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# Auckland firm performance in Covid-19 lockdown

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# Document information

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**Abstract**

Auckland – New Zealand's largest city – was subject to region-specific lockdowns to prevent the spread of Covid-19 during the pandemic. We estimate the impact of these lockdowns on firm sales revenue and expenses using a matched difference-in-difference dataset that covers almost all firms in the private sector, and with a control group of Christchurch firms. Estimated effects assume an unlikely best-case scenario where Covid-19 doesn't impact the Auckland regional economy in the absence of lockdowns. Under this assumption, we find the initial effect on Auckland sales to be similar in magnitude to the impact of the Canterbury Earthquakes on the most affected firms, though with shorter duration matching the length of the lockdown restrictions. Raw statistics are consistent with the initial nationwide lockdown being more impactful – and relatively well-navigated by Auckland firms – but don't account for the myriad of factors that prevented business-as-usual during the early stages of the pandemic.

**JEL codes**

D22 – firm behaviour: empirical analysis; H25 – business taxes and subsidies; I18 – government policy, regulation, public health

**Keywords**

Covid-19; lockdown; economic impact; matched difference-in-difference

**Summary haiku**

Lockdowns hurt Auckland

Some firms did worse than others

Knowing helps planning

# 1 Motivation

New Zealand's largest city, Auckland, was subjected to region-specific lockdowns as part of the Government's elimination response to Covid-19. Both nationwide and regional lockdowns occurred during 2020 and 2021, with the incidence and burden of these increasingly shifting to Auckland – the primary entry point of new Covid cases and variants into the country. Aucklanders spent close to four months longer in lockdown compared to most of New Zealand and – on the back of a nationwide lockdown starting in August 2021 – endured over 100 consecutive days of travel and work restrictions.

Auckland-specific lockdowns were initiated in response to Covid-19 in the community and the potential for escalation of the outbreak and associated loss of life. Our analysis doesn't critique the need for these lockdowns, nor the lifesaving value of such decisions, which were estimated at the time using epidemiological models and the observed experience of other countries. Rather, we focus on quantifying previously unknown economic costs, specifically lost sales revenue for Auckland businesses and the uneven distribution of these costs. The scale of revenue losses suggest other unestimated impacts, including financial insecurity, job loss and stress on business owners and employees.

We estimate the sales revenue impact using comprehensive Goods & Services Tax (GST) data and using Christchurch firms as a counterfactual for Auckland firm performance in the absence of lockdowns. The choice of Christchurch firms as an appropriate counterfactual is open to multiple valid criticisms. Firstly, the "average" Christchurch firm is not like the "average" Auckland firm. We address this concern by matching like firms, weighting and controlling directly for firm characteristics.

Secondly, despite substantial geographic distance between the two locations, Christchurch firms may have been affected by the Auckland lockdowns, for example, through supply chains. We show that government support, in the form of the Covid Wage Subsidy (CWS), is limited for Christchurch firms during these periods compared to during national lockdowns, mitigating this concern. We cannot rule out that Christchurch firms in the tradeables sector benefited from the Auckland lockdowns due to, for example, increased demand from Auckland consumers or reduced competition from Auckland firms. Given the closer proximity of other cities to Auckland, we maintain that this outcome is unlikely.

Finally, the South Island of New Zealand was free of Covid-19 during the period of Auckland-specific lockdowns. As such, our counterfactual represents the behaviour of firms and consumers in the absence of the risk of contracting Covid. This is unlikely to be the appropriate alternative outcome for Auckland, given that Covid-19 was present in the community. We interpret the estimated effects, therefore, as a bound on the potential negative impact of Auckland firms sales. We mean this in the sense that – in the absence of a lockdown – the (unlikely) best case scenario is that the Covid-19 outbreak did not spread further. A scenario where Covid-19 spreads is assumed to be worse for the local economy and, therefore, our estimated effects are an upper bound for how much better off Auckland firms would be without regional lockdowns.

Section 2 outlines the data that we use and the timing of national and Auckland-specific lockdowns. Section 3 reports estimates of the impact of these lockdowns on Auckland firms, while section 4 summarises findings.

# 2 Data & method

## 2.1 Data

We use the Longitudinal Business Database (LBD) and related user-generated tables for most variables. Plant-level data in the Fabling-Maré labour tables (Fabling and Maré 2015) identify active employing firm locations, and the Business Register identifies working proprietor-only (WP-only) locations. Monthly GST sales and purchases come from the method developed by Fabling (2024) that apportions two- and six-monthly returns to a monthly frequency.[1] GST data are additionally used to track firm exit (that is, the end of GST activity). Restricting the analysis to firm (GST) sales and purchases allows us to include WP-only firms in the analysis, which are otherwise restricted to annual frequency of observation. We exclude the government and not-for-profit sectors, for whom sales revenue is unlikely to be a good measure of performance or continuity.

Employer Covid Wage Subsidy (CWS) data is drawn from the Integrated Data Infrastructure (IDI) and linked to firms using confidentialised Inland Revenue numbers. The CWS was paid to firms during lockdowns to enable them to retain workers in cases where the impact of Covid-19 and associated events was substantial.[2] We use these data to confirm that we have correctly identified Auckland firms, to allay concerns that Christchurch firms were adversely affected by Auckland-specific lockdowns, and to establish industry groupings that were more and less affected by the pandemic. Because of the wage subsidy, we do not consider firm employment outcomes, which may present an unduly rosy picture for recipients.

## 2.2 Lockdown identification

New Zealand operated a four stage alert level system over the period where lockdowns occurred. According to NZRC (2024):

> Levels 3 and 4 of New Zealand's Alert Level System can be understood as 'soft' and 'hard' lockdowns, respectively, because they required people to stay at home, closed schools and businesses, and involved heavy restrictions on public gatherings. [section 3.1, footnote 1]

[1] These data are updated annually by the author, and available to all authorised users of the LBD via secure Datalab access. We use the 202410 instance, which are the latest available at the time of analysis. Sales and purchases are GST-exclusive and deflated by the Consumer Price Index.

[2] See Hyslop et al. (2023) for an evaluation of the CWS and discussion of the related data.

We follow this categorisation treating all level 3 or 4 periods as lockdowns, ignoring distinctions between the two levels for ease of analysis. Using the timeline reported by DPMC (2023), table 1 summarises the periods of nationwide and Auckland-specific lockdowns. In subsequent figures, we simplify this timeline to the monthly level of our data by classifying September 2021 as a NZ-wide lockdown month, despite the majority of the month being Auckland-specific.

## 2.3 Matching firms

To establish a counterfactual for Auckland firm outcomes, we apply a combined matching and regression approach. Matching follows a similar methodology to Fabling et al. (2014), who study the impact of the Canterbury earthquakes on firm performance. Firms are located in the Auckland or Christchurch functional urban area if the majority of total labour input is located in one of those areas.[3] Thus multi-region firms are included in the analysis when secondary locations are small relative to the primary location.

Christchurch firms are weighted based on matching to Auckland firms within firm cells defined by: industry;[4] whether the firm has employees (or is WP-only); GST sales ($S_{it}$); and prior sales growth ($\Delta S_{it}$). To account for volatility in monthly sales, we aggregate over a six month base period (from October 2019 to March 2020), requiring both sales and purchases to be positive in March 2020 (the base month). Change in GST sales is relative to the same six-month period a year prior and is measured using the "DHS growth rate" (Davis et al. 1998):

$$\Delta S_{it} = 2\frac{S_{it} - S_{it-1}}{S_{it} + S_{it-1}}. \tag{1}$$

Using average sales across the two periods as the denominator, includes entering firms ($S_{it-1} = 0$) in the analysis without special treatment.[5]

Cell boundaries are defined in an iterative manner by first dividing each industry sub-division into firms with and without employees (ie, WP-only). Each industry by labour type cell is then split into four using Auckland firm quartiles of $S_{it}$. Finally each industry-labour type-size cell is split into three using Auckland firm tertiles of $\Delta S_{it}$. This process yields 24 cells per industry – for a total of 1,176 cells – classified by, for example, small employing food retailers that grew relatively rapidly over the prior year (for a small employing food retailer).

While the quintile-based process assures an even distribution of Auckland firms across cells (within industry-labour type), cells can have a relatively small number of Christchurch firms. We drop cells where there are fewer than one Christchurch firm for every twenty Auckland firms. Assigning a weight of one to each Auckland firm, Christchurch firms are weighted by the

[3] We rely on plant-level employment to identify the relative size of firm locations because sales/output is only available at the firm-level.

[4] A total of 49 subdivisions (ANZSIC'06 two-digit industries) after the removal of a small number of industries with fewer than 200 Auckland firms.

[5] By construction, $\Delta S_{it}$ is bounded between $-2$ (exiting firms, $S_{it} = 0$) and $2$ (entering firms). Because we require firms to have positive sales in the base month $-2 < \Delta S_{it} \leq 2$ in matching.

ratio of Auckland to Christchurch firms in the relevant cell. The weighted count of Christchurch firms, therefore, equals the (un)weighted count of Auckland firms in each cell. These weights are used throughout the analysis.

Since GST is mandatory above a minimal filing threshold, and our data-based exclusions are minor, we consider the resulting sample of 96,636 private-for-profit Auckland firms – 51,708 WP-only and 44,928 employee – to be highly representative of the population. Results represent the average experience of Auckland firms relative to similar Christchurch firms. We track sales, purchases and firm survival from April 2019 (a year prior to the base month) through to March 2024 (the latest complete March year) – a total of 60 months. By tracking results prior to the base month, we can assess the quality of the matching by checking for parallel trends violations that might invalidate the comparison.

We initially compare raw (weighted) aggregates for Auckland and Christchurch firms, before switching to an Ordinary Least Squares (OLS) regression framework, controlling for remaining (base period) differences between Auckland and Christchurch firms. The general regression approach for firm $i$ in month $t$ is represented by

$$Y_{it} = \alpha_t + \beta_t^A \delta_t^A + \beta_t^Z Z_i + \epsilon_{it} \tag{2}$$

where $Y_{it}$ is the outcome of interest, $\delta_t^A$ is an indicator variable set to one for Auckland firms and zero for Christchurch firms, $\alpha_t$ is a set of month intercepts, $\epsilon_{it}$ is an error term, and $Z_i$ is the set of base period controls made up of:

- A set of indicators for industry
- An indicator for multi-region firms
- An indicator for exporters (based on zero-rated GST)
- An indicator for WP-only firms
- An indicator for whether $S > P$ in the base month
- A second order polynomial in log sales ($s$) and log purchases ($p$)

Coefficients on the base period controls are allowed to vary by industry and, in the case of the polynomial in $s$ and $p$, also vary by whether $S > P$ in the base month. We allow all coefficients to vary by $t$ and, for practical reasons, estimate this by running separate monthly regressions.

The outcomes of interest are:

- An indicator for firm activity (month is within time span of $S > 0$ and/or $P > 0$)
- Log sales ($s$), conditional on $S > 0$
- Log purchases ($p$), conditional on $P > 0$
- An indicator for $S > P$, conditional on $S > 0$ and/or $P > 0$

For each of these outcomes, the coefficient of interest is $\beta_t^A$, which captures the mean difference between Auckland and Christchurch firms. Estimated differences are measured in percentage points (pp) for indicator variables and log points for $s$ and $p$, which we then convert to pp differences.[6] In some specifications, we explore the heterogeneity in the mean effect, by estimating equation (2) separately for subsets of industries based on whether initial uptake of the CWS was low, moderate or high, reflecting the impact that the pandemic had on each industry. Because the set of control variables ($Z_i$) include base month values of the outcomes, our approach is equivalent to matched difference-in-difference with covariates.

# 3 Results

## 3.1 Covid Wage Subsidy (CWS) uptake

Table 2 reports CWS uptake rate in both Auckland and Christchurch during the two longest lockdown periods – March-May 2020 and Aug-Dec 2021. Uptake is relatively high during the initial nationwide lockdown, with close to two thirds of firms getting assistance, compared to around 40% during the nationwide lockdown in August 2021. The final column of the table shows the difference in uptake rates across the two regions. During nationwide lockdowns, uptake rates are similar in Auckland and Christchurch (within a couple of percentage points). When the focus of assistance shifts to Auckland, a sizeable gap opens up between regions suggesting that our approach does a good job at identifying predominant firm locations, and that the impact of Auckland-specific lockdowns on Christchurch firms was limited.

By industry, the initial CWS uptake rate varies from 24% for agriculture, through to 82% for road transport (appendix tables A.1 and A.2). This variation is used to classify industries into three approximately evenly sized groups of low, moderate and high Covid-19 impact. Table 3 summarises these groupings at the industry division level and reports the population share of firms in each group. The low impact group is dominated by professional, scientific and technical services (21% of firms) where there is greater potential for work-from-home to be a viable alternative during lockdowns. The high impact group is dominated by construction (18% of firms), which depends heavily on physical presence.

Table 4 reports mean initial CWS rates by impact group (5th column), together with mean GST components in the base month (March 2020) and in the first month of analysis (April 2019). These results confirm that the matching process has produced comparable populations across the two regions, even for variables not directly targeted by the match ($p$, $S > P$ and entry rate). Overall, Auckland firms are 3-4pp larger than Christchurch firms and were less likely to get the CWS, with the latter difference similar across all three impact groups. As we will see in the next subsection, Auckland firms appeared to do better than Christchurch firms during the

[6] The percentage point difference is given by $e^{\beta} - 1$ and is approximately equal to the log point difference for small $\beta$.

first nationwide lockdown, which could explain the gap in initial assistance rates.

## 3.2 Raw outcome comparison

Before presenting regression results, we graphically compare raw outcomes across the two regions for the four outcomes of interest – ongoing GST activity, sales, purchases and the indicator for $S > P$. Each figure follows the same two-panel format. The top panel shows the mean level of the outcome for Auckland and (weighted) Christchurch firms, using solid and dotted lines respectively. The bottom panel shows the difference between these two means. In each case, grey shading highlights lockdown months (table 1), with darker shading representing New Zealand-wide lockdowns.

Figure 1 shows that mean raw differences in ongoing firm activity are minimal, especially relative to the overall exit rate of firms. Specifically, in the four years from April 2020 through to March 2024, 22% of firms become GST inactive. The largest difference between Auckland and Christchurch firms is $-0.5$pp in April 2022 following the major Auckland-specific lockdown, which is suggestive of a relatively small average impact of that lockdown on firm survival.

This effect is likely to appear in April because of the way firms file their GST returns, which is aligned to balance dates and at a one-, two- or six-monthly frequency depending on firm size. Thus, for small business – which are most likely to exit – the predominant March balance date results in firm exit being identified in April and October. This filing effect can be observed in the step-like pattern in figure 1A. While the presence of six-monthly filers affects the apparent timing of exit effects, the predominant filing frequency is two-monthly, which makes monthly comparison of outcomes feasible.

Figures 2 and 3 show raw means for log sales ($s$) and log purchases ($p$) respectively. Focussing on levels (panel A), these figures show that each nationwide lockdown had a negative impact across the regions. Seasonal drops are apparent in each January, reflecting the main summer break. Panel B confirms that this pattern is removed by taking the difference between Auckland and Christchurch firms. In the year prior to Covid-19, the average sales (purchases) for Auckland firms is around 4pp (2pp) larger than for the average Christchurch firm. This pre-pandemic difference reflects the cell-based weighting approach and is controlled for in subsequent regressions. Unlike figure 1, there is a clear separation between Auckland and Christchurch firms during both nationwide and Auckland-specific lockdowns. During the first major nationwide lockdown, the raw data suggests that Auckland firms performed relatively well, compared to Christchurch firms, with sales declining by 7pp less. However, Auckland-specific lockdowns had the opposite effect, with sales (purchases) dropping as low as 8pp (9pp) below comparable Christchurch firms.

Figure 4 provides an indicator of the effect of these combined changes on whether sales exceeded purchases. Pre-Covid-19, around 90% of Auckland firms have GST sales greater than purchases, which is around 1pp higher than Christchurch firms at the start of the analysis period. In both regions, this performance metric falls by around 10pp during the major nationwide

lockdown and, after partially recovering, falls again during the second nationwide lockdown. In the latter lockdown, the decline is steeper and more prolonged for Auckland firms resulting in a $-1$pp gap. Post-lockdowns the relative difference between Auckland and Christchurch firms is almost restored to it's former level, but both Auckland and Christchurch firms have a lower mean probability of having $S > P$ than they did pre-Covid.

## 3.3 Estimated effects

Figures 5-8 graphically capture the estimated OLS effects from month-specific regressions with additional covariates (equation 2), while tables 5 and 6 report these effects at key months.[7] Focussing first on the figures, each has three panels reflecting results for all industries pooled (panel A), low impact industries (panel B) and high impact industries (panel C). Moderate impact industries are excluded from the figures for space, with results reported in table 6. Dotted lines show 95% confidence intervals for estimated effects, and the base month (March 2020) is excluded from the analysis (since variation, if any, is fully explained by covariates). Across all outcomes and subgroups, pre-Covid-19 differences between Auckland and Christchurch firms are generally insignificantly different from zero and display no clear trends, implying that the combined matching and regression control approach provides a sufficiently close counterfactual for our purposes.

Figure 5A confirms what we saw in the raw data following the major Auckland-specific lockdown – a 0.6pp (statistically significant at the 5% level) gap in the firm survival rate (GST activity). While this relative decline persists through until March 2024, it is no longer significantly different from zero (at the 5% level). Panel C shows that the effect is larger for firms in high impact industries and continues to increase until April 2023, where it reaches a peak of 1.3pp. An ongoing elevated exit effect is plausible for firms that, for example, had available capital depleted or took on debt during the lockdowns.

The first row of table 5 and each panel of table 6 report estimated effects on GST activity, standard errors and statistical significance at key months, for all industries and for industry groups separately (respectively). For example, from the bottom panel of table 6 a 1pp difference in GST activity persists in March 2024 for high impact industries and is statistically significant (at the 5% level). This effect, though, is small compared to the overall level of exit observed in the firm population (figure 1A). The estimated average effect across all firms (-0.5pp) is weakened by the lack of any effect on moderate impact industry firms (first row, middle panel of table 6). The small estimated impact on firm exit (inactivity) suggests that $s$ and $p$ results – which are conditional on positive values – are not likely to be driven by selection effects.

Across all industries, Auckland firm $s$ and $p$ were relatively high during the first nationwide lockdown. Comparing April 2019 and May 2020 estimates in table 5 the relative increase is

[7] Specifically, the first and last analysis month (April 2019 and March 2024); the final month of the initial nationwide lockdown (May 2020); and the three main months of the major Auckland-specific lockdown (September to November 2021).

2.7pp for each outcome, and no change in the relative probability of $S > P$ (the following row). The opposite was true during the major Auckland lockdown, with mean $s$ ($p$) 9pp (10pp) below Christchurch firms in September 2021, and a relative drop in the probability of $S > P$.

The heterogeneity in these effects can be seen by comparing panels B and C in figures 6-8. Both positive and negative effects are strongest for firms in high impact industries, with the first two Auckland-specific lockdowns also having clear negative effects on the high impact group. Focussing on estimates in table 6, Auckland sales are 18pp lower in September 2021 in high impact industries, compared to 8pp for moderate impact industries, and 2pp (not different from zero) for low impact industries. Purchases also decline rapidly, resulting in a 3pp relative decline in the probability that sales exceed purchases for firms in high impact industries, compared to 1pp decline for moderate impact industries and a 1pp increase for low impact industries. Effects on sales and purchases weaken somewhat but persist throughout the major Auckland lockdown.

From December 2021 to September 2022, Auckland sales are 2-3pp above expectation (figure 6A), which could reflect reversion to the pre-pandemic norm or could represent catch-up on demand deferred during the Auckland lockdown. The fact that the effect is no stronger for firms in high impact industries (panel C) than it is for low impact industries (panel B) suggests that the former explanation is more likely.

# 4 Conclusions

We focus on Auckland because of the duration of the final region-specific lockdown and the potential, therefore, to estimate causal effects on firms. However, raw sales and purchases data for both Auckland and Christchurch (figures 2A and 3A) imply that the first national lockdown had the greatest impact in both regions and, likely, the rest of New Zealand. The idea that the economic impact of the second national lockdown is significantly smaller than the impact of the first lockdown is supported by the lower uptake of the CWS during the latter lockdown (table 2). In part, this may be due to the relative duration of the two lockdowns – though for Auckland firms, the second of these lockdowns was actually longer. An alternative plausible explanation is that firms had time to adapt work practices to cope with disruptions of this kind, and that supply chains had had time to adjust.[8]

Business-as-usual was an impossibility during the initial stages of the pandemic, and we don't attempt a counterfactual for national lockdown effects. To reiterate the cautionary note in the introduction, we do not critique the decisions made for public health reasons, but rather aim to identify a cost of the decisions made. One of those decisions was the deployment of the Covid Wage Subsidy during the initial lockdown, which had broad uptake, supported firms and workers, and may have alleviated some of the effects explored in this paper (Hyslop et al. 2023).

[8]For multi-region Auckland firms, a third possible explanation is reallocation of work across regions.

Our causal results use variation across regions to identify the impact of Covid-19 lockdowns on Auckland businesses. We find that the impact of the major Auckland-specific lockdown was substantial and unevenly distributed across firms. One aspect of this heterogeneity is observed by classifying industries to groups that had low, moderate or high initial uptake of the Covid Wage Subsidy when New Zealand initially entered lockdown. This breakdown has parallels to the Canterbury earthquake analysis of Fabling et al. (2014), who classify firms based on access to the Earthquake Support Subsidy (ESS).[9] For ESS recipients (ibid, figure 6C), estimated immediate impacts on sales are slightly smaller than those estimated for Auckland firms in high impact industries, emphasising the severity of the lockdown for some firms. Where Auckland firm sales return to normalcy immediately following lockdown, negative effects persist for at least a year following the Canterbury earthquakes.

This comparison highlights an important lesson for policymakers – the power of monthly microeconomic data including GST and payroll (EMS) returns to inform our understanding of the economic impacts of shocks on firms. In the case of the lockdowns, the timeliness of GST returns means knowledge of the raw impact of the first national lockdown could have been used to inform decisions taken during the second major lockdown, including the scope and magnitude of government support.

The results we report capture the average experience of firms, not the impact on the aggregate regional economy. However, given the comprehensive coverage of GST (outside the financial sector) and wage & salary employment, aggregate indicators are feasible, enabling closer to real-time monitoring of regional economic performance. Furthermore, improved timeliness of administrative data is likely to be valuable during any crisis, be it business data or (at-risk) individual data.

We conclude by noting that persistent heightened exit of Auckland firms in high impact industries points to potential unobserved changes in firms during the lockdowns. By focussing on monthly outcomes, we have not considered the effect on changes in indebtedness, job turnover, or profitability which could have persistent effects on survival probabilities. Annual data could provide valuable insights into these issues (see, eg, Fabling 2021, and Fabling and Maré 2019 for related methods).

[9] The ESS is not directly comparable to the CWS as the former was limited to firms with 50 employees or less.

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# Tables

**Table 1: Timing and duration of lockdowns**

| Lockdown scope | Start date | End date | Duration (days) |
|---|---|---|---|
| New Zealand | 23-Mar-20 | 14-May-20 | 52 |
| Auckland | 12-Aug-20 | 30-Aug-20 | 18 |
| Auckland | 14-Feb-21 | 17-Feb-21 | 3 |
| Auckland | 28-Feb-21 | 7-Mar-21 | 7 |
| New Zealand | 17-Aug-21 | 7-Sep-21 | 21 |
| Auckland | 7-Sep-21 | 2-Dec-21 | 86 |
| **New Zealand (total)** | | | **73** |
| **Auckland (total)** | | | **187** |

Periods where the Auckland region or the whole of New Zealand was at alert level three or higher (according to DPMC 2023). Auckland continued in lockdown when the nationwide lockdown ended on 7 September 2021.

**Table 2: Covid Wage Subsidy uptake rate – major lockdowns**

| Lockdown scope | | CWS uptake rate | | Difference |
|---|---|---|---|---|
| | | Auckland | Christchurch | A—C |
| New Zealand | Mar-20 | 0.566 | 0.588 | -0.022 |
| New Zealand | Apr-20 | 0.653 | 0.664 | -0.011 |
| New Zealand | May-20 | 0.656 | 0.666 | -0.009 |
| | | | | |
| New Zealand | Aug-21 | 0.408 | 0.401 | 0.007 |
| NZ/Auckland | Sep-21 | 0.551 | 0.484 | 0.068 |
| Auckland | Oct-21 | 0.439 | 0.130 | 0.310 |
| Auckland | Nov-21 | 0.332 | 0.089 | 0.243 |
| Auckland | Dec-21 | 0.243 | 0.067 | 0.177 |

Restricted to firms that are GST active in the month. Christchurch firms weighted using match weights. Lockdowns are classified as "major" based on duration, not impact. Auckland continued in lockdown when the nationwide lockdown ended on 7 September 2021.

**Table 3: Industry division composition of population**

| | | Proportion of firms | | | |
|---|---|---|---|---|---|
| | Division | Low | Mod | High | Total |
| A | Agriculture, Forestry & Fishing | 0.018 | 0.000 | 0.000 | 0.018 |
| C | Manufacturing | 0.000 | 0.043 | 0.013 | 0.057 |
| E | Construction | 0.000 | 0.005 | 0.177 | 0.182 |
| F | Wholesale Trade | 0.000 | 0.058 | 0.000 | 0.058 |
| G | Retail Trade | 0.000 | 0.074 | 0.000 | 0.074 |
| H | Accommodation & Food Services | 0.000 | 0.004 | 0.053 | 0.057 |
| I | Transport, Postal & Warehousing | 0.000 | 0.016 | 0.031 | 0.047 |
| J | Information Media & Telecommunications | 0.000 | 0.010 | 0.000 | 0.010 |
| K | Financial & Insurance Services | 0.017 | 0.000 | 0.000 | 0.017 |
| L | Rental, Hiring & Real Estate Services | 0.046 | 0.008 | 0.000 | 0.054 |
| M | Professional, Scientific & Technical Services | 0.212 | 0.000 | 0.000 | 0.212 |
| N | Administrative & Support Services | 0.000 | 0.059 | 0.000 | 0.059 |
| O | Public Administration & Safety | 0.000 | 0.003 | 0.000 | 0.003 |
| P | Education & Training | 0.000 | 0.012 | 0.003 | 0.015 |
| Q | Health Care & Social Assistance | 0.056 | 0.007 | 0.000 | 0.063 |
| R | Arts & Recreation Services | 0.000 | 0.019 | 0.000 | 0.019 |
| S | Other Services | 0.000 | 0.000 | 0.056 | 0.056 |
| | **Total** | **0.349** | **0.318** | **0.332** | **1.000** |

Low/Mod/High are three Covid-19 impact groups based on initial mean uptake of the Covid Wage Subsidy at the two-digit industry level (reported in the appendix).

**Table 4: Base month comparison between Auckland and Christchurch firms**

| Industry | Mean (Mar-20) | | | | | Mean (Apr-19) | |
|---|---|---|---|---|---|---|---|
| group | $s$ | $p$ | $\delta(S>P)$ | Entrant | CWS | $s$ | $p$ |
| | | | | Auckland | | | |
| All | 10.03 | 9.03 | 0.899 | 0.047 | 0.566 | 10.04 | 9.04 |
| Low impact | 9.72 | 8.33 | 0.910 | 0.043 | 0.394 | 9.71 | 8.33 |
| Moderate impact | 10.36 | 9.51 | 0.884 | 0.043 | 0.594 | 10.42 | 9.54 |
| High impact | 10.03 | 9.32 | 0.902 | 0.056 | 0.718 | 10.01 | 9.29 |
| | | | | Christchurch | | | |
| All | 10.00 | 9.01 | 0.895 | 0.048 | 0.588 | 10.00 | 9.02 |
| Low impact | 9.68 | 8.29 | 0.904 | 0.044 | 0.419 | 9.66 | 8.32 |
| Moderate impact | 10.33 | 9.50 | 0.881 | 0.046 | 0.618 | 10.38 | 9.55 |
| High impact | 10.01 | 9.28 | 0.900 | 0.055 | 0.736 | 9.97 | 9.26 |
| | | | | Difference (A-C) | | | |
| All | 0.03 | 0.03 | 0.004 | -0.001 | -0.022 | 0.04 | 0.01 |
| Low impact | 0.04 | 0.03 | 0.007 | 0.000 | -0.026 | 0.05 | 0.02 |
| Moderate impact | 0.03 | 0.01 | 0.002 | -0.002 | -0.024 | 0.04 | -0.01 |
| High impact | 0.03 | 0.04 | 0.002 | 0.001 | -0.017 | 0.04 | 0.03 |

Low/Moderate/High groups based on initial mean uptake of the Covid Wage Subsidy. Mean entrant rate is proportion of firms GST inactive at Apr-19. Mean $s/p$ in Apr-19 is conditional on non-zero $S/P$. Christchurch firms weighted using match weights.

**Table 5: Estimated effects at key months**

| | Estimated effect at $t$ | | | | | |
|---|---|---|---|---|---|---|
| Outcome | Apr-19 | May-20 | Sep-21 | Oct-21 | Nov-21 | Mar-24 |
| $\delta$(Active) | 0.000 | -0.002 | -0.002 | -0.004 | -0.004 | -0.005 |
| | [0.002] | [0.001] | [0.002] | [0.002] | [0.002] | [0.003] |
| Log sales ($s$) | 0.022** | 0.049** | -0.100** | -0.078** | -0.068** | -0.014 |
| | [0.006] | [0.007] | [0.008] | [0.008] | [0.008] | [0.009] |
| Log purchases ($p$) | -0.008 | 0.019** | -0.110** | -0.117** | -0.110** | 0.002 |
| | [0.006] | [0.006] | [0.008] | [0.008] | [0.008] | [0.010] |
| $\delta(S>P)$ | 0.008** | 0.008** | -0.010** | -0.007** | -0.005* | -0.001 |
| | [0.002] | [0.003] | [0.003] | [0.002] | [0.003] | [0.003] |

Apr-19 and Mar-24 are the first and last analysis months. May-20 is the final month of the initial nationwide lockdown. Sep-21 through Nov-21 constitute the bulk of the longest Auckland-specific lockdown. Each estimated effect comes from a separate (month-specific) OLS regression. Christchurch firms weighted using match weights. **;* indicates a coefficient significantly different from zero at the 1%;5% level (robust standard errors in square brackets).

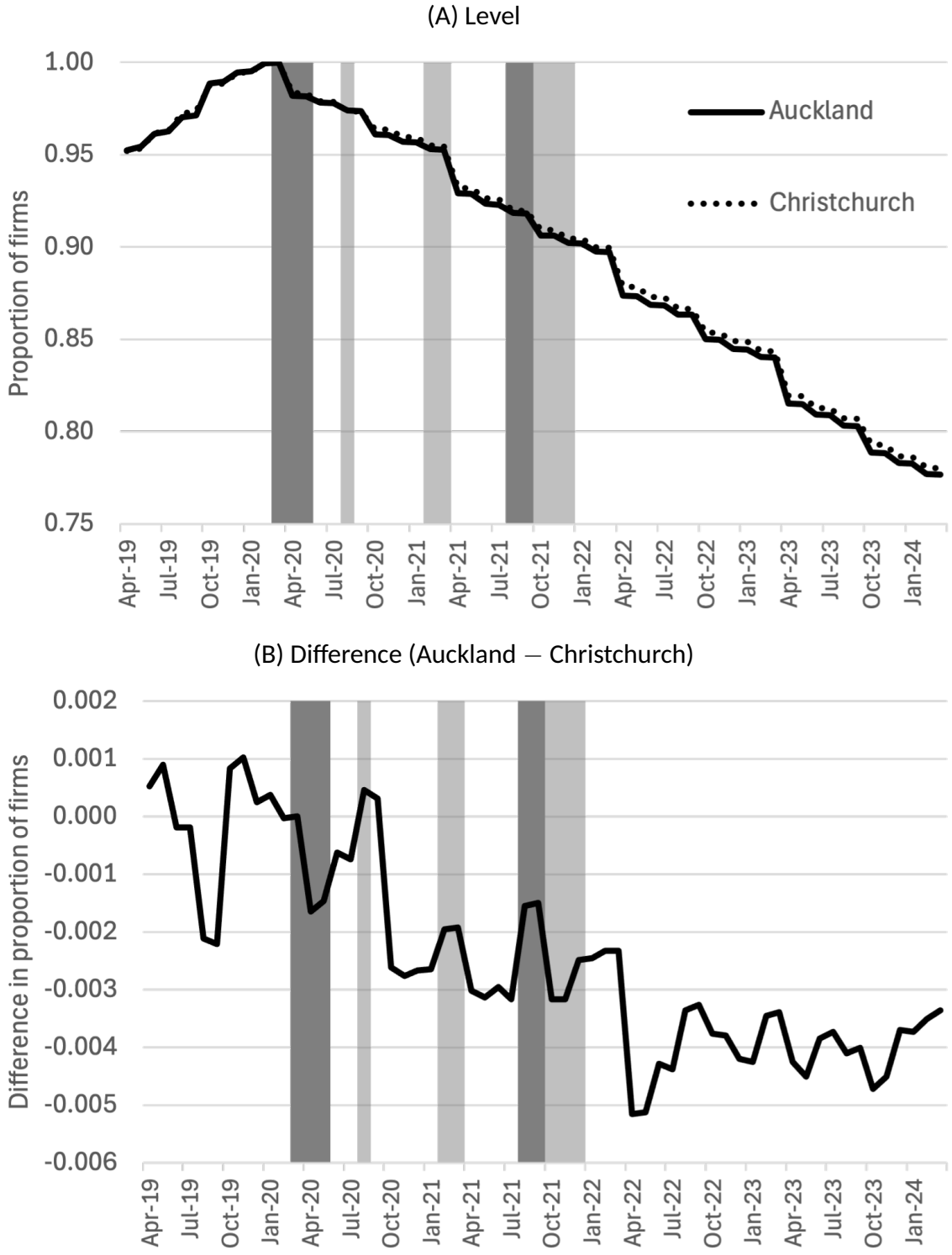
**Table 6: Estimated effects at key months by industry group**

| | Estimated effect at $t$ | | | | | |
|---|---|---|---|---|---|---|
| Outcome | Apr-19 | May-20 | Sep-21 | Oct-21 | Nov-21 | Mar-24 |
| | | | Low impact industries | | | |
| $\delta$(Active) | 0.001 | -0.005** | -0.005 | -0.006 | -0.006 | -0.006 |
| | [0.003] | [0.002] | [0.003] | [0.003] | [0.003] | [0.005] |
| Log sales ($s$) | 0.018 | 0.011 | -0.017 | -0.021 | -0.019 | -0.015 |
| | [0.010] | [0.012] | [0.013] | [0.013] | [0.013] | [0.016] |
| Log purchases ($p$) | -0.010 | -0.002 | -0.059** | -0.085** | -0.079** | 0.002 |
| | [0.012] | [0.012] | [0.014] | [0.014] | [0.014] | [0.017] |
| $\delta(S > P)$ | 0.009* | 0.001 | 0.010* | 0.003 | 0.004 | -0.003 |
| | [0.004] | [0.004] | [0.004] | [0.004] | [0.004] | [0.005] |
| | | | Moderate impact industries | | | |
| $\delta$(Active) | 0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 |
| | [0.003] | [0.002] | [0.004] | [0.004] | [0.004] | [0.005] |
| Log sales ($s$) | 0.023* | 0.049** | -0.080** | -0.066** | -0.048** | -0.005 |
| | [0.011] | [0.014] | [0.015] | [0.015] | [0.016] | [0.018] |
| Log purchases ($p$) | -0.006 | 0.028* | -0.101** | -0.112** | -0.105** | 0.005 |
| | [0.011] | [0.012] | [0.017] | [0.016] | [0.016] | [0.020] |
| $\delta(S > P)$ | 0.007 | 0.002 | -0.011* | -0.006 | -0.004 | 0.000 |
| | [0.004] | [0.005] | [0.005] | [0.005] | [0.005] | [0.005] |
| | | | High impact industries | | | |
| $\delta$(Active) | -0.002 | -0.002 | -0.002 | -0.005 | -0.005 | -0.010* |
| | [0.003] | [0.002] | [0.003] | [0.003] | [0.003] | [0.005] |
| Log sales ($s$) | 0.026** | 0.088** | -0.204** | -0.147** | -0.137** | -0.021 |
| | [0.009] | [0.011] | [0.012] | [0.011] | [0.012] | [0.014] |
| Log purchases ($p$) | -0.007 | 0.031** | -0.173** | -0.156** | -0.147** | 0.000 |
| | [0.010] | [0.009] | [0.012] | [0.013] | [0.013] | [0.016] |
| $\delta(S > P)$ | 0.008* | 0.022** | -0.030** | -0.019** | -0.016** | 0.002 |
| | [0.004] | [0.005] | [0.004] | [0.004] | [0.004] | [0.004] |

See table 5 for notes and the appendix for detailed industry groupings.

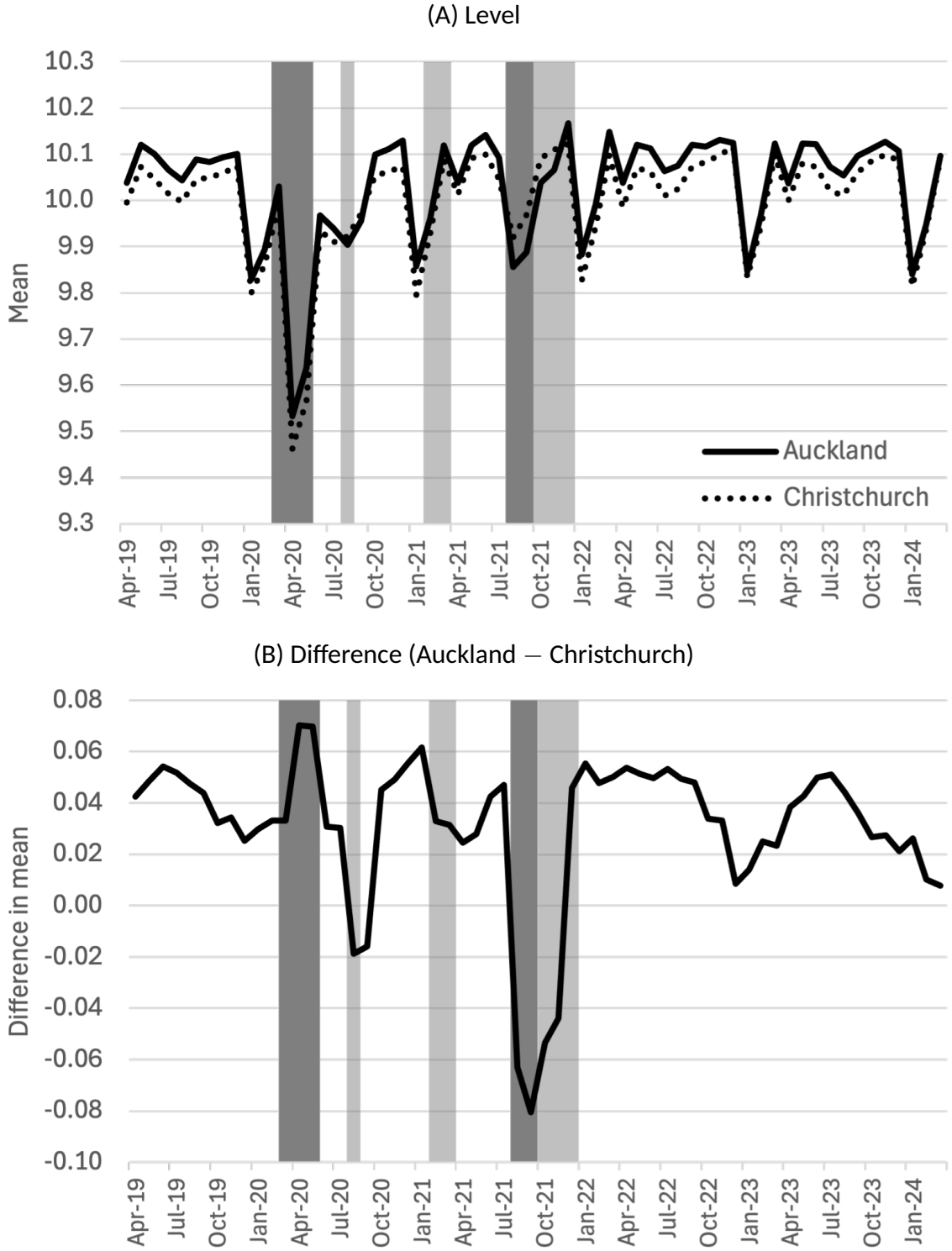
# Figures

**Figure 1: Raw proportion of GST active firms**



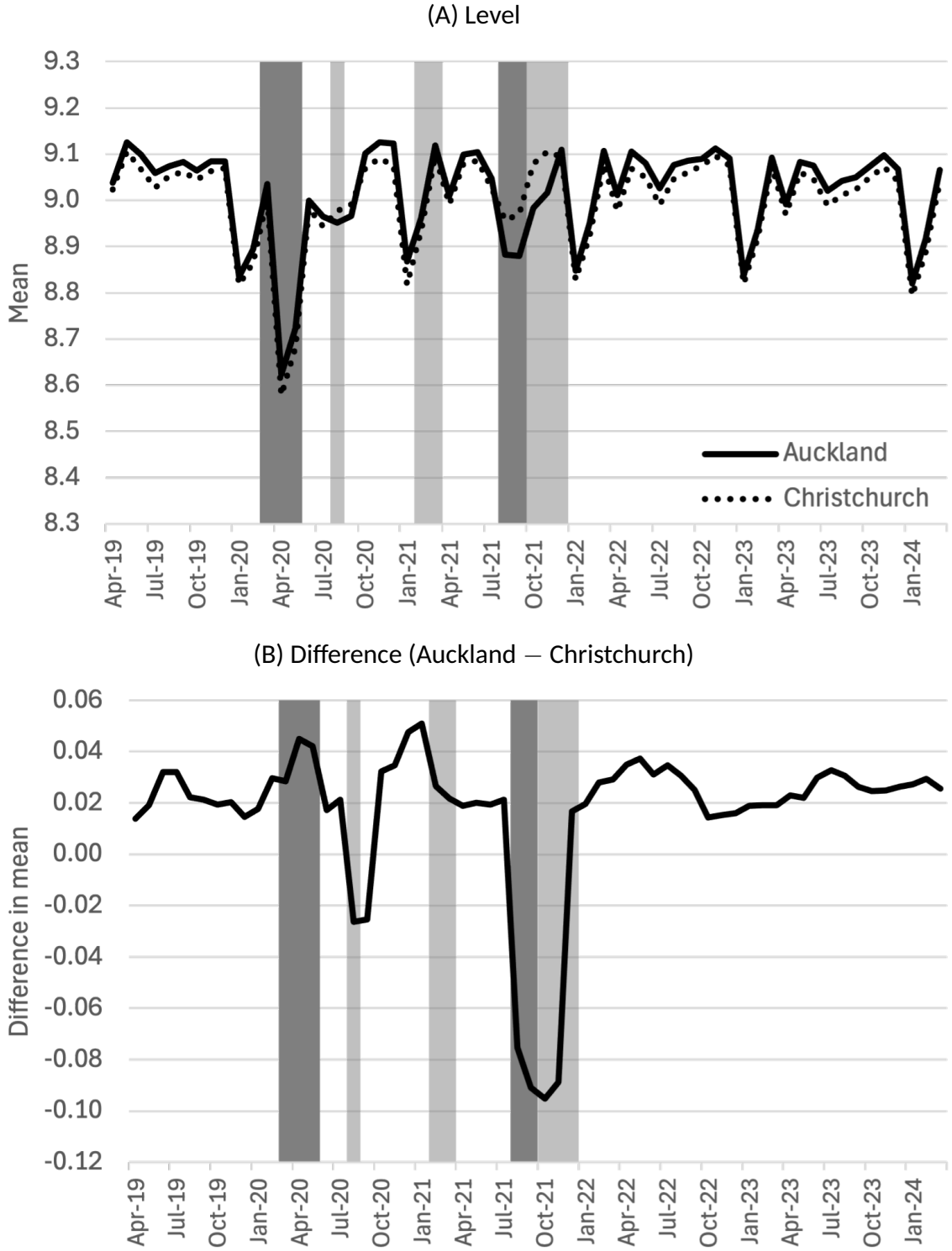

Proportion of firms where the month is within the span of positive GST $S$ and/or $P$. Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns. Step pattern in panel A is due to September/March being the predominant GST filing months of smaller businesses.

**Figure 2: Mean log GST sales ($s$) for firms with positive sales**



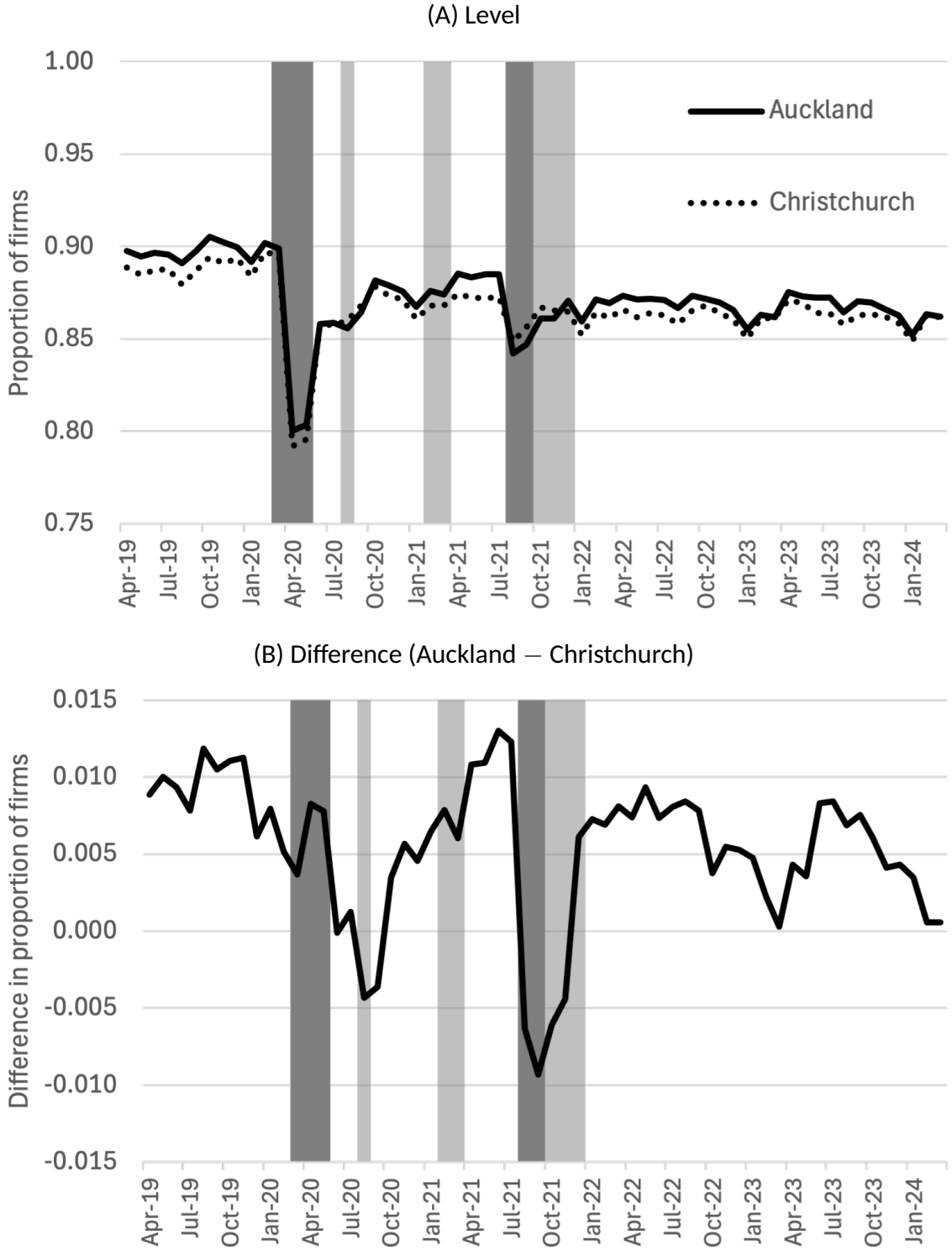

Restricted to firms with positive GST sales in the month. Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lock-downs.

**Figure 3: Mean log GST purchase ($p$) for firms with positive purchases**



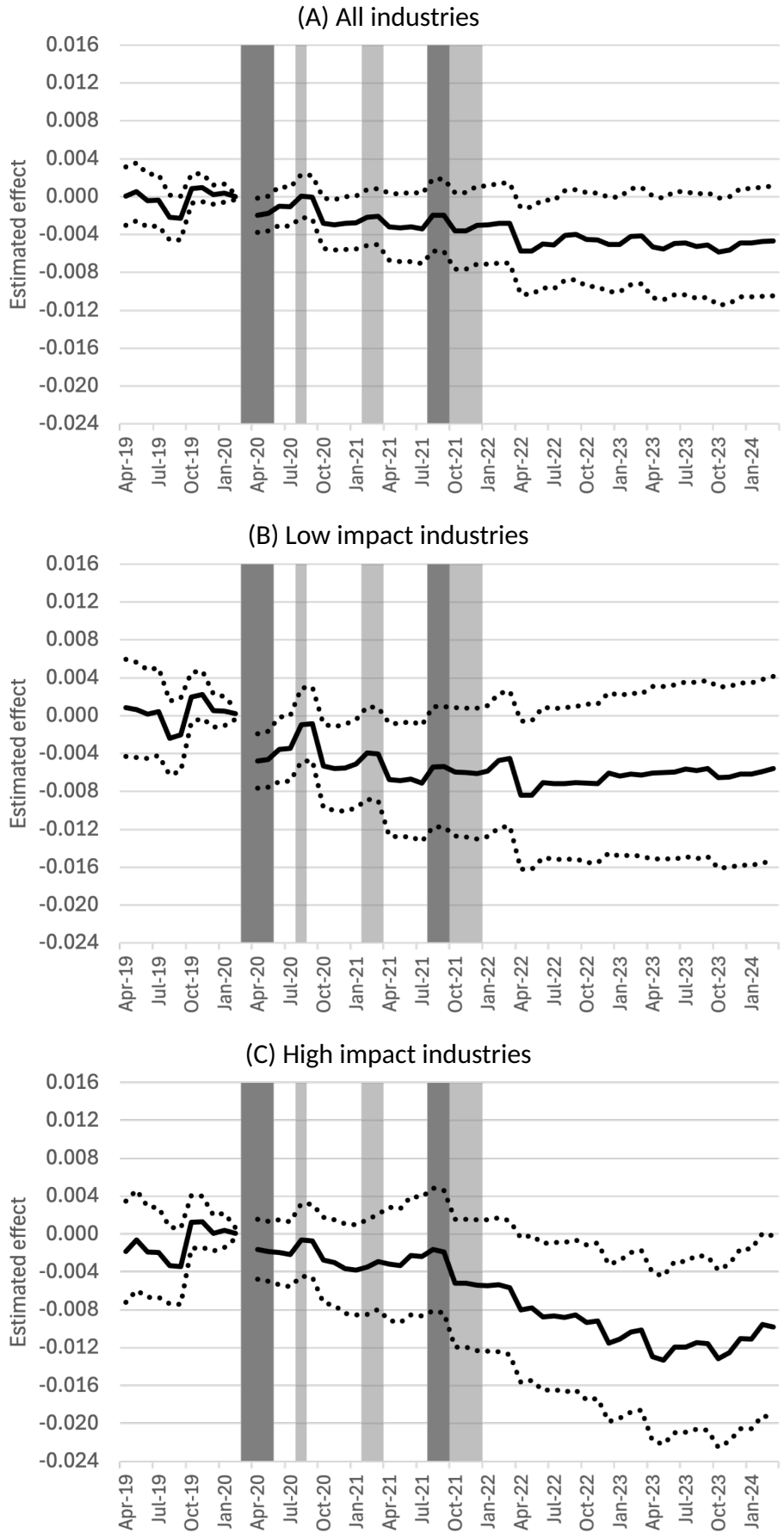

Restricted to firms with positive GST purchases in the month. Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns.

**Figure 4: Raw proportion of GST active firms with $S > P$**



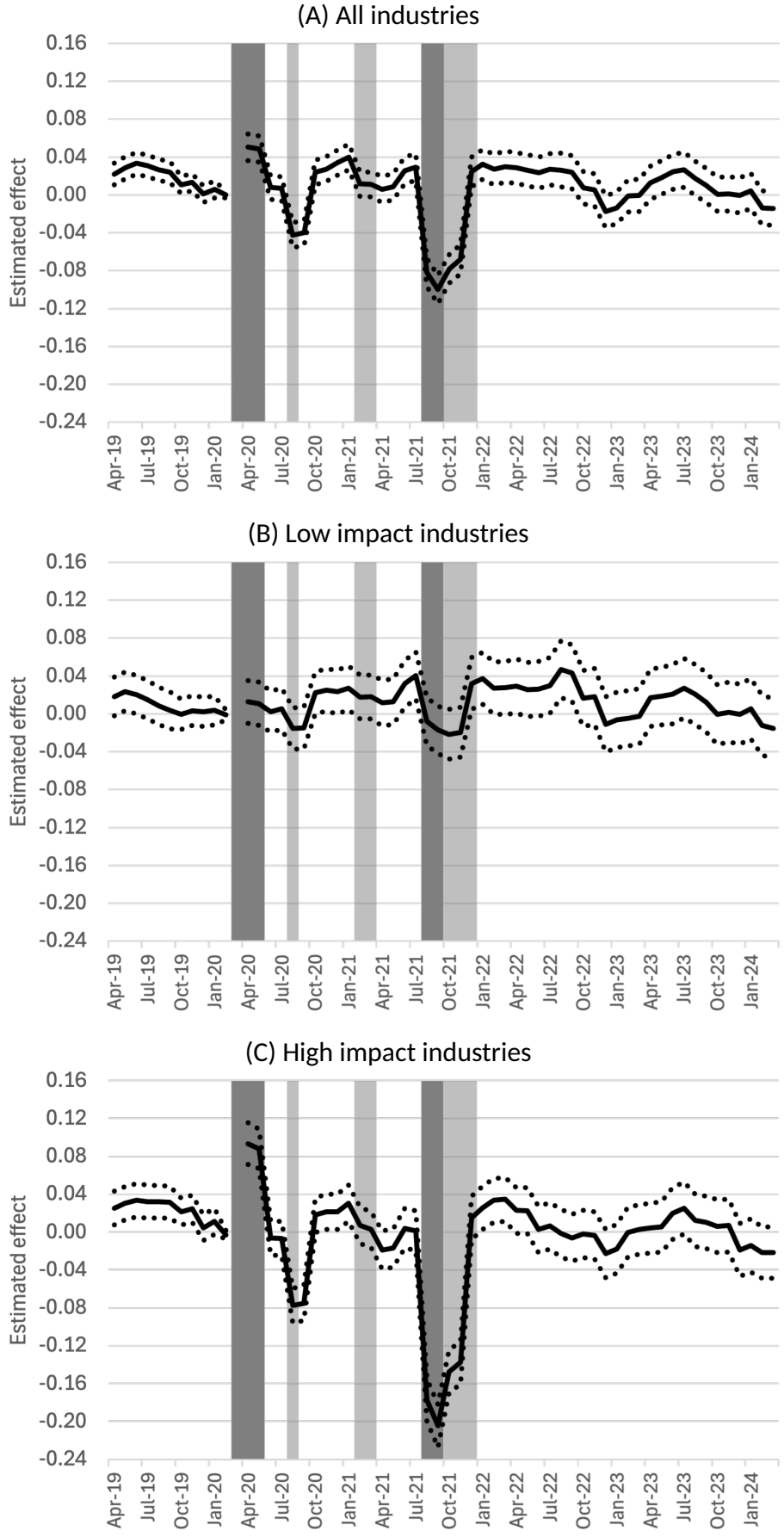

Restricted to firms with positive GST $S$ and/or $P$ in the month. Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns.

**Figure 5: Estimated effect on Auckland firm GST activity**



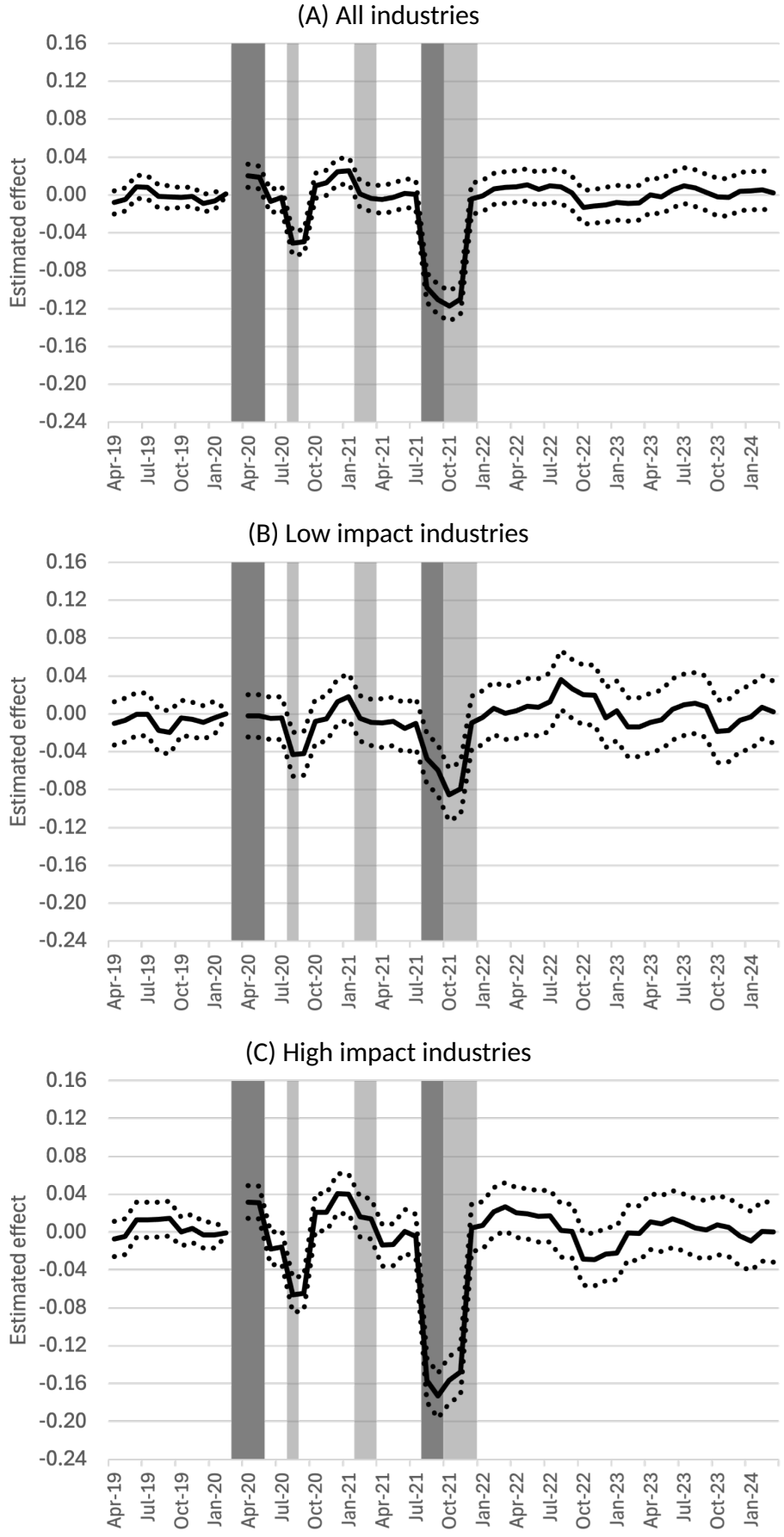

Firm outcome is that month is within the span of positive GST $S$ and/or $P$. Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns. Estimated using month-specific OLS with controls for firm characteristics. Dotted lines are 95% confidence interval (robust standard errors).

**Figure 6: Estimated effect on Auckland firm sales ($s$)**



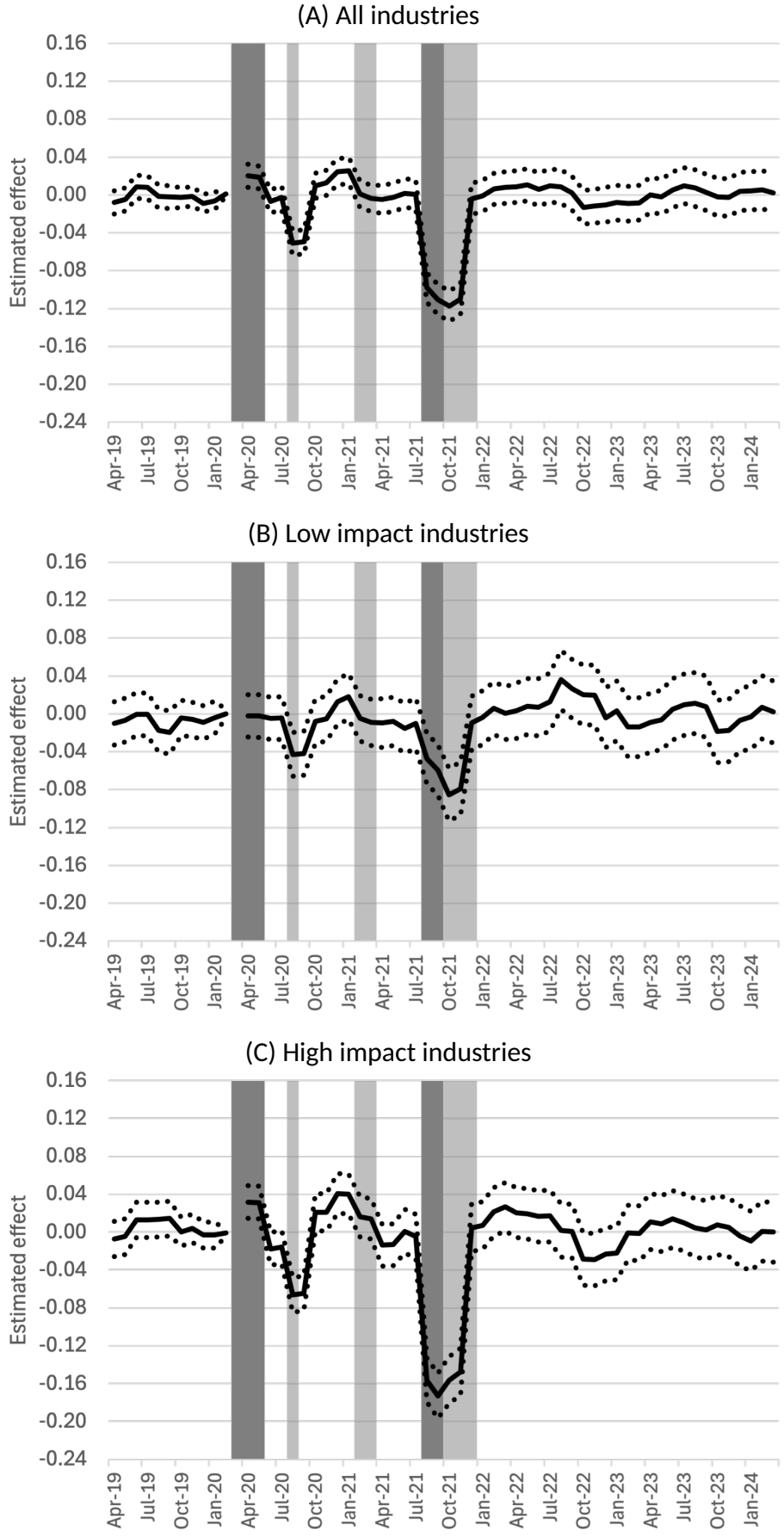

Firm outcome is log GST sales (where $S > 0$). Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns. Estimated using month-specific OLS with controls for firm characteristics. Dotted lines are 95% confidence interval (robust standard errors).

**Figure 7: Estimated effect on Auckland firm purchases ($p$)**




Firm outcome is log GST purchases (where $P > 0$). Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns. Estimated using month-specific OLS with controls for firm characteristics. Dotted lines are 95% confidence interval (robust standard errors).

**Figure 8: Estimated effect on Auckland firm net positive GST ($S > P$)**




Firm outcome is indicator for $S > P$ (for firms with positive GST $S$ and/or $P$). Christchurch firms weighted using match weights. Shading reflects months with national (dark grey) or Auckland-specific (light grey) lockdowns. Estimated using month-specific OLS with controls for firm characteristics. Dotted lines are 95% confidence interval (robust standard errors).

# A. Appendix – Additional results

**Table A.1: Initial uptake of CWS by industry sub-division – Low/High groups**

| | Industry | CWS rate | |
|---|---|---|---|
| A01 | Agriculture | 0.239 | Low |
| K62 | Finance | 0.363 | Low |
| M70 | Computer System Design & Related Services | 0.365 | Low |
| L67 | Property Operators & Real Estate Services | 0.459 | Low |
| K64 | Auxiliary Finance & Insurance Services | 0.505 | Low |
| A05 | Agriculture, Forestry & Fishing Support Services | 0.505 | Low |
| M69 | Professional, Scientific & Technical Services | 0.554 | Low |
| Q85 | Medical & Other Health Care Services | 0.554 | Low |
| S94 | Repair & Maintenance | 0.777 | High |
| C22 | Fabricated Metal Product Manufacturing | 0.779 | High |
| E30 | Building Construction | 0.782 | High |
| P80 | Preschool & School Education | 0.785 | High |
| E32 | Construction Services | 0.794 | High |
| C14 | Wood Product Manufacturing | 0.791 | High |
| C20 | Non-Metallic Mineral Product Manufacturing | 0.792 | High |
| H45 | Food & Beverage Services | 0.800 | High |
| S95 | Personal & Other Services | 0.804 | High |
| I46 | Road Transport | 0.816 | High |

Full classification of Low/High impact groups based on initial industry-level Covid Wage Subsidy uptake rate. Christchurch firms weighted using match weights.

**Table A.2: Initial uptake of CWS by industry sub-division – Moderate group**

| | Industry | CWS rate | |
|---|---|---|---|
| F36 | Grocery, Liquor & Tobacco Product Wholesaling | 0.588 | Mod |
| O77 | Public Order, Safety & Regulatory Services | 0.609 | Mod |
| J54 | Publishing (except Internet & Music Publishing) | 0.610 | Mod |
| R90 | Artistic Activities | 0.613 | Mod |
| L66 | Rental & Hiring Services (except Real Estate) | 0.621 | Mod |
| G43 | Non-Store Retailing & Retail Commission Based Buying /Selling | 0.622 | Mod |
| G41 | Food Retailing | 0.631 | Mod |
| F34 | Machinery & Equipment Wholesaling | 0.641 | Mod |
| F38 | Commission-Based Wholesaling | 0.642 | Mod |
| C19 | Polymer Product & Rubber Product Manufacturing | 0.669 | Mod |
| C24 | Machinery & Equipment Manufacturing | 0.677 | Mod |
| F33 | Basic Material Wholesaling | 0.677 | Mod |
| H44 | Accommodation | 0.680 | Mod |
| P82 | Adult, Community & Other Education | 0.681 | Mod |
| N72 | Administrative Services | 0.683 | Mod |
| F37 | Other Goods Wholesaling | 0.685 | Mod |
| J55 | Motion Picture & Sound Recording Activities | 0.687 | Mod |
| Q87 | Social Assistance Services | 0.694 | Mod |
| R91 | Sport & Recreation Activities | 0.700 | Mod |
| C11 | Food Product Manufacturing | 0.700 | Mod |
| G42 | Other Store-Based Retailing | 0.709 | Mod |
| C16 | Printing | 0.709 | Mod |
| I51 | Postal & Courier Pick-up & Delivery Services | 0.710 | Mod |
| I52 | Transport Support Services | 0.718 | Mod |
| C13 | Textile, Leather, Clothing & Footwear Manufacturing | 0.723 | Mod |
| F35 | Motor Vehicle & Motor Vehicle Parts Wholesaling | 0.724 | Mod |
| E31 | Heavy & Civil Engineering Construction | 0.746 | Mod |
| C23 | Transport Equipment Manufacturing | 0.765 | Mod |
| C25 | Furniture & Other Manufacturing | 0.769 | Mod |
| N73 | Building Cleaning, Pest Control & Other Support Services | 0.773 | Mod |
| G39 | Motor Vehicle & Motor Vehicle Parts Retailing | 0.774 | Mod |

Full classification of Moderate impact group based on initial industry-level Covid Wage Subsidy uptake rate. Christchurch firms weighted using match weights.