Labour market dynamics following a regional disaster

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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 authors not Statistics NZ, MBIE, Motu, GNS Science or Victoria University of Wellington.

Access to the anonymised data used in this study was provided by Statistics NZ in accordance with 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 paper have been confidentialised to protect these groups from identification.

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 IDI 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.

Abstract

The 2010/2011 Canterbury earthquakes caused major upheaval to the people of the region. The second major quake killed 185 people, forced many from their homes, and closed Christchurch's central business district. This paper examines the consequential effect on jobs and accumulated earnings for workers in Canterbury. In addition, we examine concurrent decisions about employment location, including job-to-job transitions and regional migration. While Canterbury workers' employment outcomes were adversely affected in the short-run, those workers were more likely to have jobs three years later (relative to a matched control group), and to have higher accumulated earnings. At the same time, they were less likely to be at the same employer, and more likely to have migrated to jobs in other New Zealand regions. Impacts vary substantially by worker characteristics and by the naturally-induced geographic variation in the severity of the shock. We show that the Earthquake Support Subsidy appears to have influenced the extent of outward migration decisions, at least for most types of workers, though not the long-term retention of the pre-quake job under which the subsidy was gained. We interpret these findings as evidence that the subsidy achieved its goal of delaying involuntary job loss and, as a result, fewer workers made immediate decisions to leave the region – decisions that persisted over the long-run.

JEL codes

D22, L11, Q54

Keywords

Natural disasters; employment; migration; response to shocks; difference-in-difference

Summary haiku

Quake! drop, cover, hold
Then employees recover
and subsidy helps.

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1 Motivation

The Canterbury earthquake sequence was the most damaging natural hazard event in New Zealand's written history. The February 2011 quake killed 185 people, forced many from their homes, and closed Christchurch's central business district (CBD). Both the September 2010 and February 2011 earthquakes caused major damage to land, property and infrastructure.[1]

We examine the effect of this disaster on jobs and accumulated earnings for workers in the Greater Christchurch region.[2] Census estimates show a declining population in Christchurch City dropping a total of 4 percent in the two years to June 2012 (Statistics New Zealand 2014a), and firms have reported difficulty hiring workers in Christchurch, with employers attributing this mainly to people leaving the area and to difficulty in attracting new staff to Christchurch (MBIE 2012). These factors lead us to also examine concurrent decisions about employment location, specifically changes in employer (job-to-job transitions) and outward migration to jobs in other New Zealand regions.[3]

This paper is a companion to earlier work examining the impact of the quakes on businesses in the region (Fabling et al. 2014). In that paper we showed that firm profitability fell by an average of 3 percentage points immediately after the second major quake, driven by an average decline of 9 percentage points in sales revenue, causing an elevated rate of firm exit immediately following the disaster, particularly among previously poor performing (low profitability) businesses. Surviving firm employment recovered, though with lower worker retention than might be expected.

Firm-level outcomes varied considerably on a number of dimensions, particularly in relation to the geography of the event. Outcomes for businesses also varied substantially by industry, consistent with aggregate statistics showing the industry composition of the region's workforce has changed markedly, with a large (59 percent) jump in the number of workers employed in the construction industry, making it the largest employing sector

[1] The Treasury (2015) estimates that total investment associated with the rebuild will be around $40 billion. This investment is spread across residential property ($16b), commercial property ($10b) and infrastructure and social assets ($11b).

[2] Greater Christchurch is taken here to include the Territorial Authorities of Christchurch City, Selwyn District and Waimakariri District. Greater Christchurch is treated as the affected area in this paper, and we use this term interchangeably with Christchurch for simplicity.

[3] A subset of results for outward migration from New Zealand are shown in the appendix.

in Greater Christchurch (Statistics New Zealand 2014a). Conversely, other industries, such as retail and hospitality, experienced an initial decline in sales, but have since recovered and are currently growing at above the national average rate (Statistics New Zealand 2014b).

The worker perspective enables a deeper understanding of this heterogeneity in outcomes, through a series of econometric (difference-in-difference) comparisons using linked employer-employee tax data. Firstly, we compare Christchurch workers to similar workers in Auckland and Hamilton, establishing an average effect on all workers. Secondly, we disaggregate these averages by sex, age and skill to uncover particularly affected sub-groups, tying these findings back to the industry dynamics observed in Fabling et al. (2014). Thirdly, we look at geographic variation in impacts comparing workers within Greater Christchurch based on the location of their job. Finally, we combine this geographic variation in impact with Earthquake Support Subsidy (ESS) data to determine the short- and long-run effects of the subsidy on worker outcomes.

We find that, while Canterbury workers' employment outcomes were adversely affected in the short-run, those workers were more likely to have jobs three years later (relative to a matched control group), and to have higher accumulated earnings. At the same time, they were less likely to be at the same employer, and more likely to have migrated to jobs in other New Zealand regions. Impacts vary substantially by worker characteristics and by the naturally-induced geographic variation in the severity of the shock. We show that the Earthquake Support Subsidy appears to have influenced the extent of outward migration decisions, at least for a subset of workers, though not the long-term retention of the pre-quake job under which the subsidy was gained. We interpret these findings as evidence that the subsidy achieved its goal of delaying involuntary job loss and, as a result, fewer workers made immediate decisions to leave the region – decisions that persisted over the long-run.

Section 2 discusses the unique contribution of this paper in the context of recent research on the labour market impacts of Hurricane Katrina in the United States. Section 3 outlines the empirical method and the data used. Results are discussed in section 4 before we summarise the findings in section 5.

2 Prior literature

This paper relates directly to recent studies of the labour market effects of Hurricane Katrina in the United States. Two of these studies – Deryugina et al. (2014) and Groen et al. (2015) – make use of administrative tax data to examine long-run consequences for workers.[4]

As in our study, Groen et al. (2015) make use of linked employer-employee tax data and a difference-in-difference (DID) estimation strategy. Their primary outcome of interest is real quarterly earnings, which are aggregated to the county level.[5] Aggregating allows them to retain non-earners in the analysis and to decompose average earnings changes into a component due to earnings growth of the employed and a transition-to-unemployment effect. They find that Katrina had a short-run negative impact on average earnings, driven by increased unemployment, while the (seven year) long-run effect was to raise average earnings, which they attribute in part to increased labour demand and decreased supply in the affected areas.

This dynamic exists for most types of workers that they consider, but the strongest short-run negative effects are concentrated in the worst affected geographic areas (measured using building damage) and amongst workers who have changed employer or moved region within a year of the hurricane. Groen et al. (2015) note that the latter of these outcomes may be an endogenous response, which complicates the interpretation of the earnings results for movers. The same could be said of job separation unless this is solely determined by the employer. Even in that case, employers may shed employees in ways systematically related to worker characteristics.

They find that, on average, women fare worse than men, which is partly attributed to job sorting and the heterogeneity of the impact by industry. Over the long-run outcomes converge across groups. Supplemental worker-level regressions suggest that short-run outward migration and job separation are substantially influenced by the level of damage done to both the region in which the employee lived and worked.

Deryugina et al. (2014) also use administrative tax data, but annual

[4] Several other studies make use of the small samples of post-Katrina evacuees in the Current Population Survey (Vigdor 2007; Groen and Polivka 2008; Zissimopoulos and Karoly 2010). These studies are restricted to examining the impact one year after the disaster (because evacuees are identified using a temporary supplemental question in the survey), and there is no pre-storm information on most evacuees.

[5] Control counties for the DID are identified using propensity score matching on labour force characteristics and economic conditions.

household tax returns, rather than linked employer-employee data. This data has the advantage of being able to track additional outcomes of interest including unemployment benefit receipt and income from self-employment. The analysis is at an individual-level DID with propensity score matching on worker characteristics to control group individuals residing in cities with similar economic and demographic characteristics to New Orleans.[6]

Using this alternative data source, Deryugina et al. (2014) also identify a similar average pattern of initial earnings loss, followed by long-run (five year) wage income gains for Katrina survivors. They link this finding to the increased cost of living in New Orleans, particularly rent increases caused by the depletion (and non-replacement) of the housing stock. Long-run positive earnings impacts are found to be weakest for the residents of the worst affected zip codes in New Orleans (according to FEMA damage classifications), and for individuals with lower incomes in the six years preceding the hurricane, where there is some correlation between these groups due to low-lying areas being poorer.

In addition, and consistent with the earnings results, Deryugina et al. (2014) identify short-run increases in non-employment (zero wage income) and unemployment benefit receipt. There is a statistically significant and persistent increase in self-employment income, though the economic magnitude of the effect is estimated to be small. Outward migration is large with 27 percent of New Orleans residents initially moving elsewhere because of the hurricane, falling to half that five years later.

As Deryugina et al. (2014) and other studies (eg, Vigdor (2007)) note, one of the key issues in analysing post-Katrina outcomes is that New Orleans was a city in decline prior to Hurricane Katrina. Not only does this make it potentially difficult to find adequate controls to determine the effect of the hurricane, but it also may make the effect unrepresentative of what may occur in an otherwise thriving city, particularly in relation to migration outcomes. In contrast, Christchurch was a growing region prior to the earthquakes, a manufacturing export centre within a diversified regional economy, and the largest city in the South Island. A key contribution of this paper, therefore, is to estimate labour market outcomes following a disaster in a previously thriving regional economy.

At a technical level, we enhance the analysis on a number of dimensions. Specifically, we examine outcomes on a monthly basis, and extend

[6]The individual followed is the primary filer on the tax return, and it is the characteristics of that individual that are matched on.

the basic matched DID approach to include direct person-level controls, job characteristic such as industry and tenure, as well as the performance of the employer prior to the earthquakes. Inclusion of direct controls may be important where matching does not yield completely equivalent treated and control groups, and may improve the precision of estimates by accounting for aspects of job loss unrelated to the disaster. The data allow us to consider additional detailed disaggregations of effects, both in terms of worker characteristics (including a proxy for worker skill) and city-block level measures of impact. The latter of these allows us to make very plausible like-for-like worker comparisons of effects *within* Greater Christchurch.

Like Deryugina et al. (2014), we examine multiple outcomes and, in particular, because of the availability of employer identifiers we can track job separation statistics over time. Acknowledging the issues of endogenous employer choice, we keep the analysis of migration decisions entirely separate from the earnings analysis. Finally, while both Deryugina et al. (2014) and Groen et al. (2015) note the extensive Federal Government support offered to Katrina survivors, neither paper is able to link this funding directly to specific outcomes for workers. Our analysis, by comparing ESS recipients to similarly affected non-recipients makes a first attempt at describing the short- and long-run impact of a wage subsidy following a major disaster. Understanding the effect of such policies is likely to be beneficial to improving post-disaster responses in future.

3 Estimation approach and data

The empirical strategy employs two difference-in-difference (DID) approaches, with extensive pre-quake (July 2010) controls relating to firm, job and worker characteristics. The first approach compares changes in labour market outcomes of affected workers in Greater Christchurch to "similar" unaffected workers in Auckland and Hamilton City (the "control" group), providing a counterfactual for what might have happened to affected workers in the absence of the earthquakes. The difference between this counterfactual and the actual average outcome for Christchurch-based workers is an estimate of the effect of the quakes.

The second DID approach compares subgroups of Christchurch workers, distinguished by worker characteristics, pre-quake job location, and/or whether the employer received the ESS. Comparing groups within Greater Christchurch demonstrates the heterogeneity of outcomes between workers whose jobs were most directly affected by the earthquakes and those less directly affected. Comparison between ESS recipients and non-recipients in similarly badly affected areas provides evidence regarding the effect of the subsidy on employment and migration decisions.

Data come from Statistics New Zealand's Integrated Data Infrastructure (IDI), exploiting the linking of full-coverage firm- and worker-level administrative datasets. The Longitudinal Business Database (LBD) provides firm characteristics – business type, plant location, profitability, and detailed industry.[7] These firm-level variables are constructed exactly as in Fabling et al. (2014), with profitability defined as the return on sales derived from tax (GST and PAYE) data.[8]

Worker characteristics (age and sex), and monthly jobs, benefit receipt, ACC receipt, and border movement data come from the IDI. The PAYE-based jobs data is discussed in detail in Fabling and Maré (2015), and we make use of their derived FTE measure of labour input and their method for identifying and removing working proprietors from the PAYE data. Also derived from the Fabling and Maré dataset, we use the two-way wage fixed effects estimates of Maré et al. (2015), interpreting the estimated worker fixed effects from that model as a proxy for worker skill.[9] Additional firm-level controls are derived from the employment data, including total firm employment, change in firm-level employment over the prior three years, and firm age based on first PAYE employing month.

While these data are incredibly rich, employee residential address information are not subject to regular updating since most workers no longer need to file tax forms with Inland Revenue. This shortcoming places two constraints on the analysis. Firstly, we cannot consider the effect of changes in the housing stock on the outcomes of interest, instead focussing purely on the flow-on effects of the impact on the employer.[10] Secondly, PAYE data is reported at the firm level so that, in the absence of good residential address information, it is difficult to know whether a person employed in a multi-region firm is employed in Greater Christchurch. As a consequence,

[7] Firms are enterprises with longitudinal identifiers repaired following the method of Fabling (2011).

[8] Fabling and Sanderson (2016) provide extensive detail on the underlying data in the LBD.

[9] The two-way fixed effects model includes controls for year, and worker age by gender. The average (FTE-weighted) contribution of observed worker characteristics is included as a firm-level control, as is the average worker "skill" level and the firm fixed effect.

[10] Statistics New Zealand have recently added other administrative residential address information to the Integrated Data Infrastructure, which may make it possible to extend the study in future to additionally consider the effect of changes in the housing stock.

we restrict attention to workers who we can assign with certainty to a region (Greater Christchurch or Auckland/Hamilton) in the reference month.

The effect of this – and other – restrictions on the sample size is shown in table 1. The population of interest excludes the public sector, and includes 144,300 jobs as at the reference month of July 2010.[11] We lose an estimated quarter of private-for-profit jobs because the employee works in a firm with locations both within and outside Christchurch.[12] A further 19 percent of jobs are lost because of firm-level restrictions, particularly the requirement of a firm-size common support which excludes the largest firms operating in Greater Christchurch.[13] Since these largest firms are generally multi-region (Fabling et al. 2014), a substantial proportion of the loss due to firm characteristics would be attributed to uncertain job location if the (sequential) accounting of the restrictions was reversed. Other restrictions have relatively minor effects on population coverage, but make the analysis and interpretation substantially easier, namely dropping workers: missing key characteristics (1.2% of population); with multiple jobs in the pre-quake reference month of July 2010 (5.0%); in jobs that start or end in the reference month (3.6%);[14] and without a control-group match or not aged 15-75 (1.6%).[15]

Matching is done based on reference month characteristics and is a combination of exact matching on sex, and approximate matching on:

- age (plus or minus two years);

[11] The public sector is excluded to focus on workers in businesses at risk of closure or substantial job loss, and to allow profitability to be included as a pre-quake control variable that predicts such exit. Public sector jobs that workers subsequently move to post-earthquakes are included in the outcome measure.

[12] This number is derived from Statistics New Zealand's allocation of workers to plants within multiple location firms, based on survey data on employment shares across regions. We assume that these shares are accurate enough for our assessment of population loss, but that the actual allocation of workers is not accurate enough to know *which* of the firm's workers are in a specific region.

[13] The firm-level study also included firms without the profitability measure for a subset of the analysis. We exclude those firms here, since we use the return on sales measure as a regression control in all estimates.

[14] The reference month is taken as July 2010 because we require this to be an interior job month (ie, not the start or end of a job spell). If we took the reference month to be August 2010 then it would not be possible, with this criteria, to observe the worker being unemployed in the month of the first major quake (September 2010).

[15] This last category also includes a requirement that the worker appears to be resident in NZ in the reference month, defined as not being out of the country for the entire reference month and for more than half of the prior year.

- job tenure (plus or minus three (six) months for worker with tenure less than 2 (≥ 2) years);
- wage ($\pm 10\%$);
- worker FTE groups (full-time, FTE in $[0.5, 1)$, FTE in $[0, 0.5)$);
- total firm FTE groups ($L < 50$, $L \geq 50$).

In unweighted terms, matching yields an average of slightly over three Auckland/Hamilton workers per Greater Christchurch worker. Christchurch workers are assigned a weight of one, and Auckland/Hamilton control workers have a weight equal to $\sum_{i \in I_j} 1/N_i$, where I_j is the set of Greater Christchurch workers that control (j) matches to and N_i is the total number of controls matched to Greater Christchurch worker i.

Tables 2 and 3 report means and standard deviations for worker/job and firm-level controls respectively, using these match weights. Match variables are highlighted in bold and the tables demonstrate the close approximation of controls for these and other variables in the reference month. In subsequent regressions, all continuous control variables are included with both linear and quadratic terms, except the number of benefit and ACC months in the year which are each included as a set of month count dummies. All regressions also include pre-quake employer 4-digit industry (ANZSIC'96) dummies.

In terms of match variables, 44 percent of workers are female, average age is 38.5 and current job tenure averages approximately 3 years and 3 months. Two thirds of workers are identified as full-time using the Fabling-Maré methodology.[16] The average log (FTE) wage converts to \$3,181/month (gross), and the average worker is in a firm with 14 (FTE) employees.

We make use of Earthquake Support Subsidy (ESS) data for two purposes – to establish the hardest hit geographic areas of Greater Christchurch, and to identify workers in firms that received the ESS. The ESS was established to assist firms wishing to continue employing, but which couldn't meet their wage bill because of the earthquakes. The subsidy initially ran from 22 February 2011 for up to six weeks, paying \$500 per week (gross) per full-time employee (MSD 2011), which is a substantial proportion of the average log wage.[17] ESS administrative data is linked to other data on the basis of

[16]Since we focus on workers with mid-spell, single jobs in the reference month the FTE$=1$ dummy largely identifies workers whose total earnings in the month are above what a minimum wage worker would earn using a reasonable full-time hours assumption (Fabling and Maré 2015).

[17]Part-time (20 hours or less a week) workers received \$300 per week.

employer tax identifiers and the match is, therefore, exact.

This data has the advantage over, say, land damage information in that it factors in infrastructural loss or network effects (eg, loss of adjacent businesses or supply chains) in assessing the impact on firms. The key disadvantage of using the subsidy data is that it does not give a complete picture of the most affected firms. In particular, a business owner may decide to immediately exit post-event and, therefore, be heavily affected but not a subsidy recipient. Importantly, also, the subsidy was limited to firms with less than 50 employees. We expect, however that the geographic location of recipient firms provides a good indicator of whether firms not receiving the subsidy are heavily affected.

Following Fabling et al. (2014) we identify firms which had a plant in any location where the majority of eligible (ie, less than 50 employee) firms received the ESS; and firms not in these areas.[18] Workers in these firms are then assigned based on their employers' job locations, and we label these high and low impact areas respectively. The analysis includes workers in firms where the firm has multiple locations within a region. For the 7.9 percent of workers where this is the case, the identification should be thought of as a substantial shock to the employer, rather than necessarily to the *specific* place of work for that employee.

Figure 1 is copied from Fabling et al. (2014) and shows the geographic distribution of recipient firms – the upper panel shows Greater Christchurch, while the lower panel shows Christchurch City.[19] Many recipients were clustered in and around the Christchurch CBD, but this was not the only area where the majority of businesses were hit hard.

In the DID comparisons that follow, we examine heterogeneity in outcomes by the impact area, and additionally by the subsidy status of the employee in the firm.[20] In the latter case, Greater Christchurch workers fall into three categories depending on subsidy receipt and whether the firm meets the firm size criteria for eligibility.[21] Table 4 shows the distribution

[18]Location is measured at the meshblock level, which is the most detailed available, and approximately corresponds to a city block in dense urban areas.

[19]While the subsidy was limited to firms in Christchurch City Council area, there appears to be some spillover of payouts into adjacent areas affected by the quake. The fact that the subsidy was limited to specific locations does not present a problem if the boundaries were chosen accurately to include all areas where firms might be expected to be badly affected.

[20]ESS receipt is granted at the firm level, and all workers at an ESS recipient firm are assumed to have received the subsidy, consistent with the rules of the scheme.

[21]Employment (L) eligibility criteria is that firm has: a headcount of less than 50 employees;

of workers across these two dimensions – ie, impact area and ESS receipt. Slightly more than half the sample of workers (53%) had jobs in high impact areas just prior to the first major quake. By construction, ESS recipients are concentrated in high impact areas with 77% of recipients in high impact areas, and 70% of eligible workers in high impact areas receiving the ESS. Conversely, 26% of eligible workers in low impact areas received the ESS. Ineligible (primarily large firm) workers make up 19% of the sample and are fairly evenly distributed between high and low impact areas.

We consider five outcome variables: employment; benefit receipt; accumulated earnings; continued employment with the pre-quake employer; and employment in the pre-quake region. Accumulated earnings is real (CPI-deflated) log gross wage and salary (PAYE) earnings, plus benefit and ACC receipt.[22] All other outcomes are binary indicators set to one if the outcome holds, and zero otherwise.

Internal migration outcomes are subject to observing a job location because of the data issues outlined above, and these data issues also restrict the analysis to workers who have jobs in known locations. Specifically, we have to exclude workers who move to jobs in firms with employment in multiple regions, where one of those regions was the initial location of the pre-quake employer.[23] In the appendix we present average effects on external migration using three alternative (binary) metrics based on time outside of New Zealand over the prior year.

To allow the control variables to have a time-varying influence on outcomes, we estimate a separate regression for each (of five) outcome in each (of 43) post-quake month. That is, for example, the relationship between pre-quake job tenure on employment is allowed to vary over time. Because of the volume of coefficients this estimation process creates, most DID estimates are presented in graphical form, without reporting the relationship between outcomes and control variables. Interpretation of results focuses on effects that are significantly different from zero at the 5% level or better.

and is still employing at the time of the second major earthquake (February 2011).

[22] Workers with zero accumulated earnings are assigned $1.

[23] For example, a Christchurch worker who changes job to a firm that has locations in Christchurch and Wellington is dropped from the analysis when they change jobs, because we can no longer tell whether they are working in Christchurch. In contrast if the same Christchurch worker changed jobs to a firm that had locations in Auckland and Wellington, then they would remain in the sample because, even though we do not know whether they've moved to Auckland or Wellington, we know that they are no longer in Christchurch, which is what the outcome variable captures.

4 Results

4.1 Average impact on Greater Christchurch workers

Figures 2 and 3 show the estimated average impact on each outcome by month, including the 95% confidence interval (shaded region). Vertical dashed lines show the timing of the two major earthquakes in September 2010 and February 2011. Figure 2 shows the three outcomes that are measured for all pre-quake workers, while figure 3 reports outcomes that are conditional on being in a job (panel A), or being in a job in a known-region firm (Panel B), following the earthquakes.

Likelihood of employment (panel A, figure 2) initially rises after the first major quake, before falling rapidly after the second major earthquake. The initial rise in employment is consistent with a reduced willingness to be (temporarily) out of work during the uncertain period after the first quake. Unlike the September earthquake, the second major quake induced substantial firm exit (Fabling et al. 2014), making involuntary job loss a dominant driver of subsequent employment dynamics. From peak to trough, the probability of employment falls by 2.6 percentage points (pp) in the space of five months. By November 2011, employment recovers with estimates insignificantly different from zero. Effects are positive and significant from January 2012, and become increasingly positive over time ending in March 2014 with Greater Christchurch workers being, on average, 3.3pp more likely to have a job than comparable Auckland/Hamilton workers.

Benefit receipt (panel B) is consistent with employment patterns, showing a distinct hump over the period April 2011-November 2011 when involuntary job displacement was at its strongest.[24] Benefit receipt is not lower than expected (relative to the control group) between the two earthquakes, consistent with the possibility that the initial rise in employment came from fewer workers voluntarily moving out of work following the uncertainty caused by the September quake. By March 2014 benefit receipt is 1.5pp less likely for Christchurch workers compared to the control group.

Accumulated earnings (panel C) are persistently higher for Greater Christchurch workers, presumably initially reflecting the higher relative em-

[24] Following the second major earthquake the government established the Earthquake Job Loss Cover benefit for workers who couldn't make contact with their employer, or whose workplace had closed permanently, meaning that workers who lost their jobs had timely access to the benefit, with payments starting on 2nd March 2011 (MSD 2011).

ployment rate. Over the longer term the accumulated earnings gap continues to expand, reaching 4.4pp by the end of period. On average, employment rates over the period are only elevated by 1.4pp, suggesting other mechanisms are driving earnings up in Canterbury. Obvious candidates are the combination of reduced aggregate labour supply, and the potential need to provide financial inducement to stay in the region. As Deryugina et al. (2014) and Groen et al. (2015) note, a change in the household budget constraint due to loss of assets may also induce some workers to increase their hours worked, which would manifest as higher accumulated earnings.

Workers in Christchurch are more likely to switch jobs (figure 3, panel A), and job change is often associated with rapid wage growth in New Zealand.[25] Accelerated separation from the pre-quake employer starts immediately following the first major earthquake before accelerating further when firms start exiting after February 2011. The estimated effect bottoms out at -6.0pp in May 2012, implying a substantial loss of job-specific human capital in the Greater Christchurch area. Beyond that point the differential impact of the earthquakes reduces, ending the period at -4.1pp. This tailing off is consistent with firm-level findings that suggest some of the acceleration in firm exit in Christchurch is of firms that would have subsequently exited in later years anyway due to poor performance. If true, then we expect worker separation rates to converge somewhat as firm exits in the Auckland/Hamilton population catch up over the long-run.

Finally, changes in employer go hand-in-hand with internal migration (panel B). The migration effect is initially weaker than the separation effect, consistent with adjustment costs being higher for location change compared to job change. However, by March 2014 internal migration to other parts of New Zealand is 5.0pp higher for Greater Christchurch workers.

The appendix (figure A.1) presents evidence of a short-run increase in outward international migration for Christchurch workers also. This data comes from administrative border control data and so, unlike the internal migration results, is not conditional on employment. The three panels show the estimated effect using alternative definitions of outward migration. Panel C reflects a common permanent migration definition, of the individual being out of the country for the entire past year. In contrast, panels A and B relax this to three and six months respectively, though still measuring accumulated absence over a one year period.[26] The purpose of including the shorter time

[25] See, eg, Maré et al. (2014), for evidence of this using the IDI.

[26] For simplicity, absence does not need to be in a single spell, to allow for the fact that migrants to Australia, say, may make return visits to New Zealand. By construction,

frames is to explore the short-run migration dynamics, since the primary outcome of interest (permanent migration) is only inferable after sufficient time has passed.[27] This can be seen from figure A.1 where the onset of increased outward migration is displaced to the right in panel C compared to panels A & B. Taking this measurement issue into account, all three panels show an elevated increase in outward international migration, likely occurring immediately following the second major earthquake.

While the short-run picture is consistent, the longer-term differs somewhat across the three measures. Specifically, both the six-monthly and yearly measures show effects insignificantly different from zero by March 2014, while the three-monthly measure shows a significant negative effect at the end of the period. The longer term results may suggest a story similar to that for firm exit, in that there may have been a cohort of Christchurch workers who had intentions to migrate prior to the quakes who accelerated those departure plans following the quakes, leading to the initial upward jump in migration, after which migration in the control areas catches up due to the underlying natural rate of outward migration.[28] For the remainder of the paper, the migration analysis focuses on movements within New Zealand, because of the larger magnitude and persistence of these effects, and to remove the need to choose a preferred definition for overseas migration.

4.2 Heterogeneity by worker characteristic

Tables 5-14 present results for each of the five outcome measures by either age and sex (odd-numbered tables) or skill and sex (even-numbered tables), where both age and skill are divided into three groups. For age, these groups are labelled young (age less than 26), prime-aged (26-49) and old (50+).[29] Skill categories are based on estimated worker fixed effects (WFE) as defined in section 3 and are labelled low-skill (bottom quartile of WFE), med(ium)-skill (two middle quartiles of WFE), and high-skill (top quartile of WFE).

workers who meet the panel B (C) binary definition of outward migration also meet the panel A (A & B) definition.

[27] We have no data on migration intentions (eg, departure card responses), which would help with this issue.

[28] Alternatively, convergence may be driven by weaker outward migration pressures from Greater Christchurch in the longer term because of the relative improvement in, eg, employment prospects. However, this interpretation is inconsistent with the internal migration effects, which do not show any convergence over the long-run.

[29] Workers are classified based on age as at July 2010, ie, they do not change groups as they age over the analysis period.

Coefficients for each subgroup are estimated by interacting the treatment dummy with worker sub-group dummies. Formal statistical tests of coefficient equivalence are presented at the bottom of each table, and average effects across all workers (as shown in figures 2 and 3) are presented at the top of the table for ease of comparison. Because of the volume of estimated coefficients, we report results on six-monthly intervals, and the discussion focuses on September 2011 and March 2014 (the third and last columns of estimates) as representative of the short- and long-run impacts respectively.

Tables 5 and 6 look at heterogeneity in employment status effects. Together the two tables show that the short-run negative impact on employment is restricted to prime-aged, and low/med-skilled women, and low-skilled men. In contrast young, and med/high-skilled men have elevated employment prospects throughout the period, even following the second major earthquake. While all subgroups have increased likelihood of employment by March 2014, young (old) women have a 2.0pp (2.4pp) lower effect than young (old) men (significant at the 5% level). Similarly, medium-skilled women have a 1.8pp lower effect than medium-skilled men. Across all subgroups, high-skilled women have the lowest employment probability gains (at 1.2pp), significantly lower than low-skilled women.

These general patterns of job loss and recovery are linked to the prequake distribution of workers across industries, and the differential effect the earthquakes had on the ability of firms to continue operating. Table 15 shows the distribution of worker characteristics by broad industry, together with the industry share of jobs (rightmost column), for the sample of workers in this analysis. For example, while low and high skilled workers each make up 25% of the sample, these workers are not evenly distributed across industries, so that the proportion of workers in an industry that are high-skilled ranges from 36% (in property and business services) to 16.5% (in cultural and recreational services).

The bottom panel of table 15 classifies these industries based on the estimated initial firm-level employment effects found by Fabling et al. (2014). Three groups are constructed based on whether the estimated effect as at September 2011 was significantly positive or negative, or insignificantly different from zero (neutral).[30] Female employees are substantially overrepresented in the negatively affected industries, and underrepresented in con-

[30] Construction is the only positive impact industry as at that date. Neutral employment growth industries are Agriculture, Forestry & Fishing; Mining; Manufacturing; Wholesale Trade; and Transport & Storage. All other industries experienced negative initial employment growth.

struction (the sole positive industry) prior to the earthquakes. Older workers are also underrepresented in construction, while young workers are overrepresented in negative impact industries.

Increased benefit receipt is prevalent in the short-run for low and medium-skilled workers in both sexes (tables 7 and 8). The absence of increased benefit uptake for high-skilled men seems consistent with that group's estimated 2pp increased rate of employment following the quakes. In contrast, high-skilled women do not experience increased benefit uptake, and do not have increased employment probability in the short-run. Over the longer term, all skill groups have reduced likelihood of benefit receipt, consistent with improved across-the-board employment outcomes.

The effect of time out of work for prime-aged women and the relatively weak rebound in employment is evidenced in accumulated earnings results (table 9). This is the first evidence of a subgroup with persistent negative impacts over the longer-term, with earnings 5.8pp below expectation by March 2014. This result is quite startling, given that the three subgroups with the greatest long-run gain in employment terms (young women, and young and old men) have accumulated earnings gains of between 9.0 and 17.5 percentage points. Table 10 suggests that the hardest hit group, in earnings terms, is low-skill women, consistent with the overrepresentation of women in negatively affected industries.

Tables 11-14 examine employer status, in terms of job and location stability. Aside from these being measured conditional on employment, they differ from the outcomes already discussed in that the average long-run effect is persistently negative. Aside from high-skilled men where the outcome is no significant difference in job retention at the original employer (table 12), all subgroups experience a significant decrease in the probability of being at the same employer, or at still being in Greater Christchurch, by March 2014.

While these negative impacts are ubiquitous, some subgroup effects are significantly stronger. In particular, focussing on differences by age (tables 11 and 13), young workers are more likely to have moved regions than old workers (significant at the 1% level). For women, young workers have a 7.6pp greater internal migration effect than old workers, while the equivalent young-old differential for men is a more moderate 1.8pp. Indeed, young women are the most affected in terms of outward migration stretching back as far as the immediate aftermath of the second major earthquake, with a 1.1pp (significant at the 1% level) gap in outward migration over young men (the next most affected group) already evident in March 2011. This young female-male migration gap widens over time to end the period at 6.5pp. It seems likely that these differences stem at least in part from the initial industry distribution of workers, and the subsequent shift in production towards construction, which is a male-dominated industry (table 15).

4.3 Heterogeneity by original employer location

Figures 4 and 5 address the possibility of heterogeneity in average outcomes based on employer location and the geography of the earthquake's impact. Specifically, we consider the effect on workers based on whether the firm they worked in pre-quakes had a location in an area where the majority of firms claimed the ESS after the second major quake (a high impact/ESS uptake region). Outcomes for these workers are then compared to other Christchurch workers who worked in firms that only had locations in low ESS uptake (impact) regions. Within the regression framework, we estimate two treatment coefficients (one each for the low and high impact areas) and these estimates are shown to the left of each panel. On the right of each panel we report the difference between the low and high impact area estimates together with the corresponding 95% confidence interval (the shaded region).

For example, compare panel A of Figure 4 to that of Figure 2. While the average short-run negative impact on employment for Christchurch workers is around 1pp (figure 2), the effect in high impact areas is 3pp higher than in low impact areas (figure 4, significant at the 5% level). In fact, because of the slight rise in employment probability after the first major quake, the low impact area point estimate on the employment effect is never negative (though insignificantly different from zero over the period April-July 2011). The gap in employment prospects is persistent over the long-term, ending the period at 1.7pp. Consistent with these differences in employment prospects, benefit receipt is more prevalent (at least in the short-run) for high impact area workers (figure 4 panel B, right-hand figure), and accumulated earnings are lower both in the short- and long-run (panel C, right-hand figure).[31]

Figure 5 repeats the analysis for employer status. The left-hand figures show that workers in both low and high impact areas are more likely to change employer or region, relative to Auckland/Hamilton workers. These

[31] It is unclear why there is a low-high impact area gap in estimated accumulated earnings prior to the second major earthquake since none of the other outcomes exhibit such a gap. While unexplained, this gap is only marginally significantly different from zero (at the 5% level) for a subset of the months prior to February 2011. The 95% confidence interval as at March 2014 indicates a 2.8-4.2pp gap, which suggests that the long-run gap is significantly greater than the January 2011 gap of 1.9pp.

effects are persistent out to March 2014 for each group (significantly different from zero at the 1% level). Comparing the effect for low and high impact area workers (right-hand figures) we observe short-run differences in the effect of the quakes with both employer and location change being more likely for high impact area workers, relative to low impact area workers. However, these gaps in effect dissipate over the longer-term with effects not significantly different from zero by March 2014, though point estimates still show high impact area workers as more affected in the long-term for both outcomes.

To summarise, we observe differences in the short-term effect of the earthquakes depending on the geographic locations of the employer. These differences persist in the long-run for employment and accumulated earnings, but don't persist for benefit receipt and employer/location choice. Where differences do not persist, this is due to convergence in the estimated impacts for Greater Christchurch workers rather than the dissipation of earthquake effects. That is, workers in both low and high impact areas are less likely to be on benefit in the long-run due to the increased employment opportunities caused by the earthquakes. In the long-run, Christchurch workers are also more likely to have changed employer or region due to the quakes, regardless of whether their employer was located in a high impact area or not.

4.3.1 Policy impact of the Earthquake Support Subsidy

We now ask whether receipt of the ESS affected any of these outcomes. We do this by comparing workers in firms who received the subsidy to those in firms who didn't receive the subsidy, but where the firm was located in a high impact area. Through this comparison we aim to eliminate the intensity of the shock as a potential explanator for differences in worker-level outcomes.[32] We estimate effects using three mutually exclusive treatment dummies (ESS receipt, or non-recipient by high-low impact area). Additionally, we restrict the analysis to workers in firms who meet the employment eligibility criteria for accessing the ESS – a headcount of less than 50 employees; and still employing at the time of the second major earthquake (February 2011). As table 4 shows, this restriction results in a loss of around 19% of the Greater Christchurch workers in the estimation sample, roughly evenly distributed between low and high impact area firms. Of the remaining sample, there are 26,100 workers in ESS recipient firms, 8,500 workers in non-recipient firms

[32] The analysis includes a large number of direct controls for worker and firm characteristics, which also act to remove other explanations for observed differences in outcomes across groups.

with high impact area locations prior to the quakes, and 16,800 non-recipients in firms with only low impact area locations.

Figures 6 and 7 show estimated impacts for the three Greater Christchurch subgroups of workers (left-hand figures) and for the difference-in-difference comparison between ESS recipients and non-recipients in high impact area firms (right-hand figures). Figure 6 shows that there are very few significant differences in employment, benefit and accumulated earnings outcomes for these two groups, which gives reassurance that the comparison is legitimately comparing workers who experienced similar employment shocks. Where significant differences in employment probabilities exist, these follow directly from our expectation of the short-run effect of the policy, which is to keep workers in their pre-quake job during the life of the subsidy.[33] This is observable from the employment effect results (figure 6) as a significant upward blip in the right-hand figure of panel A in April 2011.

This short-run effect is more clearly evident in panel A of figure 7. The left-hand figure shows a clear rightward shifting of the job separation effect for ESS recipient workers (dashed line) relative to non-recipients in high impact area firms (solid line), followed by a later convergence of the two lines. This corresponds to significantly higher relative job retention for ESS recipients over the five months from February to June 2011, but no significant differences between the two groups after that time (right-hand figure).

These estimates suggest that the policy was successful in the short-run on at least two fronts. Firstly, the fact that the job separation effect converges later is consistent with the policy applying to at least some firms that were at substantial risk of shedding jobs immediately after the second major earthquake. Second, the policy appears to have had the effect of keeping some workers at the firm that sought the subsidy when they might otherwise have lost that job and not immediately gained another job elsewhere, either in Greater Christchurch or outside the region.

By March 2014 there is no significant employment difference between the worst affected workers who received the subsidy and those that didn't, consistent with benefit and earnings outcomes. However, as panel B of figure 7 shows, there is a persistent long-run difference in migration outcomes for the two groups. As the left-hand figure of panel B shows, over the five

[33] The subsidy was initially due to expire at the end of March 2011. This was later extended to 18 April 2011 (announced on 28 March 2011), followed by a second round of assistance with tighter application criteria, and running for a further six weeks with a gradually reducing subsidy rate (Key 2011), meaning that the latest date for receiving the (reduced) subsidy was the end of May.

month period where job retention was (relatively) improved by the ESS, outward migration patterns between the two groups of worst-affected workers diverged, rising to a 1.5pp difference in effects by June 2011 (significant at the 1% level). By March 2014, the difference is 2pp which represents a substantial proportion of the average impact of the earthquakes on outward migration (of 5pp). As a consequence, the long-run effect of the earthquakes on ESS recipients remaining in Greater Christchurch (-4.6pp) is less than that of non-recipients in low impact areas (-5.3pp), and substantially less than that of non-recipients working in high impact area firms (-6.6pp).

In summary, even though ESS-recipient workers were eventually equally likely to have changed jobs as non-recipients working in high impact area firms, the ones that had the (up to) five month extension to their tenure at the pre-quake employer were more likely to have stayed in Greater Christchurch three years after the quakes. This difference in long-term internal migration rates appears linked to the fact that forced job loss requires some badly affected non-ESS workers to make immediate decisions about taking jobs in other regions. In contrast, ESS recipients stay in Christchurch at their original employer for longer, because that employer remains in business, and this choice to stay persists.

Table 16 tests whether the policy effect varies by worker sex, skill or age. Because of sample sizes involved, these tests are done by each characteristic group pair/triple separately, rather than by two-way subgroups (as in section 4.2). For example, the top panel of table 16 shows estimates of the policy effect separately for males and females, using sex-specific treatment variables and differencing the ESS recipient and non-recipient (high impact area) coefficients. The middle (bottom) panel repeats the exercise, in separate regressions, for the three skill (age) groups.

These results suggest the effects were the same across almost all subgroups.[34] Focussing on long-run impacts, there are no significant differences between men and women, and an isolated (single coefficient) difference by skill group. The only systematic difference in policy outcomes is between prime-aged and older workers, where the policy effect on migration for the latter groups is insignificantly different from zero.[35] This is perhaps due to older workers being less likely to migrate in general, an explanation supported by the age-specific average effects (table 13), which show that older

[34] Significant differences in the estimated policy effects across groups (at the 5% level) are indicated using superscript.

[35] Estimates of the policy effect for young workers are also sometimes insignificantly different from zero, but these estimates are never significantly different from prime-aged workers.

workers are, on average, the least likely to leave the Greater Christchurch region following the earthquakes.

5 Conclusions

Despite major upheaval in their lives, and short-term job loss, workers affected by the Canterbury earthquakes have bounced back. Remarkably, three years on from the devastating shocks, these workers are more likely to have jobs than similar workers in Auckland and Hamilton, have lower probability of being on the unemployment benefit, and have higher accumulated earnings, though the latter of these effects may merely compensate for higher living costs post-disaster. Greater Christchurch workers have been more mobile, in terms of both job change to new employers, and outward migration from the region to other parts of New Zealand. Both these effects are linked to the initial shedding of jobs and firms that occurred directly after the second major quake in February 2011.

At face value, and given the extensive and consistent results from the literature on displaced workers (eg, Jacobson et al. (1993), von Wachter et al. (2009)), it seems initially counter-intuitive that Christchurch workers have not experienced long-term losses either in terms of employment or earnings. However, these positive findings are consistent with studies of Hurricane Katrina survivors (Deryugina et al. 2014; Groen et al. 2015) and likely relate, in part, to the simultaneous increase in demand for, and reduced supply of, labour.

Impacts vary substantially by worker characteristics and by the naturally-induced geographic variation in the severity of the shock. Workers in firms that were located in badly affected areas, have persistently worse outcomes. Prime-aged and low-skilled women have persistently lower earnings than expected given their pre-earthquake characteristics, consistent with job sorting by industry and the shift in relative demand following the quakes towards construction.

We find sustained higher rates of outward migration are present for all types of worker. From a public policy perspective, we show that the Earthquake Support Subsidy influenced the extent of outward migration decisions, at least for most types of workers, though not the long-term retention of the pre-quake job under which the subsidy was gained. We interpret these findings as evidence that the subsidy achieved its goal of delaying involuntary job loss and, as a result, fewer workers made immediate decisions to leave the region – decisions that persisted over the long-run.

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Tables & figures

Table 1: Coverage of Greater Christchurch private-for-profit sector jobs

	Jobs	
	N	Proportion
Included in analysis	**63,600**	0.441
Excluded from analysis	**80,700**	0.559
Firm-level restrictions	27,800	0.193
Uncertain job location	36,500	0.253
Unknown age or sex	1,700	0.012
Multiple job-holder	7,200	0.050
Start or end of job spell	5,200	0.036
Unmatched/not aged 15-75 (inclusive)	2,300	0.016
Total jobs in private-for-profit firms	**144,300**	1.000

Firm-level restrictions are primarily (75%) due to the imposition of a common support criterion, particularly in relation to firm size (Fabling et al. 2014). Employment counts do not match the firm-level study because that paper used employment as at the 15th of the month, averaged over the five months to August 2010. The current paper uses a headcount measure as at July 2010. Estimated total private-for-profit (PFP) jobs are lower than official Linked Employer Employee Data (LEED) statistics, because PFP is more restrictive than the related private sector concept in LEED.

Table 2: Summary statistics for pre-earthquake worker/job regression controls

	Greater Christchurch		Auckland/Hamilton	
Worker-level control	Mean	St. dev.	Mean	St. dev.
Dummy for female	0.442	0.497	0.442	0.497
Age	38.55	13.92	38.55	13.92
Tenure (months/12)	3.261	3.244	3.247	3.244
Dummy for left-censored tenure	0.071	0.256	0.069	0.254
log of base month wage, ie ln(gross earnings/fte)	8.065	0.388	8.063	0.385
Worker fixed effect from two-way log wage estimates	-0.080	0.254	-0.098	0.259
log of base month benefit (zero for non-recipients)	0.207	1.166	0.188	1.108
Dummy for benefit receipt in base month	0.031	0.175	0.028	0.166
log of avg of non-zero benefit over year to base month (zero for non-recipients)	0.477	1.709	0.485	1.718
log of base month ACC (zero for non-recipients)	0.020	0.368	0.012	0.287
Dummy for ACC receipt in base month	0.003	0.055	0.002	0.043
log of avg of non-zero ACC over year to base month (zero for non-recipients)	0.238	1.274	0.162	1.060
FTE	0.846	0.274	0.847	0.273
Dummy for full-time (FTE= 1)	0.668	0.471	0.668	0.471
Proportion of base month outside NZ	0.021	0.101	0.023	0.107
Proportion of year to base month outside NZ	0.027	0.077	0.030	0.077
Dummy if out of NZ in year, but not base month	0.272	0.445	0.297	0.457
Dummy if out of NZ in base month	0.061	0.240	0.069	0.254
Dummy for self-employment in another business in the 2010 financial year	0.036	0.187	0.024	0.152
Number of months of benefit receipt in year to base month	0.514	2.141	0.499	2.074
Number of months of ACC receipt in year to base month	0.087	0.624	0.058	0.504

All statistics for Auckland/Hamilton workers weighted to reflect composition of Greater Christchurch workforce. Worker-level match variables are highlighted in bold: sex; age ($\pm 1/2$ year); tenure (plus or minus three (six) months for worker with tenure less than 2 (≥ 2) years); wage ($\pm 10\%$); worker FTE groups (full-time, FTE in $[0.5, 1)$, FTE in $[0, 0.5)$). All continuous control variables are included in regressions with both linear and quadratic terms, except the number of benefit and ACC months in the year which are each included as a set of month count dummies. Two-way fixed effects estimates follow Maré et al. (2015).

Table 3: Summary statistics for pre-earthquake employer regression controls, at the worker level

	Greater Christchurch		Auckland/Hamilton	
Firm-level control	Mean	St. dev.	Mean	St. dev.
Business type				
Independent company	0.734	0.442	0.689	0.463
Domestic group	0.137	0.344	0.156	0.363
Foreign-owned group	0.064	0.246	0.104	0.305
Partnership	0.038	0.191	0.030	0.170
Sole proprietor	0.027	0.161	0.022	0.147
Dummy for multi-location (single-region) firm	0.079	0.269	0.113	0.317
log total firm FTE (L)	2.662	1.454	2.703	1.544
log change in L, base to three years earlier (zero if non-employing earlier)	0.052	0.445	0.070	0.513
Dummy if non-employing three years earlier	0.135	0.342	0.137	0.344
Age of firm based on first employing month	8.654	3.576	8.530	3.605
Dummy for left-censored age	0.533	0.499	0.524	0.499
log of average return on sales (ie, profitability)	0.094	0.242	0.091	0.246
Firm fixed effect from two-way log wage estimates	-0.080	0.127	-0.051	0.149
FTE-weighted average worker fixed effect from two-way log wage estimates	-0.069	0.138	-0.056	0.155
FTE-weighted average worker characteristics from two-way log wage estimates	10.60	0.143	10.60	0.135

All statistics for Auckland/Hamilton workers weighted to reflect composition of Greater Christchurch workforce. Firm-level match variables are highlighted in bold: total firm FTE groups ($L < 50$, $L \geq 50$). All continuous control variables are included in regressions with both linear and quadratic terms. All regressions also include 4-digit industry (ANZSIC'96) dummies for the pre-quake month employer. Two-way fixed effects estimates follow Maré et al. (2015).

Table 4: Distribution of Greater Christchurch workers by region (impact area) and receipt of ESS

Employer status	Impact area Low	High	Share in high area
ESS recipient	6,000	20,100	0.770
Eligible (on firm L criteria) non-recipient	16,800	8,500	0.336
Ineligible (on firm L criteria)	7,000	5,200	0.426
Total number of workers	**29,800**	**33,800**	**0.531**
Share of eligible workers receiving ESS	0.263	0.703	

Employment (L) eligibility criteria is that firm has: a headcount of less than 50 employees; and is still employing at the time of the second major earthquake (February 2011). "Eligible non-recipients" are largely expected to be ineligible on the basis that the earthquakes did not impact materially on their ability to pay their wage bill. ESS receipt is granted at the firm level, and all workers at an ESS recipient firm are assumed to have received the subsidy, consistent with the rules of the scheme.

Table 5: Average impact of earthquakes on employment status, by age and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.002**	0.003	-0.005*	0.006*	0.017**	0.026**	0.029**	0.033**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Female								
Young	-0.001	-0.001	-0.008	0.012	0.020**	0.033**	0.039**	0.047**
	[0.003]	[0.005]	[0.006]	[0.006]	[0.006]	[0.006]	[0.007]	[0.006]
Prime-aged	-0.001	-0.008*	-0.028**	-0.018**	-0.008	0.001	0.008*	0.014**
	[0.002]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Old	0.004	0.001	-0.006	0.001	0.018**	0.027**	0.030**	0.032**
	[0.002]	[0.004]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]	[0.006]
Male								
Young	0.010**	0.030**	0.021**	0.037**	0.051**	0.058**	0.059**	0.067**
	[0.002]	[0.004]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]	[0.006]
Prime-aged	0.002	0.004	-0.003	0.004	0.013**	0.018**	0.019**	0.019**
	[0.001]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]
Old	0.001	-0.001	0.003	0.017**	0.034**	0.050**	0.051**	0.056**
	[0.002]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]
Female (Y=O)	0.180	0.772	0.790	0.175	0.780	0.518	0.269	0.061
Male (Y=O)	0.001	0.000	0.010	0.004	0.018	0.261	0.266	0.178
Young (F=M)	0.001	0.000	0.000	0.001	0.000	0.001	0.012	0.013
Prime-aged (F=M)	0.129	0.001	0.000	0.000	0.000	0.000	0.049	0.315
Old (F=M)	0.292	0.680	0.137	0.012	0.017	0.002	0.004	0.001

Difference-in-difference estimates of the impact of the earthquakes on worker-level outcomes using ordinary least squares regression, estimated separately for each post-quake month (at six-monthly intervals). The dependent variable is the change in outcome from the pre-quake period to the current month. Top panel shows the average effect across all Greater Christchurch workers. Middle panel shows average effects by age group (young, aged < 26 at July 2010; old, aged ≥ 50 at July 2010) and sex. Robust standard errors (clustered on employer) shown in square brackets. **;* indicates coefficient significantly different from zero at the 1%;5% level respectively. Bottom panel shows p-values for test of equivalence of specified coefficients. Each regression includes worker and firm-level controls as listed in tables 2 and 3.

Table 6: Average impact of earthquakes on employment status, by skill and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.002**	0.003	-0.005*	0.006*	0.017**	0.026**	0.029**	0.033**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Female								
Low-skill	0.001	-0.006	-0.029**	-0.011	0.002	0.015*	0.022**	0.032**
	[0.003]	[0.005]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Med-skill	0.001	-0.004	-0.017**	-0.003	0.012**	0.020**	0.027**	0.031**
	[0.002]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
High-skill	-0.002	-0.001	-0.006	-0.005	-0.003	0.005	0.010	0.012*
	[0.002]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]	[0.006]
Male								
Low-skill	-0.002	-0.009*	-0.017**	-0.003	0.012*	0.024**	0.025**	0.030**
	[0.002]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.006]
Med-skill	0.005**	0.012**	0.008*	0.018**	0.033**	0.041**	0.045**	0.049**
	[0.001]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]	[0.004]
High-skill	0.009**	0.024**	0.020**	0.027**	0.029**	0.032**	0.026**	0.026**
	[0.002]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]	[0.005]	[0.005]
Female (L=H)	0.312	0.343	0.001	0.388	0.508	0.203	0.109	0.015
Male (L=H)	0.000	0.000	0.000	0.000	0.008	0.205	0.826	0.494
Low (F=M)	0.293	0.592	0.094	0.260	0.172	0.264	0.734	0.855
Med (F=M)	0.088	0.000	0.000	0.000	0.000	0.000	0.001	0.001
High (F=M)	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.064

Difference-in-difference estimates of the impact of the earthquakes on worker-level outcomes using ordinary least squares regression, estimated separately for each post-quake month (at six-monthly intervals). The dependent variable is the change in outcome from the pre-quake period to the current month. Top panel shows the average effect across all Greater Christchurch workers. Middle panel shows average effects by skill group (low, bottom quartile of worker fixed effect; high, top quartile of worker fixed effect) and sex. Robust standard errors (clustered on employer) shown in square brackets. **;* indicates coefficient significantly different from zero at the 1%;5% level respectively. Bottom panel shows p-values for test of equivalence of specified coefficients. Each regression includes worker and firm-level controls as listed in tables 2 and 3.

Table 7: Average impact of earthquakes on benefit status, by age and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.001	-0.001	0.007**	-0.004**	-0.009**	-0.013**	-0.012**	-0.015**
	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Female								
Young	0.002	0.002	0.018**	0.004	0.005	-0.004	-0.001	-0.005
	[0.001]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Prime-aged	0.000	-0.002	0.005*	-0.009**	-0.014**	-0.017**	-0.019**	-0.023**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Old	0.001	0.000	0.010**	0.001	-0.007**	-0.009**	-0.009**	-0.010**
	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Male								
Young	0.001	-0.004	0.010**	-0.005*	-0.008**	-0.019**	-0.011**	-0.019**
	[0.001]	[0.002]	[0.003]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Prime-aged	0.001	0.000	0.002	-0.007**	-0.012**	-0.015**	-0.014**	-0.016**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Old	0.002	0.004*	0.006**	0.000	-0.006**	-0.005*	-0.008**	-0.004
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Female (Y=O)	0.406	0.459	0.021	0.375	0.001	0.213	0.039	0.201
Male (Y=O)	0.515	0.006	0.193	0.086	0.456	0.000	0.240	0.000
Young (F=M)	0.507	0.073	0.032	0.013	0.000	0.000	0.004	0.000
Prime-aged (F=M)	0.482	0.343	0.320	0.385	0.458	0.362	0.030	0.004
Old (F=M)	0.362	0.098	0.222	0.872	0.670	0.221	0.746	0.080

See table 5 for notes.

Table 8: Average impact of earthquakes on benefit status, by skill and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.001	-0.001	0.007**	-0.004**	-0.009**	-0.013**	-0.012**	-0.015**
	[0.000]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Female								
Low-skill	0.002	0.004	0.016**	-0.001	-0.005	-0.013**	-0.015**	-0.021**
	[0.001]	[0.003]	[0.004]	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]
Med-skill	0.001	-0.001	0.009**	-0.004	-0.009**	-0.012**	-0.012**	-0.015**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
High-skill	-0.001	-0.005**	0.003	-0.006**	-0.007**	-0.010**	-0.008**	-0.009**
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Male								
Low-skill	0.002	0.006**	0.014**	0.000	-0.009**	-0.012**	-0.013**	-0.013**
	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Med-skill	0.001	-0.003*	0.003*	-0.007**	-0.013**	-0.017**	-0.015**	-0.018**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
High-skill	0.001	-0.003**	0.000	-0.006**	-0.004**	-0.008**	-0.006**	-0.008**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Female (L=H)	0.059	0.005	0.001	0.161	0.507	0.465	0.061	0.001
Male (L=H)	0.511	0.000	0.000	0.051	0.109	0.142	0.016	0.051
Low (F=M)	0.824	0.447	0.562	0.937	0.312	0.915	0.480	0.041
Med (F=M)	0.803	0.454	0.014	0.125	0.080	0.034	0.265	0.174
High (F=M)	0.114	0.383	0.128	0.998	0.183	0.448	0.302	0.637

See table 6 for notes.

Table 9: Average impact of earthquakes on accumulated earnings, by age and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.005	0.024**	0.019**	0.025**	0.029**	0.035**	0.040**	0.044**
	[0.008]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Female								
Young	0.034	0.110**	0.099**	0.121**	0.129**	0.144**	0.155**	0.159**
	[0.020]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
Prime-aged	-0.044**	-0.026*	-0.039**	-0.045**	-0.053**	-0.056**	-0.059**	-0.058**
	[0.013]	[0.011]	[0.010]	[0.010]	[0.011]	[0.011]	[0.011]	[0.011]
Old	-0.008	0.021	0.003	0.001	-0.001	0.002	0.003	0.005
	[0.015]	[0.012]	[0.012]	[0.013]	[0.013]	[0.014]	[0.014]	[0.015]
Male								
Young	0.040*	0.038**	0.035*	0.051**	0.059**	0.070**	0.081**	0.090**
	[0.016]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.015]
Prime-aged	0.011	0.010	0.006	0.008	0.013	0.015	0.017	0.018
	[0.010]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.010]
Old	0.027	0.066**	0.084**	0.106**	0.128**	0.148**	0.162**	0.175**
	[0.014]	[0.012]	[0.012]	[0.012]	[0.012]	[0.013]	[0.013]	[0.014]
Female (Y=O)	0.066	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Male (Y=O)	0.540	0.121	0.006	0.003	0.000	0.000	0.000	0.000
Young (F=M)	0.794	0.000	0.001	0.000	0.000	0.000	0.000	0.001
Prime-aged (F=M)	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000
Old (F=M)	0.056	0.002	0.000	0.000	0.000	0.000	0.000	0.000

See table 5 for notes.

Table 10: Average impact of earthquakes on accumulated earnings, by skill and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	0.005	0.024**	0.019**	0.025**	0.029**	0.035**	0.040**	0.044**
	[0.008]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Female								
Low-skill	-0.031	-0.039*	-0.056**	-0.058**	-0.066**	-0.065**	-0.065**	-0.059**
	[0.017]	[0.016]	[0.016]	[0.016]	[0.016]	[0.016]	[0.016]	[0.017]
Med-skill	0.005	0.058**	0.043**	0.044**	0.042**	0.045**	0.048**	0.049**
	[0.013]	[0.010]	[0.010]	[0.010]	[0.010]	[0.010]	[0.011]	[0.011]
High-skill	-0.040*	0.002	-0.007	0.001	0.003	0.007	0.008	0.010
	[0.017]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]	[0.014]
Male								
Low-skill	-0.029	0.012	0.012	0.021	0.030*	0.038**	0.047**	0.053**
	[0.017]	[0.013]	[0.013]	[0.013]	[0.013]	[0.014]	[0.014]	[0.015]
Med-skill	0.027**	0.029**	0.029**	0.038**	0.048**	0.057**	0.065**	0.073**
	[0.010]	[0.008]	[0.008]	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]
High-skill	0.066**	0.047**	0.054**	0.065**	0.075**	0.080**	0.083**	0.083**
	[0.013]	[0.011]	[0.011]	[0.011]	[0.012]	[0.012]	[0.012]	[0.012]
Female (L=H)	0.682	0.043	0.014	0.003	0.001	0.000	0.000	0.001
Male (L=H)	0.000	0.031	0.010	0.008	0.008	0.015	0.042	0.085
Low (F=M)	0.930	0.008	0.000	0.000	0.000	0.000	0.000	0.000
Med (F=M)	0.150	0.023	0.267	0.631	0.656	0.375	0.211	0.076
High (F=M)	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000

See table 6 for notes.

Table 11: Average impact of earthquakes on job stability, by age and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	-0.001	-0.016**	-0.044**	-0.054**	-0.055**	-0.050**	-0.048**	-0.041**
	[0.001]	[0.003]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Female								
Young	0.001	-0.053**	-0.097**	-0.113**	-0.105**	-0.094**	-0.081**	-0.072**
	[0.003]	[0.007]	[0.010]	[0.010]	[0.010]	[0.009]	[0.009]	[0.008]
Prime-aged	0.001	-0.005	-0.032**	-0.042**	-0.043**	-0.036**	-0.034**	-0.029**
	[0.002]	[0.005]	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Old	-0.001	-0.010	-0.038**	-0.043**	-0.045**	-0.040**	-0.049**	-0.044**
	[0.002]	[0.006]	[0.009]	[0.009]	[0.010]	[0.010]	[0.011]	[0.011]
Male								
Young	0.000	-0.019**	-0.040**	-0.057**	-0.048**	-0.037**	-0.038**	-0.029**
	[0.003]	[0.007]	[0.009]	[0.009]	[0.009]	[0.009]	[0.008]	[0.008]
Prime-aged	-0.001	-0.010*	-0.039**	-0.047**	-0.052**	-0.051**	-0.046**	-0.039**
	[0.002]	[0.004]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]	[0.008]
Old	-0.005**	-0.021**	-0.044**	-0.054**	-0.059**	-0.057**	-0.061**	-0.057**
	[0.002]	[0.005]	[0.007]	[0.008]	[0.008]	[0.009]	[0.009]	[0.010]
Female (Y=O)	0.330	0.000	0.000	0.000	0.000	0.000	0.006	0.022
Male (Y=O)	0.059	0.708	0.651	0.716	0.246	0.049	0.022	0.007
Young (F=M)	0.625	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Prime-aged (F=M)	0.452	0.323	0.396	0.544	0.279	0.076	0.202	0.259
Old (F=M)	0.075	0.083	0.504	0.275	0.164	0.115	0.259	0.279

See table 5 for notes. Restricted to workers who have a job in the relevant month.

Table 12: Average impact of earthquakes on job stability, by skill and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	-0.001	-0.016**	-0.044**	-0.054**	-0.055**	-0.050**	-0.048**	-0.041**
	[0.001]	[0.003]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]	[0.006]
Female								
Low-skill	0.003	-0.008	-0.045**	-0.045**	-0.042**	-0.034**	-0.037**	-0.032**
	[0.002]	[0.007]	[0.011]	[0.012]	[0.012]	[0.012]	[0.012]	[0.012]
Med-skill	-0.001	-0.026**	-0.064**	-0.074**	-0.071**	-0.065**	-0.065**	-0.056**
	[0.002]	[0.005]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
High-skill	0.000	-0.008	-0.022**	-0.040**	-0.045**	-0.036**	-0.028**	-0.024**
	[0.002]	[0.006]	[0.008]	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]
Male								
Low-skill	-0.004	-0.031**	-0.066**	-0.080**	-0.083**	-0.083**	-0.086**	-0.078**
	[0.002]	[0.006]	[0.009]	[0.009]	[0.009]	[0.009]	[0.010]	[0.010]
Med-skill	-0.002	-0.014**	-0.040**	-0.052**	-0.059**	-0.056**	-0.056**	-0.046**
	[0.002]	[0.004]	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]	[0.007]
High-skill	0.001	0.001	-0.013*	-0.018*	-0.011	-0.001	0.008	0.010
	[0.002]	[0.004]	[0.006]	[0.007]	[0.007]	[0.008]	[0.008]	[0.008]
Female (L=H)	0.195	0.974	0.022	0.681	0.802	0.839	0.486	0.488
Male (L=H)	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Low (F=M)	0.004	0.002	0.045	0.002	0.000	0.000	0.000	0.000
Med (F=M)	0.719	0.023	0.002	0.005	0.132	0.315	0.298	0.238
High (F=M)	0.693	0.136	0.280	0.017	0.001	0.001	0.000	0.001

See table 6 for notes. Restricted to workers who have a job in the relevant month.

Table 13: Average impact of earthquakes on location stability, by age and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	-0.001	-0.011**	-0.029**	-0.035**	-0.043**	-0.047**	-0.049**	-0.050**
	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]
Female								
Young	-0.001	-0.028**	-0.059**	-0.071**	-0.088**	-0.100**	-0.106**	-0.113**
	[0.001]	[0.004]	[0.005]	[0.006]	[0.007]	[0.007]	[0.008]	[0.008]
Prime-aged	-0.001	-0.009**	-0.025**	-0.033**	-0.041**	-0.044**	-0.048**	-0.050**
	[0.001]	[0.002]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]
Old	-0.001	-0.006**	-0.016**	-0.024**	-0.030**	-0.032**	-0.037**	-0.037**
	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.004]	[0.005]	[0.005]
Male								
Young	-0.002	-0.017**	-0.035**	-0.037**	-0.043**	-0.046**	-0.048**	-0.048**
	[0.002]	[0.003]	[0.004]	[0.004]	[0.005]	[0.006]	[0.006]	[0.006]
Prime-aged	-0.001	-0.010**	-0.030**	-0.036**	-0.044**	-0.048**	-0.046**	-0.047**
	[0.001]	[0.002]	[0.002]	[0.003]	[0.003]	[0.004]	[0.004]	[0.004]
Old	0.000	-0.005**	-0.014**	-0.020**	-0.025**	-0.028**	-0.026**	-0.030**
	[0.001]	[0.002]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]	[0.005]
Female (Y=O)	0.627	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Male (Y=O)	0.218	0.000	0.000	0.001	0.002	0.007	0.001	0.009
Young (F=M)	0.620	0.005	0.000	0.000	0.000	0.000	0.000	0.000
Prime-aged (F=M)	0.643	0.844	0.128	0.432	0.511	0.438	0.643	0.617
Old (F=M)	0.261	0.652	0.364	0.340	0.259	0.519	0.056	0.211

See table 5 for notes. Restricted to workers who have a job in the relevant month. Excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region.

Table 14: Average impact of earthquakes on location stability, by skill and sex

	Sep-10	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Overall	-0.001	-0.011**	-0.029**	-0.035**	-0.043**	-0.047**	-0.049**	-0.050**
	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]	[0.003]	[0.003]
Female								
Low-skill	-0.001	-0.008**	-0.024**	-0.031**	-0.037**	-0.042**	-0.044**	-0.044**
	[0.001]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]	[0.005]	[0.006]
Med-skill	-0.001	-0.015**	-0.035**	-0.044**	-0.055**	-0.057**	-0.064**	-0.067**
	[0.001]	[0.002]	[0.003]	[0.004]	[0.004]	[0.004]	[0.005]	[0.005]
High-skill	-0.001	-0.012**	-0.027**	-0.037**	-0.045**	-0.053**	-0.056**	-0.060**
	[0.001]	[0.002]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]	[0.006]
Male								
Low-skill	-0.002	-0.012**	-0.034**	-0.041**	-0.047**	-0.054**	-0.057**	-0.058**
	[0.001]	[0.002]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]	[0.005]
Med-skill	-0.001	-0.010**	-0.029**	-0.033**	-0.041**	-0.044**	-0.041**	-0.042**
	[0.001]	[0.002]	[0.002]	[0.003]	[0.003]	[0.003]	[0.004]	[0.004]
High-skill	-0.001	-0.008**	-0.018**	-0.025**	-0.031**	-0.033**	-0.031**	-0.033**
	[0.001]	[0.002]	[0.003]	[0.003]	[0.004]	[0.004]	[0.005]	[0.005]
Female (L=H)	0.933	0.198	0.497	0.209	0.173	0.089	0.067	0.022
Male (L=H)	0.429	0.175	0.000	0.000	0.003	0.001	0.000	0.000
Low (F=M)	0.439	0.235	0.021	0.038	0.088	0.060	0.053	0.038
Med (F=M)	0.993	0.056	0.086	0.008	0.001	0.004	0.000	0.000
High (F=M)	0.784	0.210	0.037	0.010	0.013	0.001	0.000	0.000

See table 6 for notes. Restricted to workers who have a job in the relevant month. Excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region.

Table 15: Greater Christchurch workforce composition by industry

	Share of workers in industry					Industry
	Female	Young	Old	Low-skill	High-skill	share of jobs
Agriculture, Forestry & Fishing	0.310	0.264	0.209	0.292	0.258	0.038
Manufacturing	0.265	0.139	0.287	0.288	0.224	0.186
Construction	0.102	0.246	0.174	0.147	0.292	0.101
Wholesale Trade	0.342	0.140	0.281	0.239	0.303	0.057
Retail Trade	0.497	0.364	0.210	0.248	0.204	0.177
Accommodation, Cafes & Restaurants	0.599	0.469	0.123	0.249	0.171	0.104
Transport & Storage	0.266	0.124	0.326	0.303	0.201	0.037
Property & Business Services	0.494	0.161	0.217	0.223	0.362	0.149
Education	0.789	0.183	0.264	0.229	0.282	0.019
Health & Community Services	0.899	0.134	0.382	0.290	0.286	0.084
Cultural & Recreational Services	0.531	0.315	0.169	0.307	0.165	0.020
Personal & Other Services	0.676	0.372	0.162	0.262	0.188	0.023
All other industries pooled	0.458	0.185	0.263	0.197	0.282	0.005
TOTAL	**0.443**	**0.243**	**0.233**	**0.250**	**0.250**	**1.000**
Industries grouped by initial						
effect on employment: Positive	0.102	0.246	0.174	0.147	0.292	0.101
Neutral	0.284	0.152	0.281	0.281	0.239	0.318
Negative	0.590	0.289	0.220	0.250	0.251	0.583

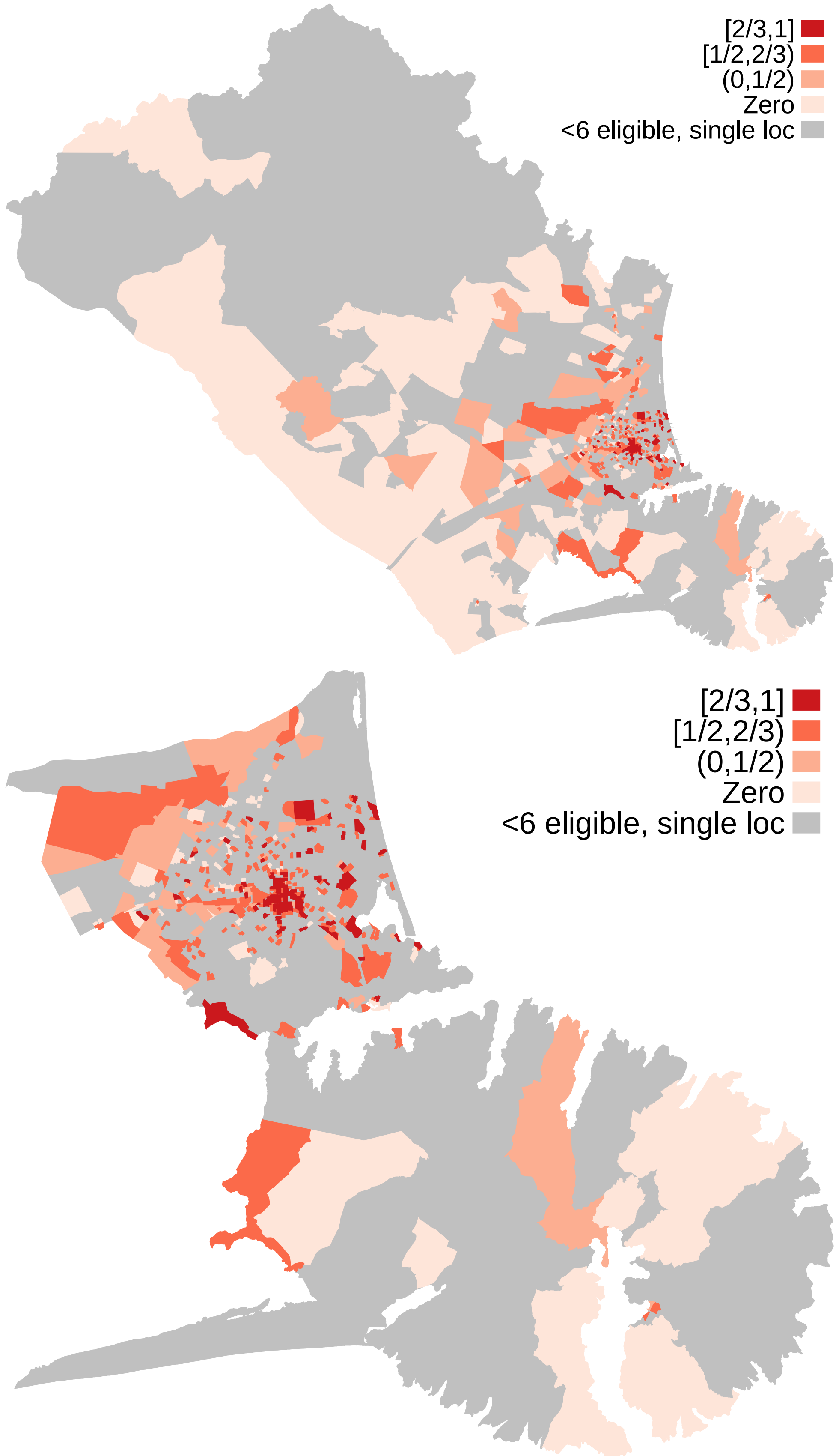
Industry groupings for initial employment effect are based the sign of (high impact intensity area) firm-level industry-specific coefficients for September 2011 (Fabling et al. 2014, Appendix A). Construction is the only positive impact industry as at that date. Neutral employment growth industries are Agriculture, Forestry & Fishing; Mining; Manufacturing; Wholesale Trade; and Transport & Storage. All other industries experienced negative initial employment growth. Totals may not reconcile in table due to random rounding of underlying counts.

Table 16: Effect of ESS receipt on location stability by worker characteristics

	Difference between ESS recipient and non-recipient (high impact) coefficients						
	Mar-11	Sep-11	Mar-12	Sep-12	Mar-13	Sep-13	Mar-14
Female	0.015**	0.012	0.019*	0.022*	0.027**	0.019	0.021*
	[0.005]	[0.006]	[0.008]	[0.009]	[0.010]	[0.010]	[0.010]
Male	0.011**	0.019**	0.023**	0.025**	0.024**	0.021*	0.020*
	[0.004]	[0.006]	[0.007]	[0.008]	[0.008]	[0.009]	[0.009]
Low-skill	0.011*	0.017*	0.025*	0.036**	0.036**	0.041**^{M}	0.028*
	[0.006]	[0.008]	[0.010]	[0.011]	[0.011]	[0.012]	[0.012]
Med-skill	0.012**	0.015*	0.018**	0.019*	0.022**	0.012^{L}	0.014
	[0.004]	[0.006]	[0.007]	[0.008]	[0.008]	[0.009]	[0.009]
High-skill	0.016**	0.018*	0.025**	0.022*	0.022*	0.019	0.027*
	[0.005]	[0.007]	[0.009]	[0.010]	[0.011]	[0.011]	[0.013]
Young	0.015*	0.014	0.029*	0.024	0.029*	0.017	0.020
	[0.006]	[0.010]	[0.013]	[0.014]	[0.014]	[0.015]	[0.015]
Prime-aged	0.015**	0.020**	0.025**^{O}	0.030**^{O}	0.029**	0.030**^{O}	0.025**
	[0.005]	[0.006]	[0.007]	[0.008]	[0.009]	[0.009]	[0.009]
Old	0.006	0.009	0.007^{P}	0.009^{P}	0.012	0.002^{P}	0.010
	[0.004]	[0.005]	[0.006]	[0.007]	[0.008]	[0.009]	[0.010]

See tables 5 and 6 for notes, including group definitions. Restricted to workers who have a job in the relevant month. Each panel (sex, skill, age) and column is estimated as a separate regression. Excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region. L-M (P-O) superscripts next to coefficients indicate significant (at the 5% level or better) differerences across low-/medium-skilled (prime-/old-aged) groups.

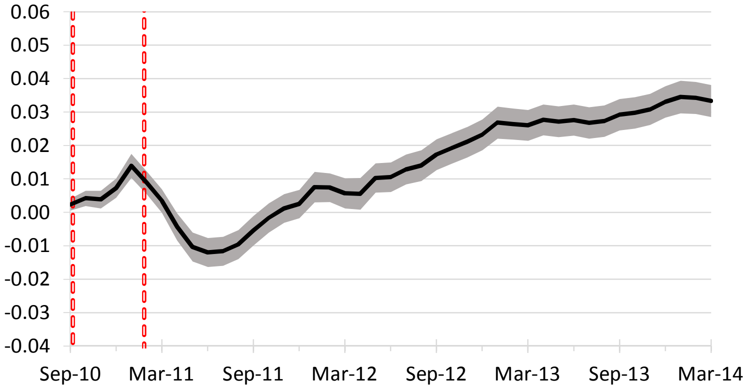
Figure 1: ESS by location – Greater Christchurch and Christchurch City



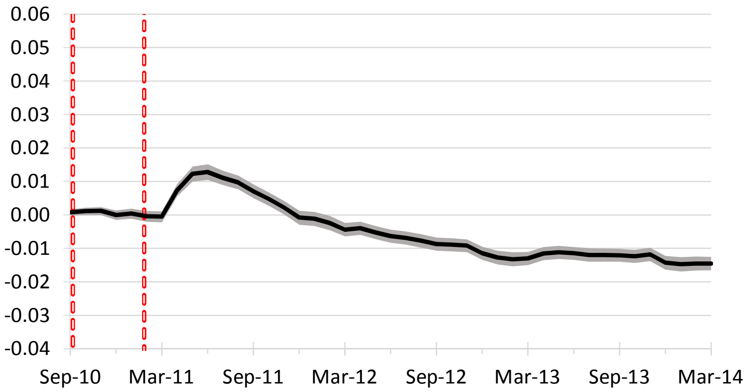
Share of single-location eligible firms receiving the Earthquake Support Subsidy (ESS). In accordance with Statistics NZ confidentiality rules, reported shares are based on random-rounded (base 3) underlying counts. We exclude meshblocks with less than six eligible firms because confidentialisation introduces substantial noise to estimated shares in these locations. In subsequent analysis meshblocks are assigned a status based on actual (unrounded) counts, enabling the classification of all meshblocks.

Figure 2: Average impact of earthquakes on employment and earnings

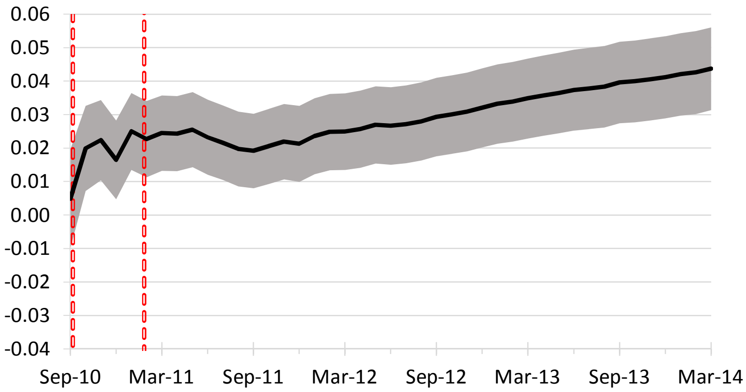
A. Employment



B. Benefit receipt



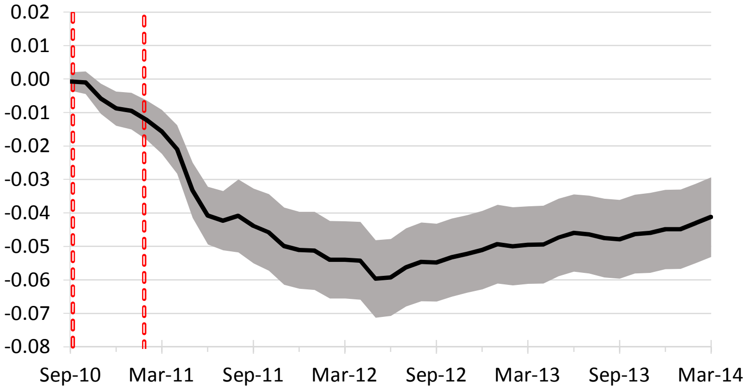
C. Accumulated (real log) earnings



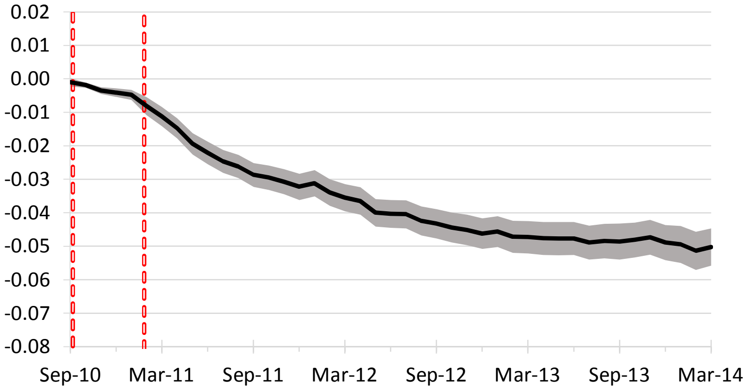
Difference-in-difference estimates of the impact of the earthquakes on worker-level outcomes using ordinary least squares regression, estimated separately for each post-quake month. The dependent variable is the change in outcome from the pre-quake period to the current month. Solid lines report point estimates of the coefficient on an indicator variable for having a job in Greater Christchurch prior to the earthquakes. Shaded area shows 95% confidence intervals (calculated with robust standard errors clustered on employer). Vertical dashed red lines denote the months of the major earthquakes. Auckland/Hamilton workers are weighted to reflect pre-quake composition of Greater Christchurch workers. Each regression includes worker and firm-level controls as listed in tables 2 and 3.

Figure 3: Average impact of earthquakes on employer status, conditional on employment

A. With pre-earthquake employer



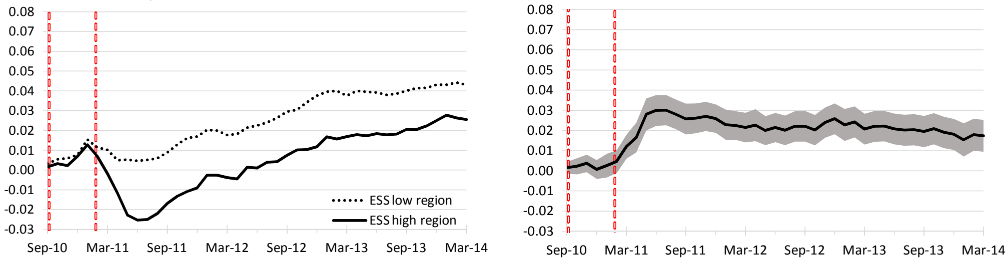
B. In pre-earthquake region



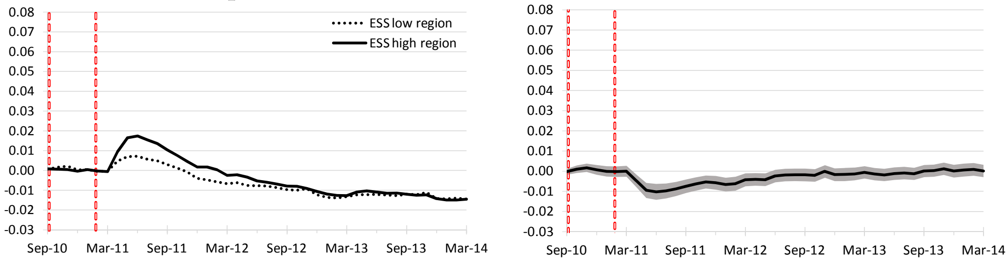
See figure 2 for notes. Panel B excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region.

Figure 4: Impact of earthquakes on employment and earnings, by impact area

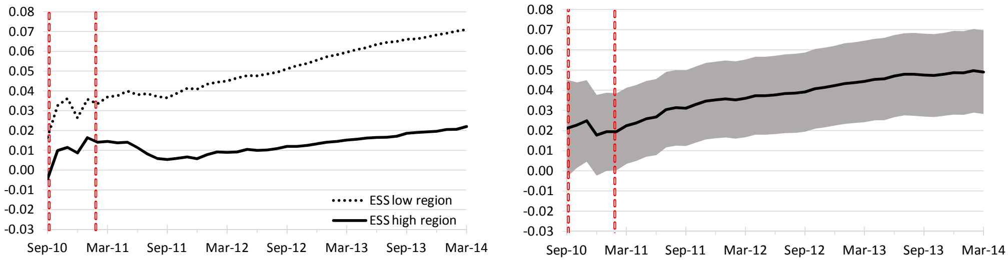
A. Employment



B. Benefit receipt



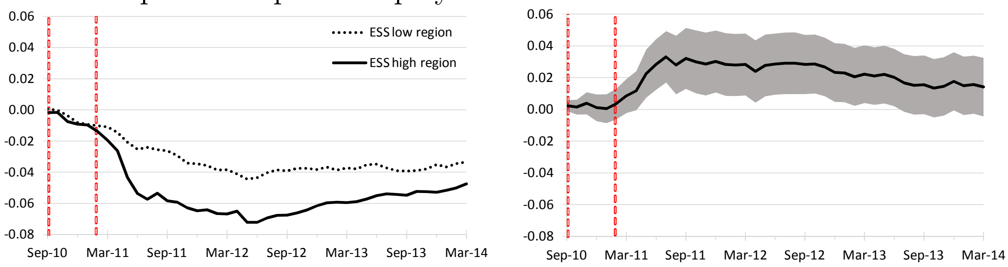
C. Accumulated (real log) earnings



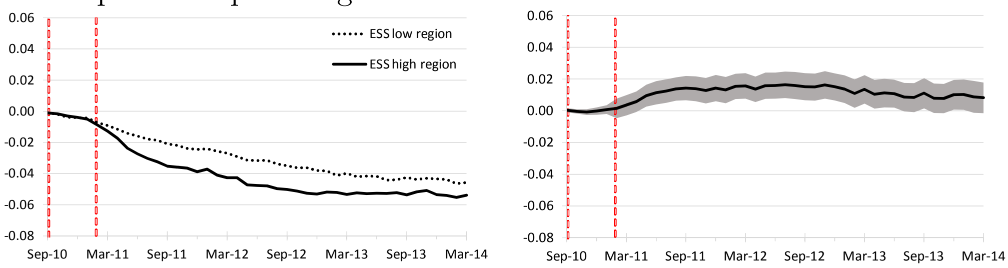
Left-hand figures shows difference-in-difference estimates of the impact of the earthquakes on worker-level outcomes using ordinary least squares regression, estimated separately for each post-quake month. The dependent variable is the change in outcome from the pre-quake period to the current month. Solid (dashed) lines report point estimates of the coefficient on an indicator variable for having a job in Greater Christchurch located prior to the earthquakes in a high (low) impact area. Right-hand figures show estimated differences in effects across the two areas (solid line) with 95% confidence intervals (calculated with robust standard errors clustered on employer). Vertical dashed red lines denote the months of the major earthquakes. Auckland/Hamilton workers are weighted to reflect pre-quake composition of Greater Christchurch workers. Each regression includes worker and firm-level controls as listed in tables 2 and 3.

Figure 5: Impact of earthquakes on employer status, by impact area

A. With pre-earthquake employer



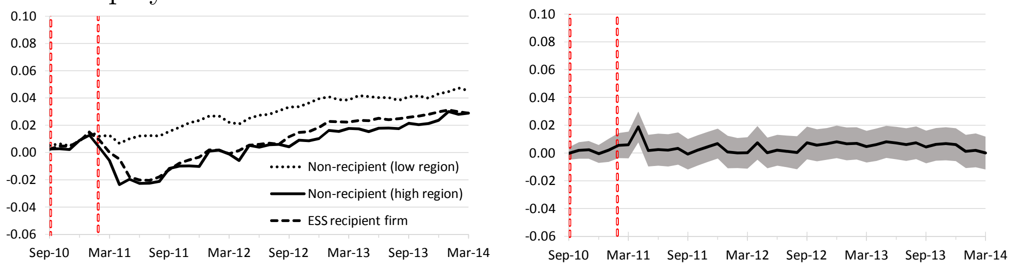
B. In pre-earthquake region



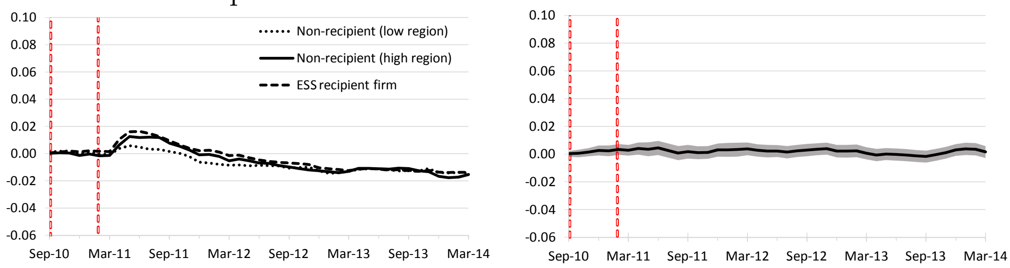
See figure 4 for notes. Restricted to workers who have a job in the relevant month. Panel B excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region.

Figure 6: Impact of earthquakes on employment and earnings, by impact area and ESS receipt

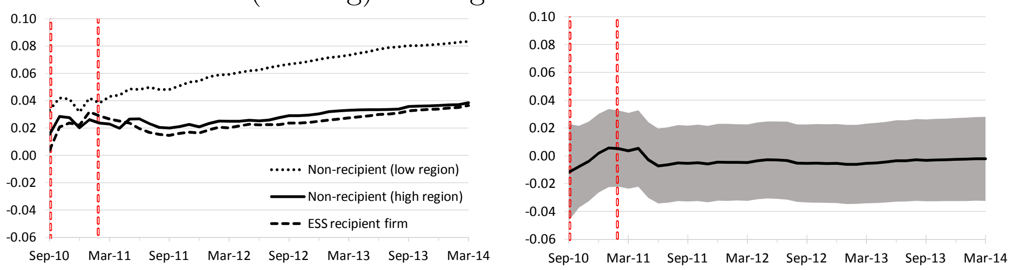
A. Employment



B. Benefit receipt



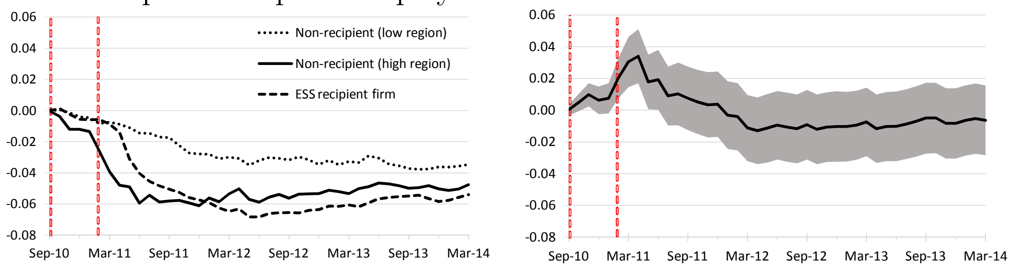
C. Accumulated (real log) earnings



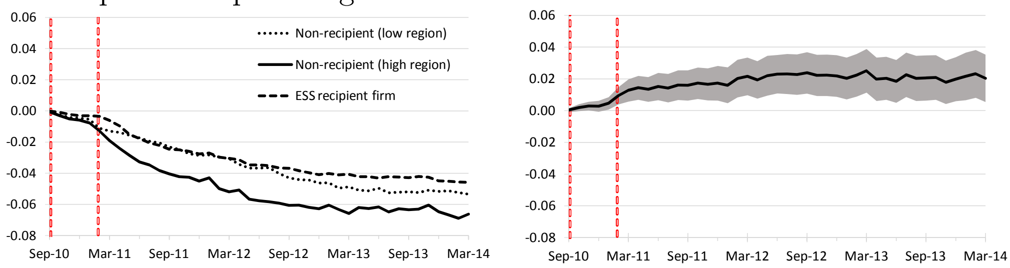
Left-hand figures shows difference-in-difference estimates of the impact of the earthquakes on worker-level outcomes using ordinary least squares regression, estimated separately for each post-quake month. The dependent variable is the change in outcome from the pre-quake period to the current month. Restricted to workers who have a job in a firm with the employment size characteristics for ESS eligibility. Solid (dotted) lines report point estimates of the coefficient on an indicator variable for having a job in Greater Christchurch located prior to the earthquakes in a high (low) impact area, where the employer did not receive the ESS. Dashed lines report point estimates of the coefficient on an indicator variable for having a job in Greater Christchurch where the employer received the ESS, regardless of impact area. Right-hand figures show estimated differences in effects between ESS firms and non-ESS firms in high impact areas (solid line) with 95% confidence intervals (calculated with robust standard errors clustered on employer). Vertical dashed red lines denote the months of the major earthquakes. Auckland/Hamilton workers are weighted to reflect pre-quake composition of Greater Christchurch workers. Each regression includes worker and firm-level controls as listed in tables 2 and 3.

Figure 7: Impact of earthquakes on employer status, by impact area and ESS receipt

A. With pre-earthquake employer



B. In pre-earthquake region

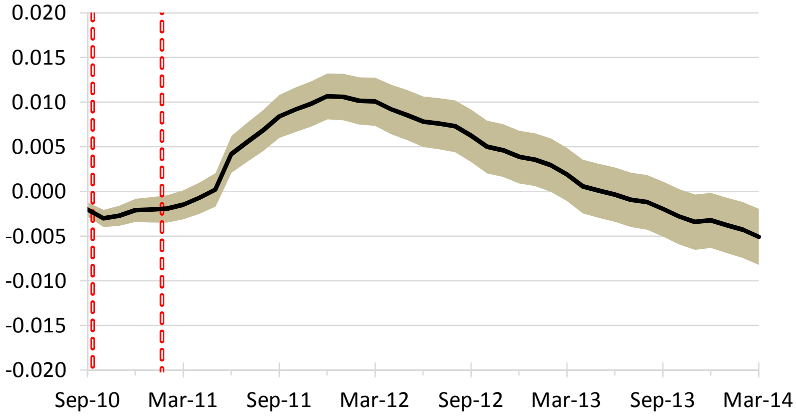


See figure 6 for notes. Restricted to workers who have a job in the relevant month. Panel B excludes workers who move to jobs with uncertain location characteristics, which are predominantly jobs in firms with plants in multiple regions including the relevant pre-earthquake region.

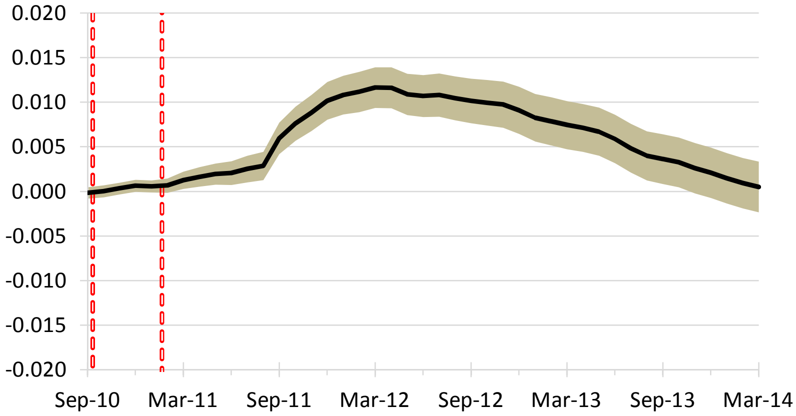
Appendix A

Figure A.1: Average impact of earthquakes on outward migration from New Zealand

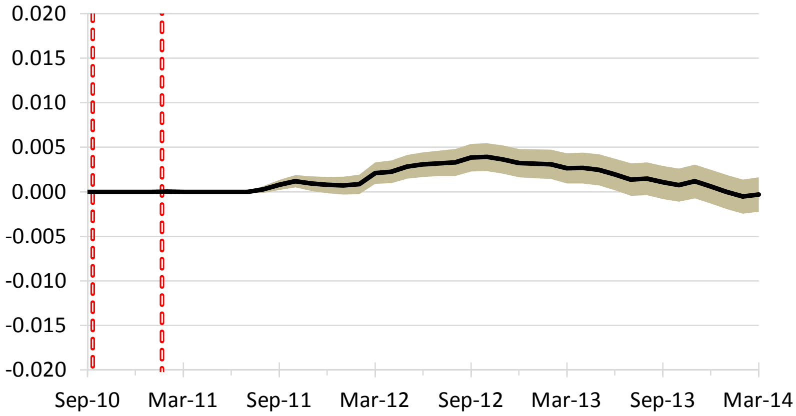
A. Out of New Zealand for at least three months of the year



B. Out of New Zealand for at least six months of the year



C. Out of New Zealand for the entire year



See figure 2 for notes.

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