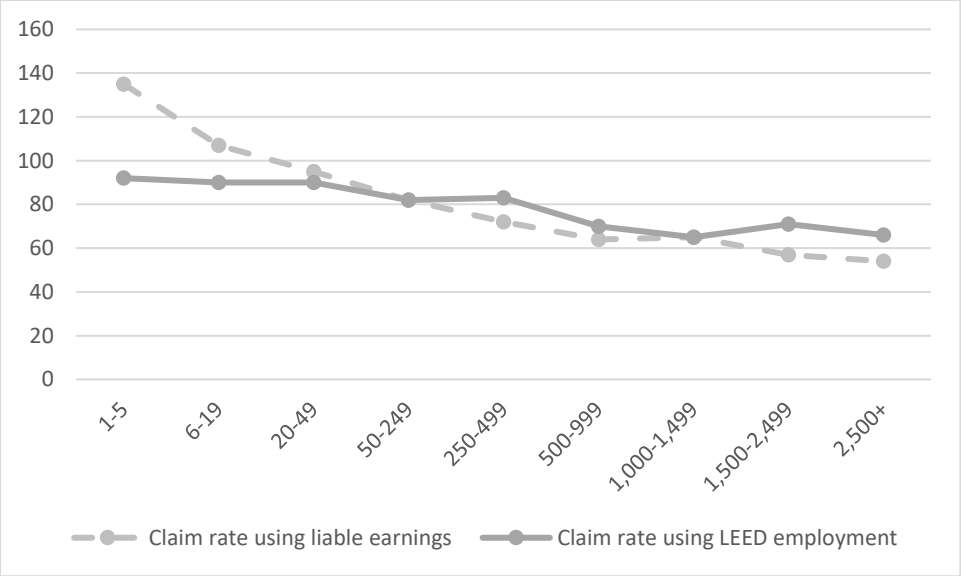
4.4. Liable earnings and number of employees

Previous studies of this type in New Zealand have relied on liable earnings as a proxy for the number of employees in an enterprise. Here I compare the differences in work account claim rates using these two measures.

To obtain employment estimates based on liable earnings information I divide total liable earnings by the average annual full-time salary for that enterprise's industry (at the one digit level). The average salary is estimated by multiplying average hourly wages from the Household Labour Force Survey by 40 hours per week and 52 weeks per year.

I find that the use of liable earnings in this way over-estimates claim rates for small enterprises (particularly those with 1-5 employees), but provides a good proxy for enterprises with 20 or more employees.

Figure 4: Total work claim rate using two different methods to estimate enterprise size, 2009/10-2014/15



Source: IDI (confidentiality rules have been applied)

4.5. Under-reporting by enterprise size

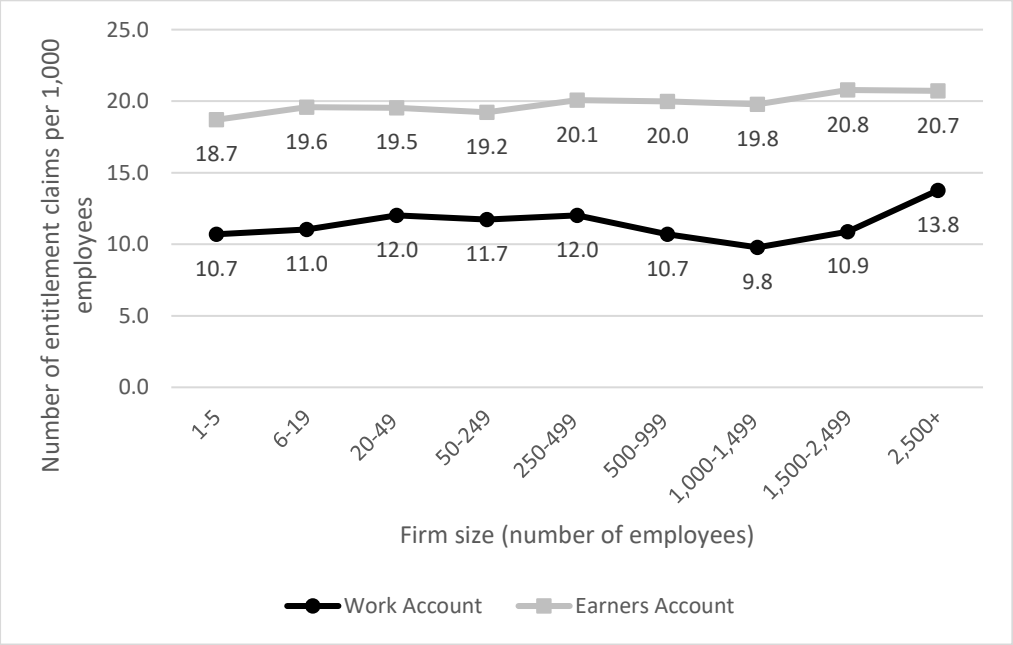
Studies that find an inverted-U shape tend to attribute it to under-reporting of injury among workers in small enterprises. I consider potential under-reporting using two methods:

1. I look at whether there is any evidence of misclassification of funding account by enterprise size
2. I look at whether workers from small enterprises who self-report having had an injury in the last 12 months are less likely to appear in the ACC claims data for the same period.

I start by comparing work account (work injury) and earners account (leisure injury) claims by enterprise size. If we expect there to be no relationship between enterprise size and leisure injury, then a higher Earner Account injury rate among workers in small enterprises may indicate misclassification of work injuries as non-work injuries. There is no reason to suppose that workers in small enterprises would be less likely to experience leisure injuries than workers in large enterprises.

Figure 5 displays the results. I find that leisure injury claims have very little relationship with enterprise size - if anything employees in small enterprises have lower leisure injury claim rates than employees in large enterprises.

Figure 5: Average entitlement claim rate per 1,000 employees by enterprise size and funding account, 2001/02-2014/15



Source: IDI (confidentiality rules have been applied)

It's still possible that workers in small enterprises are under-represented in the claims data – particularly if they are less likely to seek treatment for their injuries than workers in large enterprises.

To investigate this, I use survey data on self-reported injury and compare this to ACC injury claims (including claims from all funding accounts).

Table 4 reports the results. On average, 29 percent of injured workers (SoFIE) had no ACC claims for that period. The proportion was similar across enterprise sizes, implying that injured workers in small enterprises are just as likely to make an ACC claim as injured workers in large enterprises.

Table 4: SoFIE respondents who reported having an injury at work in the last 12 months that stopped them doing their usual activities for more than a week.

Enterprise size	Total number who had an injury at work	Number that did not have an accepted claim.	Percent that had a work injury but did not have an ACC claim
1-19 employees	16,200	4,300	27%
20-249 employees	27,200	7,500	28%
250+ employees	124,700	37,100	30%
Total	**168,200**	**48,900**	**29%**

Source: IDI (confidentiality rules have been applied). Survey responses weighted using the longitudinal sample weights.

To test for potential correlates that may be confounding the results I run a linear regression controlling for demographic characteristics. The sample is all those who reported in SoFIE that they had an injury at work in the last 12 months (1,038 observations). Results for the three waves are pooled and robust standard errors are applied for respondent clustering.

$$Claim_i = \alpha + \beta_1 SmallFirm_i + \beta_2 MediumFirm_i + \delta' X_i + \varepsilon_i$$

Claim is a dummy variable that equals one if the person has an ACC claim for an injury that occurred in the last 12 months, *SmallFirm* is a dummy variable for whether the person works for an enterprise with 1-19 employees, *MediumFirm* is a dummy variable for whether they work for an enterprise with 20-249 employees (large firms are omitted), and *X* captures other individual characteristics thought to be associated with health care utilisation: gender, age, whether the person is born in New Zealand, whether they identify as Māori, highest qualification and the log of household income.

The results are that the coefficients on small- and medium-sized firms are small, positive and not statistically significantly different from zero. If employees of small firms are less likely to make injury claims, it appears that they have also under-reported injury within the survey responses.

Table 5: Ordinary Least Squares Regression of whether a person had a claim, given they reported in SoFIE that they'd had an injury at work in the last 12 months.

VARIABLES	(1)	(2)	(3)
Firm size: 1-19 employees	0.03	0.02	0.008
	(0.053)	(0.054)	(0.055)
Firm size: 20-249 employees	0.02	0.01	0.002
	(0.045)	(0.046)	(0.045)
Firm size: 250+ employees	*Comparison group*		
Female		-0.06*	-0.06*
		(0.034)	(0.034)
Age (10 yrs)		-0.04	-0.03
		(0.056)	(0.056)
Age squared (10 yrs)		0.003	0.002
		(0.0061)	(0.0062)
Born in NZ			0.05
			(0.047)
Maori			0.01
			(0.046)
Highest qual: None	*Comparison group*		
Highest qual: School			0.08
			(0.051)
Highest qual: Vocational			0.08*
			(0.043)
Highest qual: Degree or higher			-0.02
			(0.068)
Highest qual: Other post-school			0.14
			(0.084)
Log(household income)			0.01
			(0.024)
Constant	0.70***	0.84***	0.59**
	(0.019)	(0.122)	(0.293)
Observations	1038	1038	1035
R-squared	0.001	0.007	0.017

*** p<0.01, ** p<0.05, * p<0.1
Robust standard errors in parentheses

Source: IDI, survey responses weighted using the longitudinal sample weights, pooled data from three waves, robust standard errors for respondent clusters.

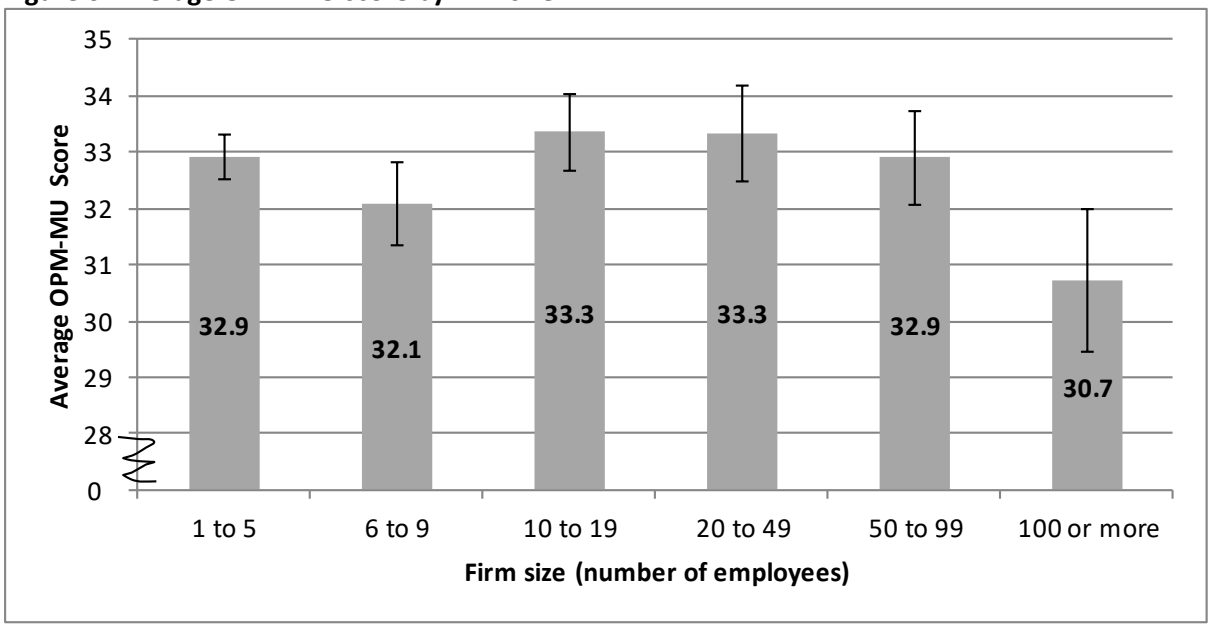
4.6. Leading indicators for workplace health and safety

The focus of this paper has been on lagging indicators of workplace health and safety – accidents that have already occurred. This section explores some leading indicators of injury by firm size for New Zealand using the OPM-MU.

The 2014 Health and Safety Attitudes and Behaviours in the New Zealand Workforce Survey of Employers included the eight questions that make-up the OPM-MU. Answers to each question range from one (strongly disagree) to five (strongly agree). The responses to each question were summed to produce a total OPM-MU score for each firm and then averaged across firm sizes. The lowest possible score is eight (strongly disagree with all eight statements) and the highest score is 40 (strongly agree with all eight statements). Letters were sent to employers requesting that the health

Figure 6 displays the average overall score by firm size. Large firms (100+ employees) had the lowest average score, while small firms (six to nine employees) had the second lowest score. The average score for large firms was statistically significantly different to the average score for micro-sized firms (one to five employees) and medium-sized firms (10 to 99 employees), but not compared to small firms (six to nine employees). There was no statistically significant difference between the other firm sizes.

Figure 6: Average OPM-MU score by firm size



Note: The error bars represent 95% confidence intervals; Excludes responses if missing firm size or missing the answers to any of the eight OPM-MU questions.
Source: 2014 Health and Safety Attitudes and Behaviours in the New Zealand Workforce: Survey of Employers.

There may be several sources of bias influencing these results. Employers in the AEP are excluded from the survey. AEP employers are generally large firms that might be expected to have higher than average occupational health and safety practices. Their exclusion may contribute to the low average score for the large firms in the survey. Companies that chose to participate in the survey might have a higher than average interest in occupational health and safety. This may mean that the average scores of those who responded to the survey are higher than they would be for the general population.

Looking at the responses to the individual statements in the OPM-MU we find that micro-sized employers were highly likely to strongly agree with seven of the eight questions, the exception being "Formal safety audits at regular intervals are a normal part of our business" (for which they were least likely to strongly agree). Large firms had a low proportion strongly agreeing across most questions, apart from this question, where it had the highest agreement.

Table 6: Percent who strongly agree to each OPM-MU statement, by firm size

	1 to 5	6 to 9	10 to 19	20 to 49	50 to 99	100+	**Total**
Formal safety audits at regular intervals are a normal part of our business	19%	20%	31%	37%	33%	55%	**23%**
Everyone at this business values ongoing safety improvements in this business	43%	34%	38%	35%	20%	33%	**40%**
This workplace considers health and safety at least as important as production and quality in the way work is done	54%	45%	51%	60%	53%	52%	**53%**
Workers and supervisors have the information they need to work safely	54%	53%	52%	53%	43%	44%	**53%**
Workers are always involved in decisions affecting their health and safety	50%	43%	46%	41%	28%	30%	**47%**
Those in charge of safety have the authority to make the changes they have identified as necessary.	64%	59%	58%	62%	61%	46%	**62%**
Those who act safely receive positive recognition	41%	24%	36%	31%	30%	23%	**37%**
Everyone has the tools and/or equipment they need to complete their work	64%	60%	59%	60%	58%	51%	**62%**

Note: Excludes responses missing firm size information.
Source: 2014 Health and Safety Attitudes and Behaviours in the New Zealand Workforce: Survey of Employers.

The original OPM-MU has an asterisk next to the question about audits with the following clarifying statement below the questions, which was omitted from the WorkSafe New Zealand survey:

> *"*For the purpose of this survey an audit means a formal process of evaluating and reporting on how the workplace manages health and safety in accordance with a recognised standard. Regular means that an audit is repeated at regular intervals, for example, once every year. "*

A similar qualifier in the New Zealand survey may improve responses to this question by small employers. However, even with this qualifier it seems likely that regular audits are more commonly a feature of large firms, rather than small firms.

There appeared to be a linear association by firm size for the question "Workers are always involved in decisions affecting their health and safety". Half of all micro firms strongly agreed with this statement, about 43% of SMEs (6-49 employees) strongly agreed with the statement, while only about 30% of firms with 50 or more employees strongly agreed.

The responses to these questions may have been influenced by the role of the person who completed the survey. In firms with less than 20 employees, the owner-operator was the most likely to complete the survey, and for firms with more than 20 employees it was the Health and Safety Manager/Director. It's likely that in small firms the owner-operator is also the health and safety manager.

Table 7: The current role of the person who completed the survey

	1 to 5	6 to 9	10 to 19	20 to 49	50 to 99	100+	Total
CEO/Managing director	11%	13%	12%	16%	8%	3%	11%
Owner - operator	72%	52%	35%	20%	7%	2%	48%
Health and Safety manager/director	4%	12%	19%	29%	37%	63%	17%
Human Resources manager/director	1%	3%	5%	6%	15%	16%	5%
Other	13%	20%	29%	30%	33%	16%	20%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: 2014 Health and Safety Attitudes and Behaviours in the New Zealand Workforce: Survey of Employers.

5. Conclusion

This paper has presented an exploratory analysis of injury rates by enterprise size using employee data in the IDI. I find little evidence to suggest that employees in small enterprises are at higher risk of work-related injury than employees in large enterprises. Although enterprises with fewer than 500 employees had higher injury claim rates than those with more than 500 employees, large enterprises of 2,500 or more employees had the highest entitlement claim rate over the period studied here. Consistent with previous New Zealand research I find a positive relationship between serious injury rates and enterprise size in Manufacturing, and an inverted-U shape in the Construction industry.

I find no evidence of under-reporting of injury in small enterprises – either through misclassification of claims or via under-claiming relative to self-reported injury. It appears that the low entitlement claim rates in small enterprises is not a result of higher levels of underreporting of injury.

The relationship between injury rates and firm size has changed over time. Entitlement claim rates in large enterprises have decreased in recent years, resulting in a convergence of entitlement claim rates by enterprise size. This suggests that firm dynamics may have an important role to play in interpreting the relationship between firm size and the health and safety environment.

There are several limitations in determining the relationship between firm size and injury rates. Firstly, high injury rates may be a consequence of high hazard exposure and/or poor hazard management; however, we are not able to distinguish between the two. For example, a firm undertaking hazardous work with good health and safety practices may have the same injury rate as a firm in the same industry but doing less hazardous work with poor health and safety practices. Differences in injury rates should be interpreted as differences in risk of injury rather than differences in health and safety practices.

Second, in some industries, such as construction, multiple small firms may work together on one work site. This introduces an additional layer of complexity. For example, an employee from one firm may be injured because of poor practice by another firm. I am unable to control for these factors with this data.

Third, this study uses administrative data. If a firm has not submitted their tax return they will not be captured in this data. Firms who do not comply with tax regulations are unlikely to be compliant with other regulations, including workplace health and safety. It seems likely that small firms would be overrepresented among non-compliant firms because they are less visible to regulators. This would place downward bias on injury rates for small firms.

I have used the number of employees in an enterprise to define firm size. Although this consistent with the literature, it may not be the most appropriate measure. Firm size definitions based on quantity produced or financial resources may better capture the relationship between size and injury rates. Further, there are likely to be other relevant characteristics worth exploring such as firm structure, age of the firm, management practices, and firm culture (Cunningham, Sinclair, & Schulte, 2014).

The results here suggest that the relationship between injury rates and firm size is not straight-forward. Firm dynamics for small firms tend to be different from large firms – on average small firms are younger, exit at a higher rate, and grow faster than large firms. Investigation into the relationship between SMEs and firm dynamics may be a promising area for further research. Irrespective of the relationship between injury rates and firm size it is clear from the literature that one size does not fit all when it comes to occupational health and safety. Interventions should be targeted to meet the needs of different sized firms.

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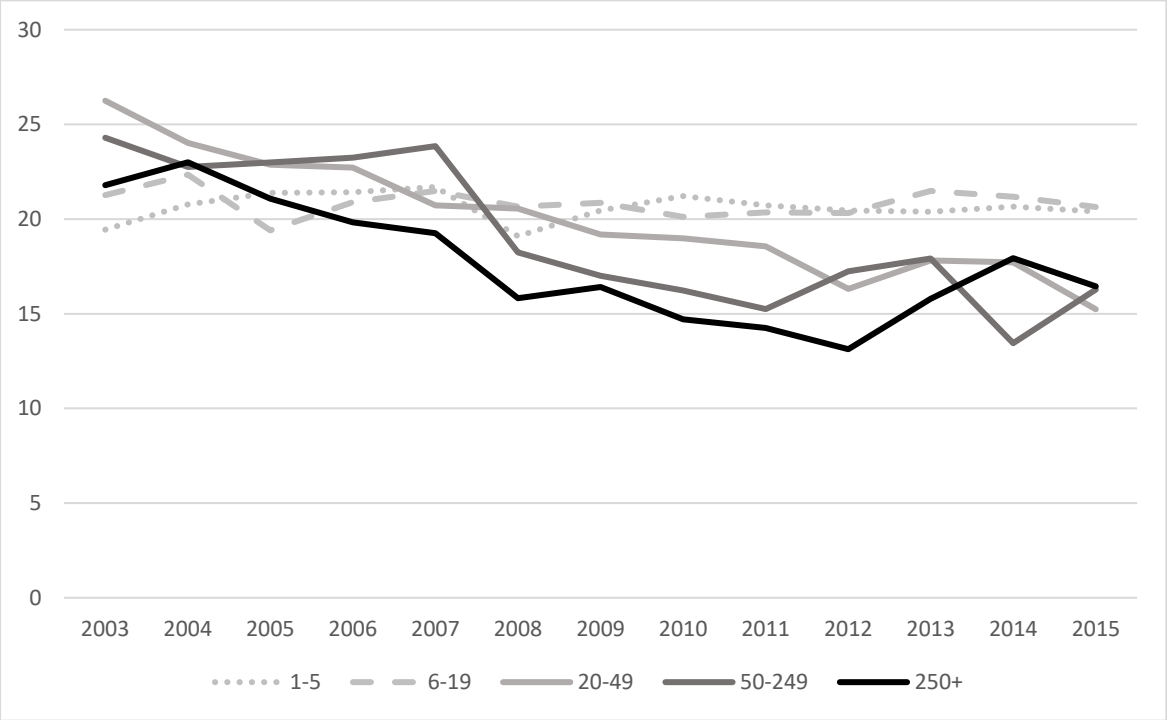
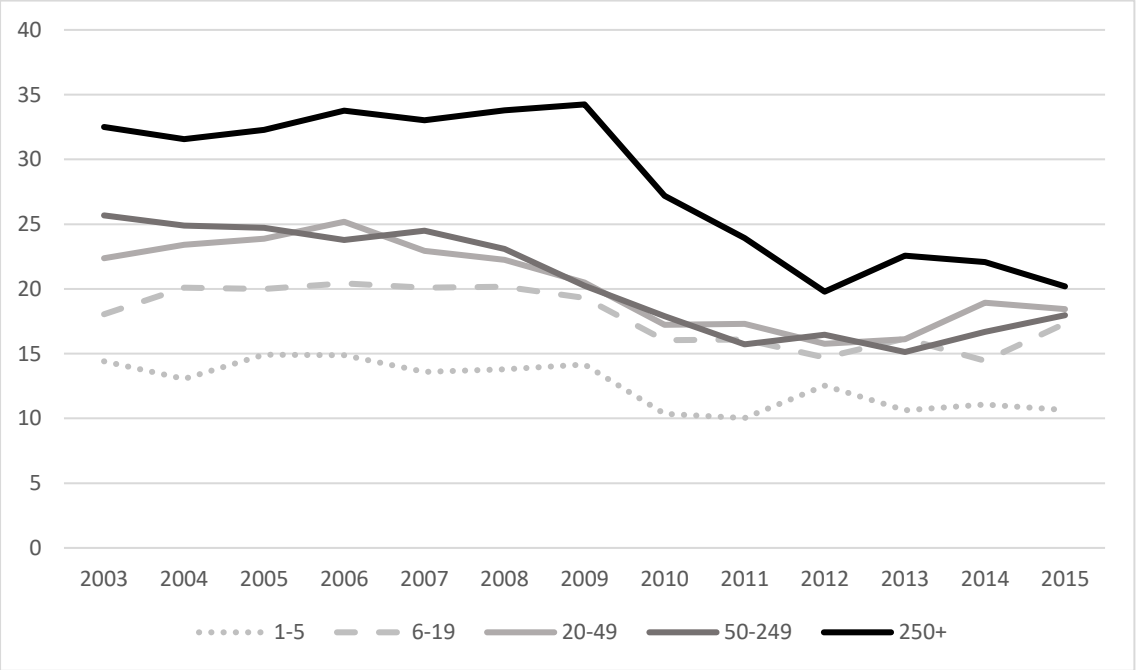
7. Appendix

Figure 7: Agriculture, Forestry & Fishing work account entitlement claim rates



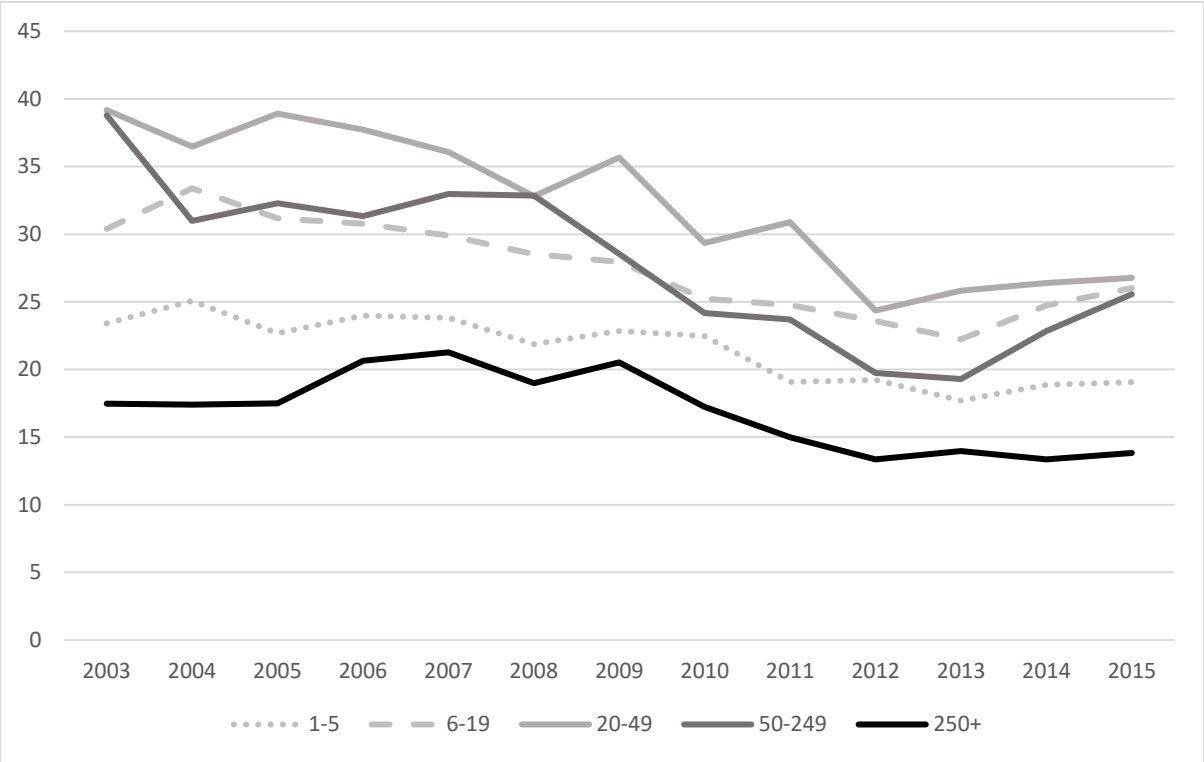
Source: IDI (confidentiality rules have been applied)

Figure 8: Manufacturing work account entitlement claim rates



Source: IDI (confidentiality rules have been applied)

Figure 9: Construction work account entitlement claim rates



Source: IDI (confidentiality rules have been applied)

Table 8: Average work account claim rate per 1,000 employees by firm size, 2001/02-2014/15 (data for Figure 2)

Enterprise size (number of employees)	All claims (left axis)	Entitlement claims (right axis)
1-5	94.09	10.69
6-19	93.71	11.04
20-49	97.74	12.01
50-249	91.6	11.72
250-499	92.03	12.01
500-999	79.11	10.7
1,000-1,499	75.56	9.78
1,500-2,499	77.57	10.88
2,500+	81.13	13.77

Source: IDI (confidentiality rules have been applied)

Table 9: Work account entitlement claim rate by firm size and financial year (data for Figure 3)

Year ending March	1-5 employees	6-19 employees	20-49 employees	50-249 employees	250+ employees
2001/02	11.17	11.31	13.13	13.52	12.8
2002/03	11.29	11.71	13.66	14.06	14.12
2003/04	11.56	12.43	13.81	13.63	13.79
2004/05	11.59	11.82	13.7	13.58	13.37
2005/06	11.7	12.26	13.32	13.17	13.66
2006/07	11.57	11.9	13.3	13.46	13.27
2007/08	10.51	11.39	12.58	12.71	13.43
2008/09	11.1	11.33	12.38	11.37	13.15
2009/10	10.54	10.12	10.67	10.15	11.34
2010/11	9.70	9.92	10.61	9.45	10.21
2011/12	9.66	9.70	9.75	9.46	9.44
2012/13	9.51	9.85	10.13	9.16	10.24
2013/14	9.96	10.13	10.46	9.79	10.47
2014/15	9.85	10.62	10.60	10.59	10.2
Total	**10.69**	**11.04**	**12.01**	**11.72**	**12.10**

Source: IDI (confidentiality rules have been applied)

Table 10: Claim rate by firm size using two different methods to estimate firm size (data for Figure 4)

Enterprise size (number of employees)	Claim rate using liable earnings	Claim rate using LEED employment
1-5	135	92
6-19	107	90
20-49	95	90
50-249	82	82
250-499	72	83
250-999	64	70
1,000-1,499	65	65
1,500-2,499	57	71
2,500+	54	66

Source: IDI (confidentiality rules have been applied)

Table 11: Agriculture, Forestry & Fishing work account entitlement claim rates (data for Figure 8)

	Enterprise size (number of employees)					
Year ending March	**1-5**	**6-19**	**20-49**	**50-249**	**250+**	**Grand Total**
2002/03	19.4	21.3	26.2	24.3	21.8	22.6
2003/04	20.8	22.3	24.0	22.8	23.0	22.6
2004/05	21.4	19.4	22.9	23.0	21.1	21.5
2005/06	21.4	20.9	22.7	23.2	19.8	21.6
2006/07	21.7	21.5	20.7	23.9	19.3	21.4
2007/08	19.1	20.7	20.6	18.2	15.8	18.9
2008/09	20.5	20.9	19.2	17.0	16.4	18.8
2009/10	21.2	20.1	19.0	16.2	14.7	18.2
2010/11	20.7	20.4	18.6	15.2	14.3	17.8
2011/12	20.5	20.3	16.3	17.2	13.1	17.5
2012/13	20.4	21.5	17.8	17.9	15.8	18.7
2013/14	20.7	21.2	17.7	13.4	17.9	18.2
2014/15	20.4	20.6	15.2	16.3	16.4	17.8
Annual average	**20.6**	**20.8**	**20.1**	**19.1**	**17.7**	**19.7**

Source: IDI (confidentiality rules have been applied)

Table 12: Manufacturing work account entitlement claim rates (data for Figure 9)

	Enterprise size (number of employees)					
Year ending March	**1-5**	**6-19**	**20-49**	**50-249**	**250+**	**Grand Total**
2002/03	14.4	18.0	22.4	25.7	32.5	22.6
2003/04	13.0	20.1	23.4	24.9	31.6	22.6
2004/05	14.9	20.0	23.9	24.7	32.3	23.2
2005/06	14.9	20.4	25.2	23.8	33.8	23.6
2006/07	13.6	20.1	22.9	24.5	33.0	22.8
2007/08	13.8	20.2	22.2	23.1	33.8	22.6
2008/09	14.2	19.3	20.5	20.3	34.2	21.7
2009/10	10.3	16.0	17.2	17.9	27.2	17.7
2010/11	10.0	16.1	17.3	15.7	23.9	16.6
2011/12	12.5	14.7	15.8	16.5	19.8	15.8
2012/13	10.6	16.2	16.1	15.1	22.6	16.1
2013/14	11.1	14.5	18.9	16.7	22.1	16.6
2014/15	10.7	17.3	18.4	18.0	20.2	16.9
Annual average	**12.6**	**17.9**	**20.3**	**20.5**	**28.2**	**19.9**

Source: IDI (confidentiality rules have been applied)

Table 13: Construction work account entitlement claim rates (data for Figure 10)

	Enterprise size (number of employees)					
Year ending March	**1-5**	**6-19**	**20-49**	**50-249**	**250+**	**Grand Total**
2002/03	23.4	30.4	39.2	38.8	17.5	29.8
2003/04	25.1	33.4	36.5	31.0	17.4	28.7
2004/05	22.7	31.2	38.9	32.3	17.5	28.5
2005/06	24.0	30.8	37.7	31.3	20.6	28.9
2006/07	23.8	29.9	36.1	33.0	21.3	28.8
2007/08	21.9	28.5	32.8	32.9	19.0	27.0
2008/09	22.8	27.9	35.7	28.5	20.5	27.1
2009/10	22.5	25.2	29.3	24.2	17.2	23.7
2010/11	19.1	24.8	30.9	23.7	15.0	22.7
2011/12	19.2	23.6	24.4	19.7	13.4	20.0
2012/13	17.7	22.2	25.8	19.3	14.0	19.8
2013/14	18.9	24.7	26.4	22.8	13.4	21.2
2014/15	19.1	26.0	26.8	25.6	13.8	22.2
Annual average	**21.5**	**27.6**	**32.3**	**27.9**	**17.0**	**25.3**

Source: IDI (confidentiality rules have been applied)