Missing migrants: Border closures as a labour supply shock *

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Abstract

We study the economic impact of the March 2020 closure of the New Zealand border. The border closed in the middle of the fall RSE arrival season, causing seasonal migrants to not enter the country as planned. We identify firms that were expecting workers but the workers did not arrive before the border closure and compare these firms to other firms where the workers arrived just before the border closure. We study the firm-level response to these 'missing migrants'. Did affected firms hire other workers? Did wages need to increase to do so? Was productivity lower as a result? We find that firms without migrants employed other workers – a combination of working holiday makers and New Zealand citizens/residents – and did not face lower employment levels. We find no evidence that firms without migrants increased wages for other workers. We find suggestive evidence that firms without migrants faced a productivity loss of up to 8%, but this result is statistically insignificant.

Keywords: Seasonal migration, New Zealand, labour markets
JEL Classification:

*We thank audience members at the NZ Productivity Commission, MBIE, and The University of Chicago for helpful comments. These results are not official statistics. They have been created for research purposes from the Integrated Data Infrastructure (IDI) and Longitudinal Business Database (LBD) which are carefully managed by Stats NZ. For more information about the IDI and/or LBD please visit https://www.stats.govt.nz/integrated-data/. The results are based in part on tax data supplied by Inland Revenue to Stats NZ under the Tax Administration Act 1994 for statistical purposes. 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. Any errors are the responsibility of the authors.

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1 Introduction

Agricultural firms face seasonal peaks in labour demand. New Zealand, alongside several other countries,[1] has a formal temporary migrant program to increase labour supply during high-season periods. While the benefits of economic migration for migrants are well-recognized, there is an active debate over the local economic effects of a seasonal worker program. Do seasonal workers crowd out economic opportunities for local workers, or are they indeed only increasing labour supply at a time when other workers are unavailable? Does the option to hire seasonal labour deter firm investment in labour -saving technology, potentially reducing productivity?

To answer these questions, we study the economic impact of a sudden cessation of the availability of migrants. On March 19, 2020, due to the COVID pandemic, the New Zealand border suddenly and unexpectedly closed to everyone who was not a citizen or resident. The closure of the border occurred in the middle of the autumn seasonal migrant arrival period. We focus our attention on the firm-level impacts of this shock, using rich linked employer-employee data from New Zealand's Integrated Data Infrastructure (IDI). We link administrative immigration arrival and visa records to administrative data on firm employment, wagebill, and sales and purchases to construct firm-level measures of exposure to the migrant shock. We do this by comparing firms where more migrants usually start work just before March 19 to those where migrants start just after March 19. We estimate that, on average, firms that were affected by the migrant shock received 27 fewer RSE than usual. We then document the impact of this migrant shock on firm-level employment, wages, and profits. We find that firms were able to fully substitute the missing migrants for other workers: RSE employment declined by 27%, but the missing migrants were replaced by New Zealand workers (with employment increasing by 7%) and working holiday makers (with employment increasing by 21%, concentrated in the initial months of the pandemic). We estimate small, economically insignificant effects on average wages, measured as average earnings per employee, in exposed firms compared

[1] Prominent examples include the H-2A seasonal visa program in the US, The Seasonal Agricultural Worker Program in Canada, The Seasonal Worker Programme in Australia and The Temporary and Circular Labour Migration program in Spain.

to non-exposed firms. We estimate a difference of 5 NZD (off a base of 3522 NZD per month). Finally, we look at the productivity effects of the change in the composition of the firm's labour force. We find suggestive evidence of a relative decrease in productivity, with affected firms receiving 8% lower sales per dollar spent on wagebill. However, this result is statistically imprecise and is concentrated in the 2020/2021 agricultural season rather than an immediate impact in March 2020.

The seasonal workers arrive in New Zealand through the *Recognised Seasonal Employer* (RSE) program. The RSE program allows horticultural and viticultural firms to employ migrant workers on a seven month visa. The program was introduced in 2007 as a policy both to address seasonal labour shortages in New Zealand and to achieve New Zealand's development goals in the region by encouraging economic development and stability in the Pacific. Employers are required to provide housing and pastoral care to employees and to pay at least NZ minimum wage. The program has grown from an initial 5,000 spaces in 2007 to 14,4000 in 2019.[2]

To understand which firms were affected by the border closure, we construct a firm-level instrument for exposure using the firm-specific timing of employment starts. We look at the firm's employment patterns one year before the border closure (i.e., March 19, 2019) and measure the share of RSE migrants that arrive in the window 30 days either side of March 19. Of these migrants, we measure how many start work before March 19 and how many start work after March 19. We use these two numbers – the total number of RSE migrants and the total number of "late" RSE migrants – to predict firm-level exposure to the border closure that occurred one year later (March 19, 2020). We use the sample of firms who hired migrant workers in the window to study the impact of the border closure one year later. We show that our measure of migrant arrival is strongly predictive of firm employment: a firm with one more predicted late arrival RSE employs 0.8 fewer RSE in 2020 compared with a firm that was hiring RSE in the same period but had migrants start work before March 19. The key identification assumption is that the timing of employment starts, within the 30 day window of March 19, is uncorrelated

[2] https://www.immigration.govt.nz/about-us/research-and-statistics/research-reports/recognised-seasonal-employer-rse-scheme

with firm-level and worker-level characteristics. We test this assumption by computing balance tests on baseline characteristics of firms and cannot reject these balance tests.

With the firm-level migrant shock in hand, we turn to studying the broader impact on affected firms. We first consider the overall composition of the firm's employment. We find that overall employment levels do not differ between firms with and without missing migrants. However, the composition of the workforce does differ: firms that did not receive migrants employ 7% more New Zealand workers (of these, one in 20 are additional workers transitioning from unemployment spells) and 23% more working-holiday makers. Overall, the reduction in RSE workers contributed to 7% lower employment, which was roughly balanced by the increases in NZ residents (adding 4% to average employment levels) and Working holiday makers (adding 2.2%). This suggests that firms that did not receive migrants responded by hiring more local New Zealanders (as well as working holiday makers when they were available).

Next, we study the wage bill incurred by firms. We show that the wage bill faced by employers increased by only 0.3% more in affected firms – equivalent to an increase in monthly wages of 5 NZD off a base of NZD 3522 – facing an RSE shortage. Average earnings (computed as earnings per worker) differed by a statistically insignificant 0.2% for RSE workers; 0.6% for NZ workers, and 2.0% for WHM workers.

Finally, we ask how total sales differed. We find that net sales, proxied by GST sales less purchases, was somewhat higher in treated firms (by 7%) but not statistically significantly different. The differences in net sales are, however, highly volatile over the year. As a proxy for labour productivity, we estimate the effect of the RSE shortage on net sales per worker, and net sales per dollar of wagebill. By either of these measures, productivity was lower in firms that faced an RSE shortage - 10% lower per employee or 8% lower per dollar of wagebill, but these results are statistically imprecise. The timing of the productivity effects also suggests impact concentrated in the subsequent 2020/2021 agricultural season, rather than immediately in the March 2020 period when the border closed. Overall, our results point to a situation where the migrant shock had limited economic impact at the firm level: firms were able to substitute towards alternative workers, did not increase wages to do so, but may have faced longer-term productivity losses as a

consequence of the changed composition of the labour force.

There are some important caveats to our results. First, our estimation strategy is to construct a set of firms that are otherwise comparable but differ only in their exposure to the migrant shock. As a result, we can cleanly measure changes that occur at the firm level, holding constant the overall economic environment – in particular, the impact of COVID – constant across firms. One caveat to our results is that if the sector is adjusting at a broader level – for example, wages adjust for the entire horticulture and viticulture labour market, and not only firms facing migrant shortages, then we will not measure this effect. We therefore supplement our analysis by looking at the broader economic patterns in the labour market, not only across our smaller analysis sample of firms that were hiring very close to the border closure. We find broader impacts consistent with our analysis sample – no evidence of a large decrease in employment or a large change in average wages. However, we caution that the sector-wide results could also contain any offsetting impacts of the effects of COVID on the economy as a whole. A second caveat is whether our estimates are specific to the specific labour market environment induced by COVID. We focus on primary sector firms that export a large share of their output, and so were less likely to face demand shocks due to COVID. Additionally, the NZ economy as a whole was extremely insulated from COVID due to the very successful containment strategy inside the country. However, the border closure also led to a direct negative impact on the tourism and hospitality sector. It is therefore possible that the labour market had more slack, due to fewer alternative jobs and so our result that firms could easily substitute to alternative workers may not be true more generally. We plan to extend our analysis to include more suggestive analysis of the scope of labour demand changes in other sectors to address this concern. Finally, the COVID shock was unprecedented and uncertain. The short-run adjustment strategies of the firm, such as choosing whether to make investment in capital rather than hiring alternative labour , may differ from the case of a permanent change in the availability of migrant workers, so we also caution against directly applying our results to estimate the impacts of reducing migration more generally.

Our paper contributes to the literature studying the destination labour market impacts of immigration. Our focus on temporary short-term immigration differs from papers an-

alyzing the impact of changes in permanent migration on local wages rates (Card, 2001; Borjas, 2003; Ottaviano and Peri, 2012; Borjas et al., 2012; Llull, 2017; Dustmann et al., 2016; Allen et al., 2019). We use detailed microlevel firm data to measure the economic impact of immigration directly on firm productivity, in the vein of recent papers that also have access to firm data (Beerli et al., 2021; Egger et al., 2021; Ghosh et al., 2015; Doran et al., 2015). However, unlike these papers, our focus is on understanding the productivity effects of short-term, seasonal, workers. Finally, we contribute to the literature studying temporary migration. Clemens et al. (2018) study the end of the Bracero seasonal migration program between Mexico and the US, showing that a reduction in seasonal workers led to mechanization in agriculture. Several papers have studied the impact of seasonal migration scheme for the migrants themselves – for example, McKenzie and Gibson (2010) find that participating in the RSE program led to an increase in household income of over 30%, Clemens and Tiongson (2017) studies the development impact of Filipino workers in Korea's employment permit scheme, and Kosack (2021) finds that the historical Bracero program in Mexico led to an increase in education investment by the Mexican state,[3] in comparison, our focus is on the impacts of this migration on the destination economy.[4] Gibson and McKenzie (2014) show case-study evidence from an apple orchard in NZ, that pays piecerate, that RSE workers are 50-60% more productive than working holiday makers, and 11-18% more productive than other NZ contract workers. Data from a mandarin orchard shows that, over a seven-day period, RSE workers picked 54% more fruit than NZ contract labour and 82% more than backpackers and working holiday makers.[5] Relative to direct measures of worker productivity, we focus on an aggregate measure of firm productivity – net firm sales – to measure broader productivity

[3] Clemens (2013) finds that randomly being awarded an H1B six-year high-skill visa leads to an increase in earnings of over 50% for Indian computer programmers. Liebensteiner (2014) finds a ten-fold increase for seasonal Armenian migrants working in the construction sector in Russia.

[4] Ramasamy et al. (2008) and Gibson and McKenzie (2014) give an overview of NZ's RSE scheme. A separate set of research papers have studied the Pacific Access Category (PAC) visa for Pacific Islanders to migrate to NZ (Stillman et al., 2009; Gibson et al., 2010; McKenzie et al., 2010, 2013). This PAC is a residence visa, allowing migrants to permanently move to New Zealand and is thus distinct from the RSE program. There is overlap in the eligible countries – citizens of Tonga, Fiji, Tuvalu, and Kiribati can apply for both PAC and RSE visas.

[5] Gibson and McKenzie (2014) also provide evidence from a citrus orchard in NZ that RSE workers who are paid piecerate earn approximately 8-10% more for each subsequent year they work, consistent with on-the-job productivity improvements.

impacts at the firm level.

The rest of the paper continues as follows. Section 2 introduces the firm-level data we use and characterizes the firm and worker sample. Section 3 discusses the agricultural and viticultural sectors in New Zealand, and provides background to the RSE scheme and COVID in NZ. Section 4 discusses the sector-wide trends in our key outcome measures of employment, wages, and output. Section 5 narrows in on our analysis sample and shows cleanly-estimated firm-level impacts of the border closure on employment, wages, and output. Section 6 concludes.

2 Data

To measure the impact of the COVID border closures on the labour market, we combine several administrative datasets contained in Statistics NZ's Integrated Data Infrastructure (IDI) [6] and Longitudinal Business Database (LBD).[7] The IDI contains confidentialised individual-level data on, among many other things: comprehensive visa application details and outcomes; passport and arrival card information for all international arrivals and departures; and earnings information sourced from employers' monthly payroll tax filings (the Employer Monthly Schedule).[8] These data are linked through the payroll tax information to comprehensive firm-level information from the LBD.

To identify our population of interest we use data from the New Zealand Immigration Service on approved visa applications. These data document when a visa was approved, the expiry data, and the visa class. For this project, we focus on visas issued under the Recognised Seasonal Employer and Working Holiday (WH) schemes.[9] At any point in

[6]Results are based on the 2021/07/20 archive of the data.

[7]See Fabling and Sanderson (2016) for further detail on the structure and coverage of the LBD, https://www.stats.govt.nz/integrated-data/integrated-data-infrastructure/ for information on the IDI, and Fabling and Maré (2015) for an in-depth discussion of employment measures in the IDI.

[8]Since April 2019, IR has shifted from monthly filings under the Employer Monthly Schedule to compulsory payday filing under the EIE. This follows a transition period since April 2018 in which firms could select whether to file monthly or through the payday filing system. For consistency, we make use of Stats NZ's processed data which allocates payday-filing information to calendar months.

[9]WH visa conditions are partner-country specific, but have some core commonalities: they are generally available to people aged between 18 and 30 (up to age 35 for some partner countries), allow the visa holder to work in New Zealand for a maximum of 12 months (23 months for the UK and Canada), and require that the primary purpose of travel should be a holiday, with work being "a secondary intention". We aggregate

time, an individual may have more than one approved visa in place. This often occurs where an individual applies for a subsequent visa prior to the expiry of their current visa, but can also occur when an individual applies, and is approved, for multiple visas at the same time, often with different conditions and expiry dates. To avoid double counting, we simplify the visa information to a set of non-overlapping visa spells using the following assumptions: (1) newly approved visas supersede existing visas (2) where multiple visas are approved on the same day we prioritise across those visas based on the usual length and degree of conditionality of the visa, prioritising first RSE, then WH, then other temporary visa types,[10] followed finally by recent (2015 or later) permanent or residence visas. If an individual does not appear in the visa applications data they are assumed to be a New Zealand citizen (including Cook Islanders[11]), long-term resident (ie, on a permanent visa issued prior to 2015), or exempt from visa requirements to work and live in New Zealand. This last group of people is described as "New Zealanders" in the discussion that follows, but also includes Australian citizens and permanent residents, who have been free to live and work in New Zealand without a visa under the Trans-Tasman Travel Arrangement (TTTA) since 1973.[12]

Having identified all individual RSE visa holders since 2015, we then draw on the monthly linked employer-employee payroll tax data to identify all firms which ever employed an RSE migrant over the same period. The employer identifier in this instance refers to the entity that submits payroll data to IR. As such, a "firm" in our analysis may represent more than one legal enterprise and may operate in more than one location. For each of these firms we then collect complete employment and payroll information as well as industry, location, and GST sales and purchases.[13] Within the firm, we identify each

together WH visas from all partner-countries. We also aggregate together a number of visa specifications within the RSE scheme, including RSE Critical Purpose visas and a range of visa extensions which have been in place since 2020.

[10] We follow MBIE guidelines and identify the following visa types as temporary visas: foreign mission and military; limited purpose; transit; visitor's; student; and work.

[11] The Cook Islands is a self-governing nation in "free association" with New Zealand. Cook Islanders are citizens of New Zealand and have the right to live and work there without restriction.

[12] https://en.wikipedia.org/wiki/Trans-Tasman_Travel_Arrangement

[13] GST returns are filed either monthly, bi-monthly, or six-monthly depending on the firm. We use information from monthly filers in the same 4 digit ANZSIC industry to attribute two- and six-monthly aggregated sales and purchases across months. Location information is based on each firm's employment shares across local government areas.

worker according to the visa and citizenship categories above[14], age and gender, and further classify New Zealanders according to their employment status in the month prior to them starting with their current employer – in paid work, on a benefit, receiving a student allowance, receiving a pension, or none of these – as identified in the monthly tax data. Firm payroll data record gross monthly income paid to workers, and hence reflect a combination of hours worked and hourly earnings.[15]

Finally, we link arrival and departure information sourced from the New Zealand Customs Service. These data are based on electronic passport and flight records combined with self-reported information from arrival and departure cards, and identify when an individual arrived in, or departed from, New Zealand. These data are used to create our instruments for "RSE shortage" and "RSE surplus" firms, discussed further below, by identifying the daily numbers of RSE (and WH) employees arriving in the country.

3 Background to agriculture and the COVID border closure

This section gives an overview of the key agricultural industries in New Zealand and the RSE scheme. It then shows the impact of the border closure in NZ on the arrival of migrants.

3.1 The RSE scheme

The *Recognised Seasonal Employer* (RSE) scheme was initiated in 2007. The scheme allows migrants, primarily from Pacific Islands, to work in New Zealand as temporary workers. Firms can employ workers from: Fiji, Kiribati, Nauru, Papua New Guinea, Samoa,

[14] Any worker that holds multiple visas or status within a month is classified under the same prioritisation as above: RSE, WH, other temporary visa, recent permanent residence visa, New Zealanders.

[15] IR moved to collecting hours paid information as part of the regular payday filing collection in April 2020 https://www.ird.govt.nz/employing-staff/payday-filing/payday-filing-version-2. The lack of historical information on hours paid, and patchy coverage since 2020 (the IR website describes the hours paid field as "optional"), prevents us from using hours information in this work.

Solomon Islands, Tonga, Tuvalu, and Vanuatu.[16] Workers receive an employment visa for seven months[17] and are required to spend at least four months out of the country between work spells. The scheme was initially set at 5,000 places when established in 2007. Since then, the RSE cap has increased. The RSE cap for November 2018, affecting the following year's hires, was set at 12,850. The RSE cap for the following year was increased to 14,400 in October 2019.[18] Only firms that have received an *Agreement to Recruit* from MBIE are eligible to recruit RSE workers. Firms undertake their own recruitment of migrants. In addition to paying at least the New Zealand minimum wage,[19] firms need to provide pastoral care (which can be at a cost that is deducted from worker paychecks) to the migrant workers. This pastoral care requirement includes proof of accommodation, transportation to/from work sites, access to personal banking services, and transportation to/from the port of arrival (provided potentially at a cost to the RSE worker). Additionally, the employer needs to pay half the cost of the return airfare to/from NZ from the worker's home country.

RSE employers are surveyed every year by MBIE. NZ employers report that RSE workers are more "enthusiastic" than workers sourced from Work and Income (i.e., workers transitioning from unemployment) – in 2019, for example, 98% of employer respondents rated RSE workers positively for enthusiasm compared to 10% for Work and Income workers, and 96% of employers rated RSE workers positively for dependability compared with 9% for workers from Work and Income. 96% of RSE employers agreed that the benefits of participating in the scheme outweighed the costs, with key benefits being a more stable seasonal workforce (100%), a higher quality and more productive workforce (99%), and the ability to employ additional New Zealanders (82%). Employers

[16] In some cases, the firm is able to hire workers from other countries if they have preexisting relationships.

[17] Employees from Tuvalu and Kiribati receive nine month visas because the costs to travel to NZ are larger.

[18] https://www.immigration.govt.nz/about-us/research-and-statistics/research-reports/recognised-seasonal-employer-rse-scheme

[19] This requirement increased to paying a living wage during COVID. The Government announced in November 2020 that 2,000 RSE workers from Fiji, Samoa, and Vanuatu were eligible to enter NZ between January and March 2021. Employers were required to pay the living wage ($22.10), as well as to cover the costs of managed isolation and quarantine, including paying the workers for 30 hours per week while in isolation. (Bedford, 2021)

further reported that having a stable workforce allowed investments in plant, equipment, and land area under cultivation (MBIE, 2019).

An early evaluation of the first two years of the RSE scheme (DoL, 2010) reported that "[f]or the majority of RSE employers, the benefit of the RSE Policy was realised immediately in the first season: employers had workers who could be relied on to turn up for work every day and who, in the most part, were enthusiastic about working and productive. Having a reliable workforce has had flow-on effects for employers: reduced recruitment and training costs, increased confidence to expand and invest, and reduced stress." (p. xvi)

3.2 Seasonal employment in NZ

The agriculture sector in NZ contributed 7% of GDP in 2019 and 76% of exports [20]. Seasonal agriculture demand fluctuates throughout the year. Throughout the paper, we focus on four primary industries — Apple growing, Packing and wholesaling, Growing, and Agricultural support services.[21] Figure 1 plots the workforce composition for each industry, separating out RSE and WHM employment. The growing sector has peak labour demand during the NZ summer, November/December. The apple sector has peak labour demand in March, around the picking season. Packing and wholesaling employment peaks after the picking season, around April and May, as the fruit is being put into coolstore and readied for export. Finally, the agricultural support sector, which provides services to many agricultural sectors, has fairly steady employment from the start of the picking season in November to the end of the packing season in August.

The seasonality of industry demand also tracks the demand for seasonal workers. The first panel of Figure 2 shows the arrival and departures of RSE migrants by month. There

[20] https://www.stats.govt.nz/tools/which-industries-contributed-to-new-zealands-gdp. Trade: https://www.stats.govt.nz/information-releases/overseas-merchandise-trade-november-2019, sum SITC categories 0-4. The main ag export (Table 5) is milk/milk powder, which is not covered by RSE.

[21] Classification is based on ANZSIC coding. 'Apple' is industry A0134: Apple and Pear Growing. 'Other Growing' includes all other RSE-employing firms in A01: Agriculture, as well as N7212: labour Supply Services, which includes labour hire firms supporting the primary sector. 'Packing and Wholesaling' includes N732: Packaging Services and F3605: Fruit and Vegetable Wholesaling. 'Support' is A0529: Other Agriculture and Fishing Support Services. 'Other' includes all other industries - RSE firms may have a primary industry classification that is unrelated to their horticulture and viticulture activities.

Figure 1: Seasonal labour force by industry

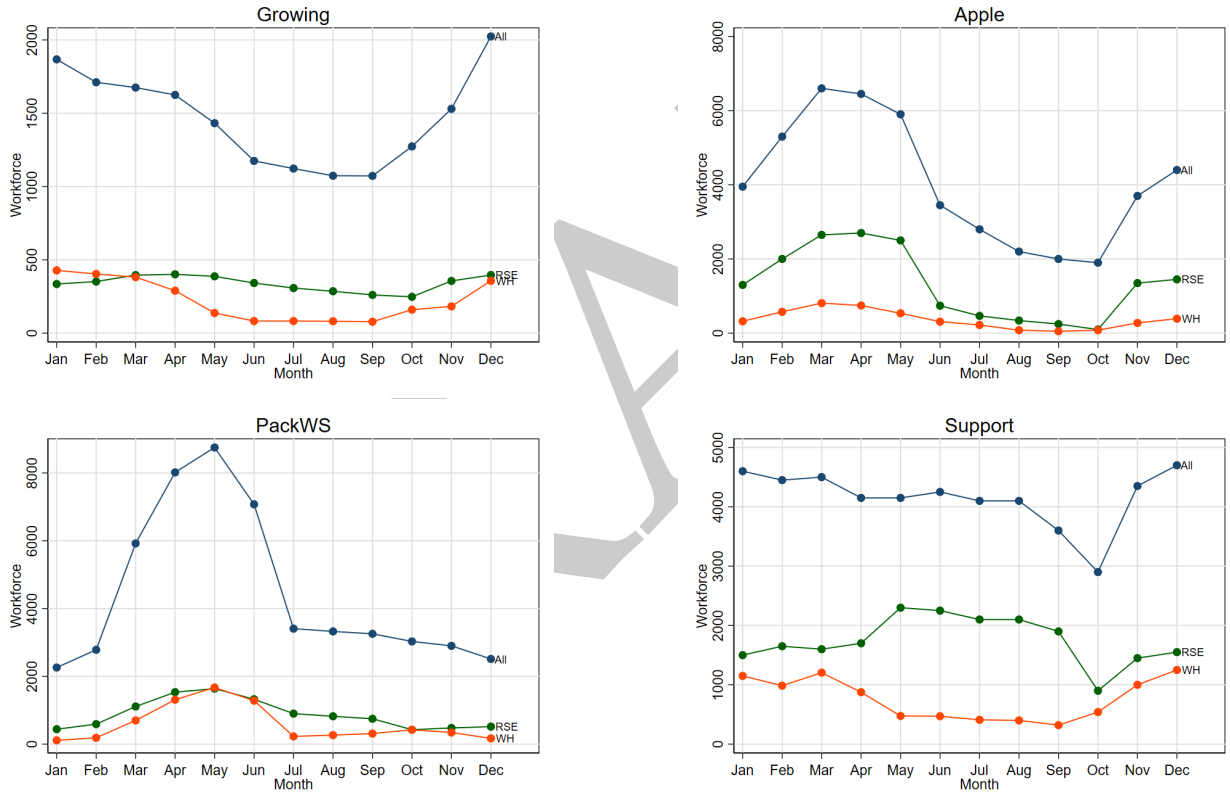
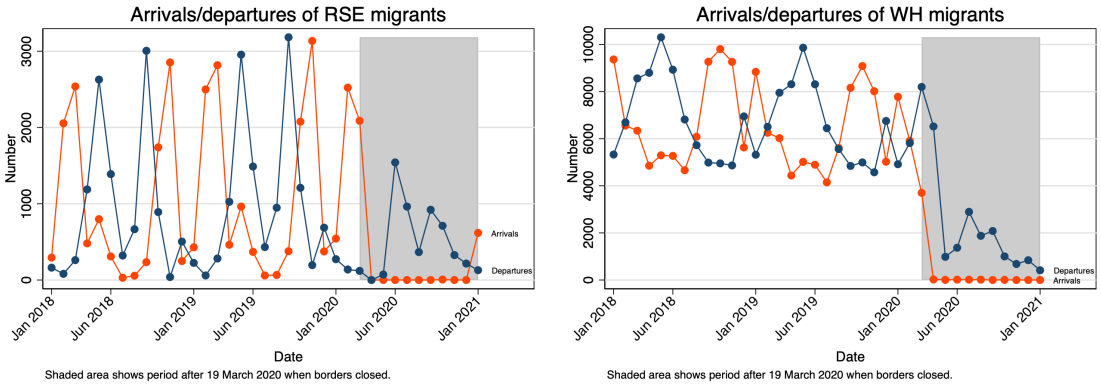


Figure 2: Arrivals and departures of RSE and WH by month



are two main cohorts of arrivals each season. The first cohort arrives in October/ November, in time for the seasonal peaks associated with harvesting of summerfruit (December to March), apples and pears, and grapes (February to April). They depart seven months later, in May/ June. The second cohort arrives in February/ March, overlapping with the first cohort, and also providing labour for the later kiwifruit harvest (May to July), as well as winter pruning and packing. The number of RSE workers is highest in March to May, at around 10,000 to 12,000. While many firms employ RSE workers from both arrival cohorts, RSE arrivals in November are concentrated in apple, growing, and support sectors, and RSE workers in the March arrival cohort are predominantly concentrated in the packing and wholesaling sectors. As a result, the COVID border closure in March disproportionally affected the packing and wholesaling sector.[22]

A second important source of seasonal labour is working holiday makers. The number of working holiday makers is approximately five times higher than the number of RSE – peaking at approximately 60,000 in January. Working holiday makers have the right to work at any employer in NZ, and tend have shorter job spells – the median job length observed is only one month – as they combine travel and employment. The arrival of working holiday makers is shown in the second panel of Figure 2; working holiday makers tend to arrive either in September/October or in January.

[22] Appendix Table 1 gives the breakdown of RSE workers by sector arriving in the March and November cohorts.

3.3 Summary statistics: firm and individual level

Table 1 summarizes firm-level employment, split by the four broad sectors identified above – apple, other growing, packing and wholesaling, agricultural support – and other. The sample is all firms who hired at least one RSE between 2015 and 2021. The table summarizes data for 2018 and 2019 – pre-COVID. The agricultural support and apple sectors have the largest average RSE share, at 30%. For growing and support industries, the RSE share of workers is lower at the seasonal peak (measured as the peak of total employment) than over the entire year. Although RSE workers are a significant source of labour at the seasonal peak, seasonal variation in non-RSE employment is even greater in these industries, as can be seen in Figure 1.

Table 1: Firm summary stats

	Num. firms	Mean employees	Median emp	Emp at peak	Mean RSE share	Median RSE share	RSE share at peak
Apple	39	103.9	39	169.2	0.25	0.21	0.34
Growing	72	87.2	27	124.2	0.17	0	0.13
PackWS	27	327.0	153	648.1	0.18	0.12	0.25
Support	51	89.6	53	100	0.30	0.19	0.22
Other	33	143.9	41	187.5	0.043	0	0.068
Pooled	225	129.5	45	185.0	0.20	0.061	0.25

Notes: Data is from 2018-9. Sample is firms that have hired at least one RSE between 2015-2021.

Table 2 gives summary statistics for the workforce. New Zealand workers comprise 49% of employment; RSE 28%; other temporary visa holders 5.2%,[23] and working holiday makers 14%. Workers earn, on average, between NZD 1971 - 3346 per month. Earnings comprise both the wage and number of hours worked; working holiday makers, for example, tend to work short stints in each location and so the lower earnings rate is likely due to fewer hours. This is consistent with the differing median job duration – the median WHM job lasts one month; whereas both NZ and RSE workers are employed by a firm for a median of six months. The mean earnings (full months) reports the mean earnings excluding workers' first and last months in a job, and thus excludes part-month payments. By this measure, monthly earnings of temporary migrants and WHM are closer to those of NZR and RSE workers. They are, however, still lower, reflecting either lower hours per month or lower productivity.

[23]Other temporary workers are workers who hold temporary migration visas (other than RSE and

Table 2: Worker summary stats, by visa type

	NZR	RSE	Temp	WHM
Employment	18800	10500	2000	5200
Employment share	0.49	0.28	0.052	0.14
Wagebill share	0.52	0.32	0.037	0.084
Mean age	39.7	32.7	29.6	25.7
Mean earnings	3346.2	3690.8	2281.7	1971.5
Mean earnings (full months)	4014.5	3825.5	3163.7	3066.9
Mean job duration	20.7	5.13	8.19	1.74
Median age	39	32	28	26
Median earnings	3094.6	3640.2	2182.7	1848.8
Median job duration	6	6	2	1

Notes: Note: Mean Wage (all months) and Mean Wage (full months) for NZ are computed for both NZ and permanent residents.

3.4 COVID and the closure of the NZ border

The first case of Covid-19 in NZ was detected on 28 February 2020,[24] approximately a month after the first detected case in the USA. The WHO declared Covid-19 a pandemic on 11 March 2020.[25]NZ first introduced a mandatory 14 day quarantine on 14 March 2020, before closing its borders on March 19, 2020 to all except for citizens and permanent residents. All temporary visa holders in NZ, including RSE workers, had their visas automatically extended until 25 September 2020 (and later to February 2021). NZ went into a strict six-week "level four" lockdown from 26 March 2020 to 27 April 2020. New Zealand reported zero new local cases of COVID-19 on 4 May 2020, and on 8 June 2020 New Zealand reported no active cases of COVID-19. NZ then remained effectively COVID-free until October 2021, barring small outbreaks that necessitated regional lockdowns in August 2020 and February 2021, until a second national lockdown began in 17 August 2021.

The sudden closure of the border to non-citizens/migrants dramatically curtailed the arrival of both working holiday maker and RSE workers, as seen in Figure 2. The sudden

WHM), such as students/ family/ essential skills visas.

[24] https://en.wikipedia.org/wiki/COVID-19_pandemic_in_New_Zealand

[25] https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-

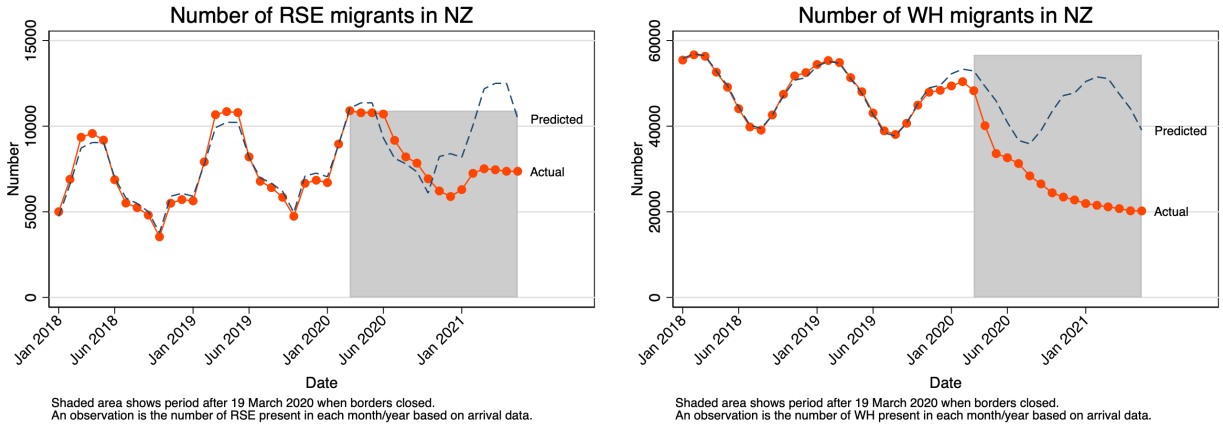
closure of the border and the extension of visas for migrants already inside the country affected two groups of RSE workers. First, it stopped workers arriving who had not yet arrived in the country (i.e., those planning to arrive after 19 March 2020). Second, workers who were already in the country were allowed to extend their visas. Whether workers could travel back to home countries also depended on border closures in Pacific Islands. Figure 3 shows that the two offsetting impacts of the border closure resulted in an overall migrant shortage only after October 2021.[26]However, at the firm level, there is differential exposure to two distinct effects: some firms were expecting migrants that did not arrive, other firms had migrants who stayed longer (some firms were affected by both of these effects.) We therefore focus on the firm-level shock.

The availability of labour for the tail end of the 2020 harvest season and for the October 2020-March 2021 harvest season generated a large public debate. Growers claimed that without seasonal workers they would not be able to harvest crops, and industry groups claimed that productivity was down 20-30% because of the lack of labour .[27]The government responded by allowing 5000 RSE workers into the country in January 2021. Employers needed to pay a living wage, cover wages for the two weeks that the workers were in mandatory managed isolation, and pay the costs for mandatory managed isolation. MBIE, the government Ministry that administers the RSE scheme, allowed RSE workers to shift between authorized employers if the sponsoring employer agreed. Otherwise, the sponsoring employer remained responsible for paying the agreed terms in the RSE contract.

[26]The stock of RSE workers in the country depends on the seasonal arrival patterns and the national cap on allowed RSE workers. We predict the stock of RSE workers by running a regression with month dummies and a linear time trend and include this on the plot.

[27]https://www.nzherald.co.nz/business/fields-of-courgettes-go-to-waste-because-grower-cant-get-worker WU663T7JRQVDDOYTBOXMA4VPIY/

Figure 3: Stocks of RSE/WH



4 Overview: sectoral trends in employment, wages, and profit

The focus of our paper is to understand the impact of the border closure on the labour market and firm productivity. We start by giving an overview of employment in each sector before moving on to our identification strategy to isolate the impact of the border closure by studying a subset of firms that were expecting to hire workers very close to the March 19 shutdown.

4.1 Employment

Figure 4 plots the monthly employment counts by sector, separately for total employment and RSE employment. The dashed line in the figure plots a simple prediction line, based on a regression with industry-by-month fixed effects and an industry-time trend. The vertical dashed line in the figure indicates March (the month of the border shutdown) of each year. We show the same figure split further by type of worker (i.e., NZ, Working holiday maker, other temporary visa holder) in Appendix Figure 1.

The figure shows that overall employment was slightly below its predicted value for April and May 2020. This is possibly due to the COVID shutdown that occurred between March 26 and April 27, 2020. Overall employment tracked its predicted value for most of

2020. Total RSE employment was above its predicted value for the first half of the border-closure period, consistent with the offsetting visa extension effects shown in Figure 2.

The impact on RSE employment and overall employment differs by sector. For the first half of 2020, the apple, growing, and support sectors were all tracking above predicted employment, both overall and for RSE. In comparison, the packing and Warehousing sector had overall employment and RSE employment below trend. In the second half of 2020, corresponding to the start of the next agricultural season, RSE employment in Apple, Packing, and Growing was below trend, consistent with the prolonged closure of the border that stopped the August/September cohort of RSEs arrivals. However, total employment remained close to trend for these sectors, suggesting that the lack of RSE workers was made up for by other workers.

Where did these workers transition from? Appendix Figure 1 shows that the post-August shortage of RSE workers was made up primarily by an increase in NZ workers. These NZ workers were fairly evenly split between NZ residents who had come from wage and salary jobs, from benefit, and 'other' (see Appendix Figure 2 and Appendix Figure 3). Appendix Figure 5 shows that the share of workers with no experience either in the industry or in the firm increased above trend, suggesting that firms were substituting to workers with less experience.

4.2 Wage bill

Figure 5 plots the mean earnings, in thousands of NZD, per worker. Overall, average wages are slightly below their predicted value during the COVID period for the average workers. Wages for NZ workers are also below their predicted value. However, part of this effect could be the change in the composition of the workforce and a larger share of low-skilled work, which pays lower wages, being performed by NZ workers.

Figure 4: Total employment and RSE employment

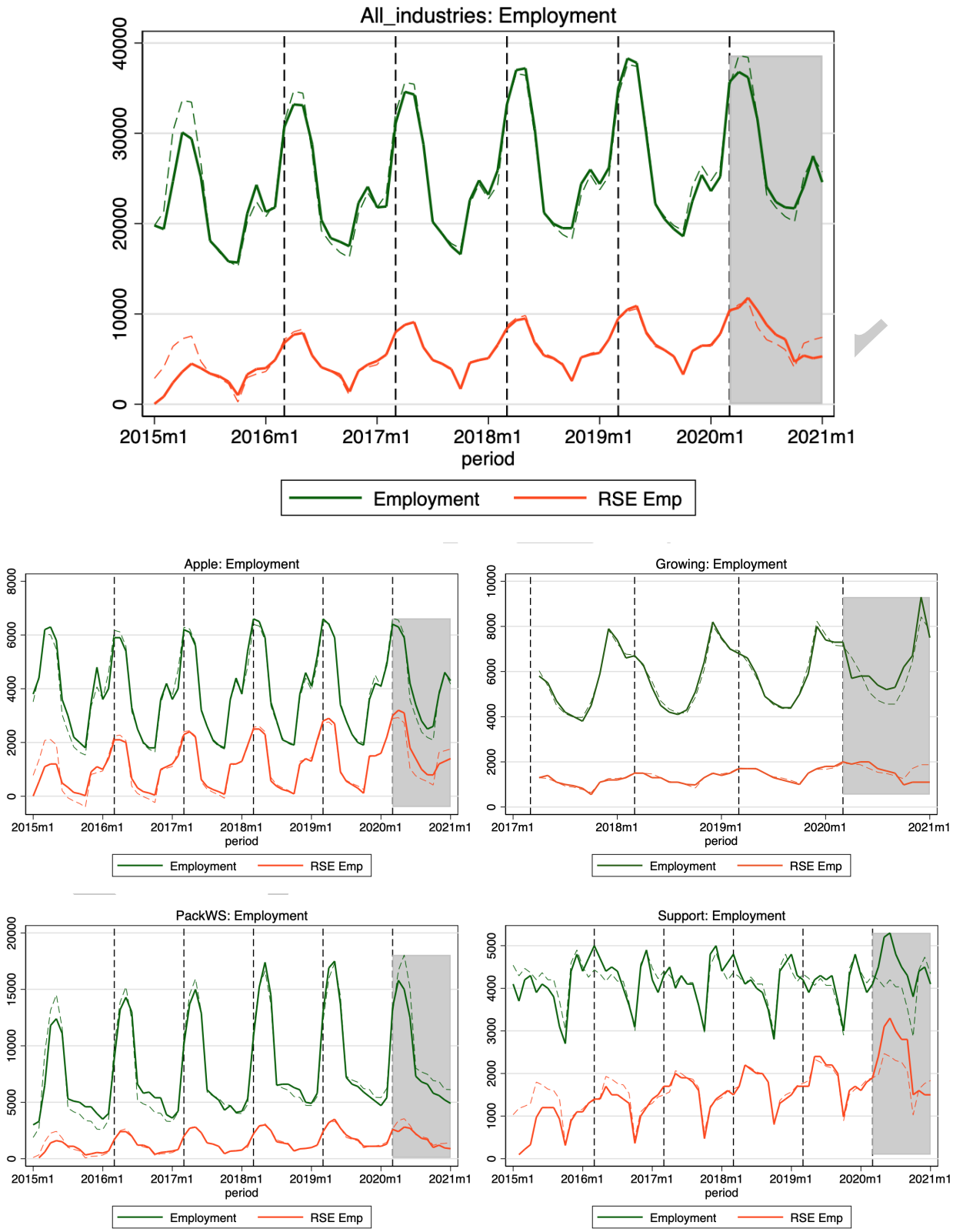
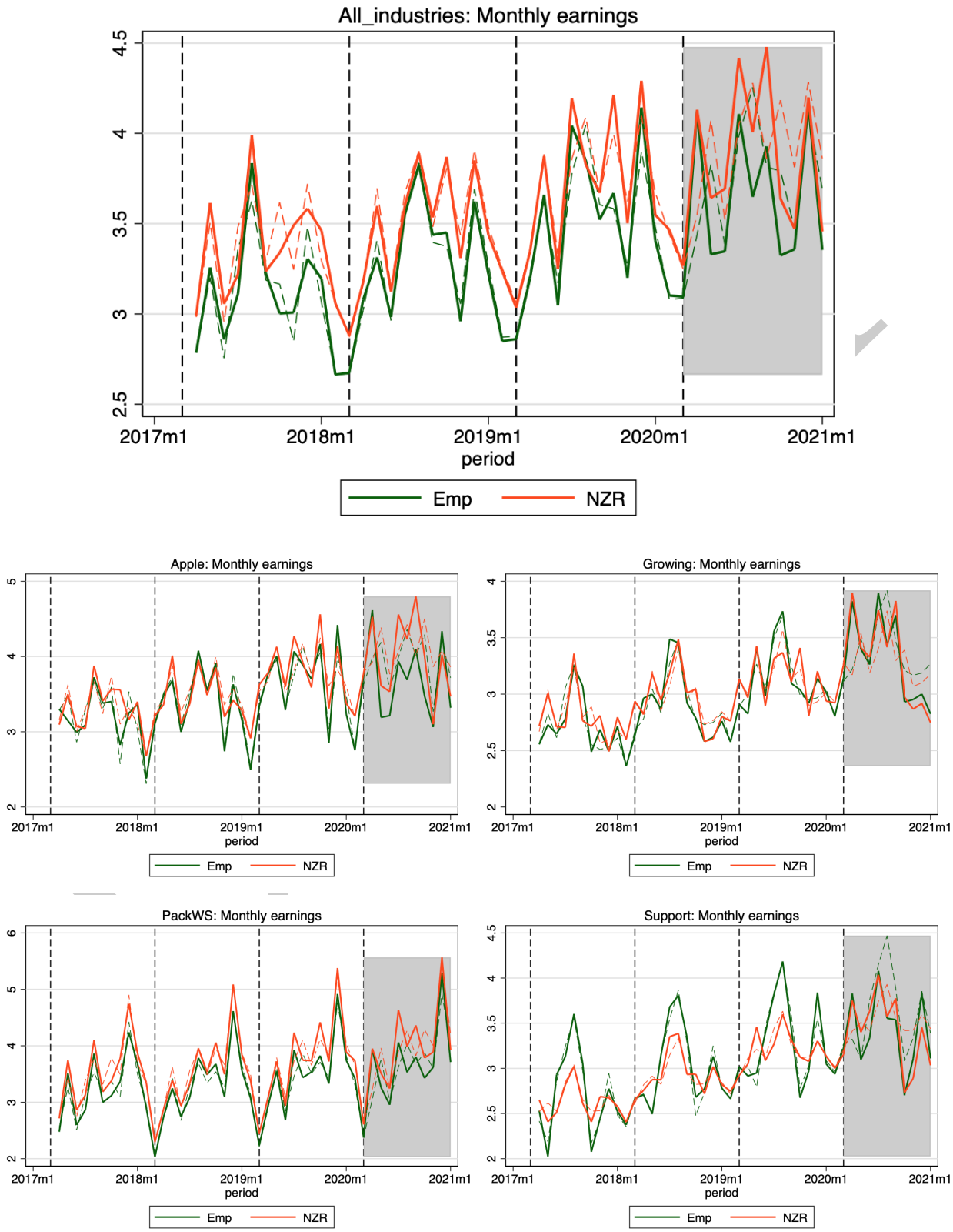


Figure 5: Average monthly earnings per worker (NZD(000))



4.3 Value added

Figure 6 plots the time series figures of GST sales, purchases, and a measure of net profit (sales - purchases - wagebill). Data are plotted at the quarterly frequency.[28] Figure 6 shows that sales, purchases, and profits track the predicted values in the COVID period fairly closely. Purchases in the packing and wholesaling industry are somewhat higher than predicted in the final months, when overall employment was lower than predicted. It is possible that delayed effects, from sales of produce produced in the 2020-2021 agricultural season (starting from August 2020) may not yet appear in the figures.

4.4 Overview

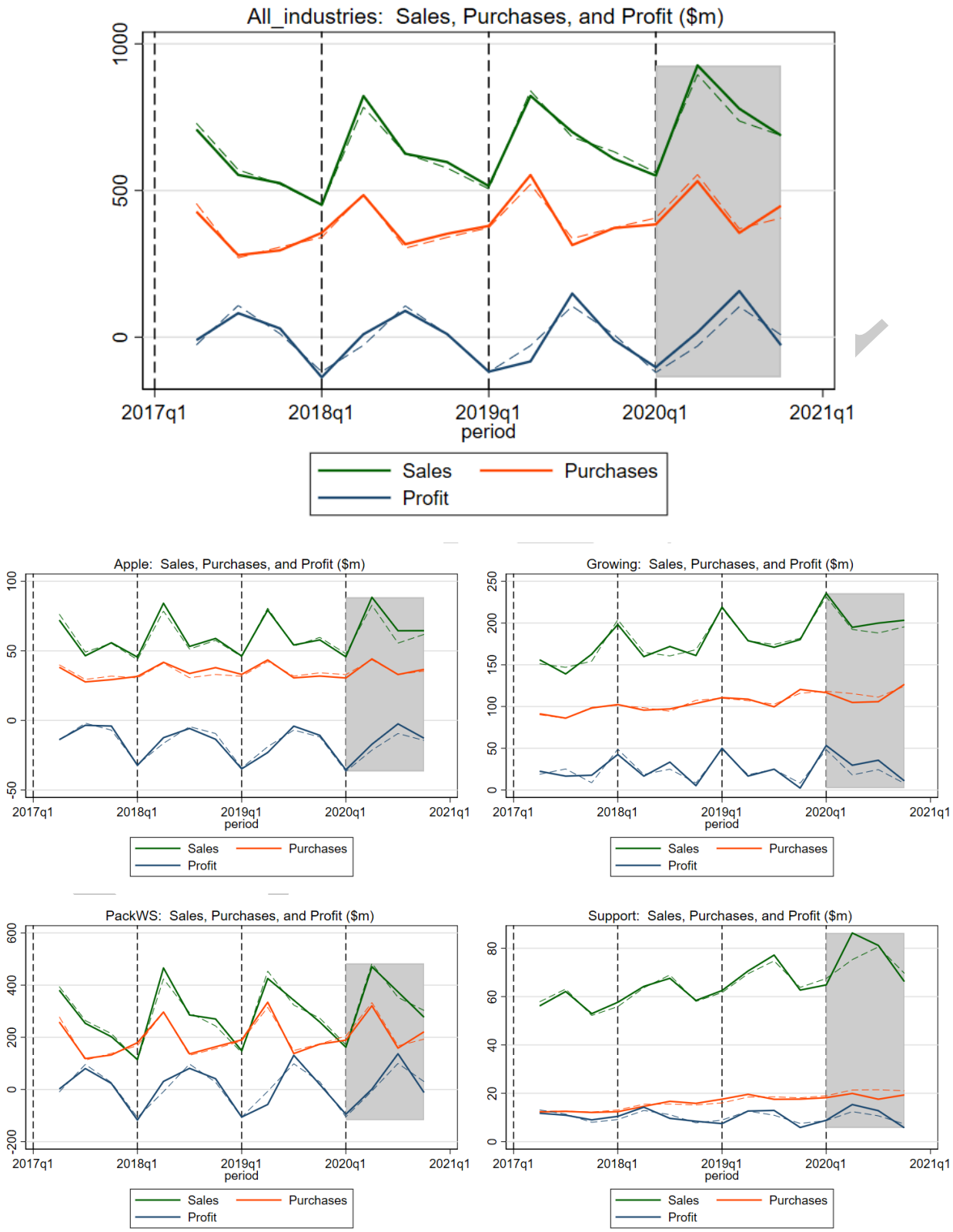
The figures above suggest that, on average, the horticulture and viticulture sector shifted away from employing RSE and WHM during the border closure and instead employed more NZ residents. However, we see very little change in the average wages paid to workers, or in the sales, purchases, or profitability of firms. The overall trends may be reflecting both aggregate changes – the impact of the COVID shock on the entire sector – and not only the direct impact of the border closure. To address this challenge, we now consider a subset of the sector where we can cleanly identify firms that were more and less exposed to the migrant shock. We do this by studying firms that were expecting to hire RSE very close to the March 19 shutdown date. This comparison group allows us to isolate the impact of the border closure, holding constant the other broader impacts of COVID.

5 Firm level exposure to the RSE shock

While the results in Section 4 are suggestive of the changes in the sector overall due to COVID, they cannot separate out the impacts of COVID overall from the impacts of having fewer RSE workers. In this section we focus in on a subset of firms from which we can construct comparable "treatment" and "control" groups to isolate the impact, at the

[28] We provide the monthly figure in Appendix Figure 4.

Figure 6: Sales, Purchases, and Profit (NZD(m) per quarter)



firm level, of having fewer RSE workers arrive. We do this by using information on the usual timing of arrivals and constructing a firm-specific exposure measure based on the number of workers expected to start before 19 March 2020 (and, hence, arrive before the border closure) with those expected to arrive after 19 March 2020 (and, hence, not arriving in the country). Because both "treatment" and "control" firms are operating in the same economic environment, both are exposed to the overall economic conditions. This thus lets us isolate the impact of fewer RSE only. We restrict our analysis in this section to firms that were expecting to hire RSE migrants within 30 days of the March 19 border closure.

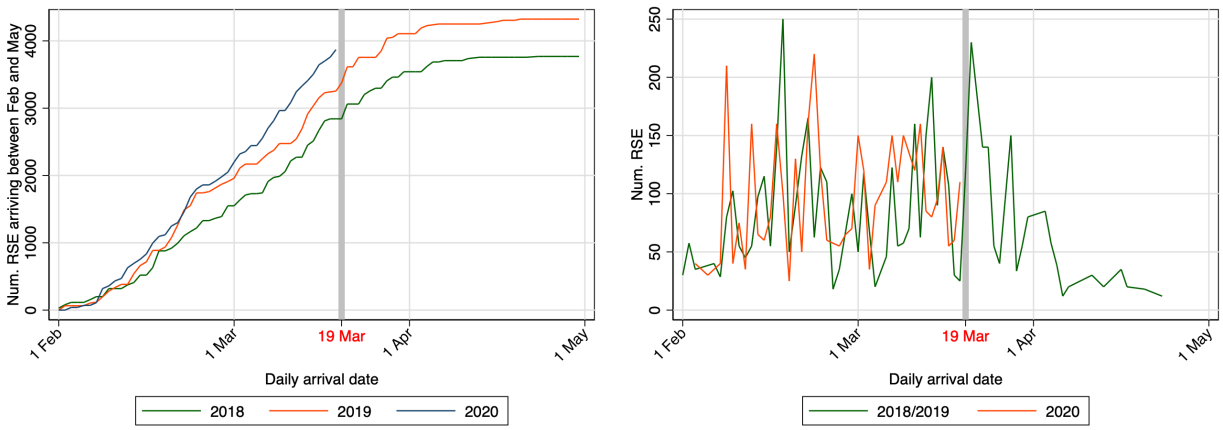
We use information on the arrival dates of all migrants who were working at a firm one year prior to the COVID lockdown, i.e., employers who were working in the window around March 19, 2019. Our identification strategy is to look at firms that usually hire workers who arrive around March 19 each year. We will then compare firms where their workers usually arrive *before* March 19, and so their workers should have arrived before the lockdown, to firms where their workers usually arrive *after* March 19, and hence they faced a labour shortage because of the lockdown. The key identification assumption is that the date of arrival around this small window is exogenous to firm outcomes.

For the period between 1 February and 1 May, approximately 65% of RSE arrivals arrive before 19 March each year. Figure 7 plots the cumulative arrivals for 2018 and 2019 (left panel)[29] and the daily arrivals (averaged for 2018/2019) on the right panel. Before the COVID border closure, RSE arrivals for 2020 were closely tracking the same arrival patterns as the previous two years. With cumulative arrivals of 4,000 by mid-March representing an estimated 65% of arrivals, this implies that the border closure prevented around 2,150 RSE workers from entering New Zealand between March and May.

Which firms were exposed? Table 3 summarises the distribution of the measure that we use as an instrument for exposure to a shortage of RSE workers. We group firms by the number of RSE arrivals in a 30 day window either side of March 19, 2019. We then show,

[29]The RSE cap increased 12% from 12,850 in November 2018 to 14,400 in October 2019. This explains the shifting up lines in the figure. It also implies that firms where migrants arrived in time received the higher level of migrants they were expecting due to the increase in the cap, where firms where workers did not arrive in time did not receive migrants at all.

Figure 7: Daily and cumulative arrivals of RSE workers



within group, the mean and median number of RSE arrivals after March 19, 2019 ("late arrivals"). On average, a firm with between 1-7 RSE workers arriving in March 2019 had 80 employees, 27 RSE workers, and 3.3 RSE arriving in March. Of these 3.3, approximately half (1.83) arrived after March 19, and half arrived before. The largest firms, with more than 50 arrivals in the March window, employed an average of 900 employees and had one sixth of their 300 RSE arriving after 19 March. Overall, the 87 firms in our analysis sample cover 1,500 of the total 2,150 late arrivals.

Table 3: Distribution of instrument (by number of arrivals around March 2019)

	Num. firms	Mean employees	Mean RSE	Mean arrivals	Mean late arrivals	Med employees	Med RSE	Med arrivals	Med late arrivals
01-07	24	79.2	27.1	3.33	1.88	67	14	4	1
08-19	24	116.7	33.3	12.5	5.42	70	26	14	5
20-50	21	214.3	61.9	32.9	9.52	148	49.5	30.5	1
51-500	21	900	300	152.4	47.6	569.5	247	126	8
TOTAL	87	323.0	104.6	48.3	17.2	122	42.5	17	1.50

Notes: Data is for firms with at least one RSE arrival within 30 days of 19 March 2019.

The key assumption for the timing to be used as an instrument is that there are no individual-level or firm-level characteristics that are correlated with the the timing of the RSE arrivals. Possible concerns are that larger firms might have either more RSE workers arrive earlier in the season; may have better RSE workers arrive earlier in the season to train to supervise newer RSE workers, or that earlier arrivals are geographically clustered relative to firms with later arrivals. To check whether we have balance on firm characteristics, we run regressions testing whether the probability that the firm has later arrivals is a function of its baseline employment, earning, and wagebill. We run the following

regressions on baseline data in January 2019 for the sample of firms that have any RSE arrivals in the 30 day window:

$$Y_i = \beta \mathbb{I}(\text{number of late arrivals} > 0) + X_i + \epsilon_i$$

where X_i controls for lagged January 2018 values and/or industry fixed effects.

The results of the balance tests are in Table 4. The first panel shows the results of regressing employment numbers, by type. There is no general pattern of imbalance across exposed and inexposed firms, but a few sporadic individual coefficients are statistically significant. Panel B shows the results of regressing average earnings on the exposure variable. We find slight evidence that firms with more exposure pay lower wages to NZ workers,[30] but only for the specifications without industry fixed effects. Panel C shows the results of regressing the total wagebill on the exposure measure. Results are balanced except for one specification (wagebill to RSE workers). Across the table, there is no consistent pattern of imbalance on baseline characteristics on the firm exposure treatment.

We now move onto studying the impact of the border closure on employment, wage bill, and firm profit. We compare the size and composition of employment for treated firms with those of non-treated firms. We run the following regression, for firm i, considering workers from visa group g:

$$\begin{aligned} E_{it}^{g} =& \alpha + \beta_t^{g1}\text{Number of late arrivals}_i + \beta^{g2}\text{Number of arrivals in window}_i \\ &+ \sum_{h=1}^{5} \gamma^{gh} E_{i,t-12}^{h} + \epsilon_{it}^{g} \end{aligned}$$

We estimate 6 employment equations - one for each type of employee and one for total employment. By including a common set of regressors, the coefficients in the total employment regression are the sum of the type-specific coefficients. The overall effect can thus be decomposed into contributions from each employee type. The estimation sample consists of all firms who were expected to employ newly-arrived RSE migrants within 30

[30] New Zealand residents in Table 4 have been separated into those observed with a permanent resident visa (PERM) and other New Zealanders (NZ).

Table 4: Firm-level balance tests

	(1)	(2)	(3)
Employment			
NZ	2.6	7.7	6.3
	(26.9)	(5.8)	(6.1)
Perm	3.2	0.5	0.7
	(2.7)	(0.7)	(0.8)
RSE	7.8	-2.8	-4.2
	(26.4)	(4.0)	(4.3)
Temp	1.2	-0.4	-0.8
	(1.3)	(0.5)	(0.6)
WHM	3.7	-3.0	-4.0
	(5.3)	(2.8)	(3.0)
Overall	18.5	-2.1	-4.4
	(48.4)	(9.5)	(9.7)
Earnings			
NZ	-483.5*	-332.2*	-303.0
	(219.6)	(158.3)	(169.3)
Perm	-414.8	-488.3	-461.0
	(359.3)	(342.6)	(364.9)
RSE	-164.9	-71.5	-165.2
	(272.1)	(283.2)	(298.2)
Temp	-14.8	-245.0	-268.1
	(419.3)	(424.4)	(484.6)
WHM	-308.3	-224.7	-200.3
	(226.4)	(196.2)	(206.6)
Overall	-262.7	-151.0	-166.3
	(196.0)	(146.7)	(160.7)
Firm wagebill			
NZ	8.8	0.1	-10.3
	(108.4)	(21.2)	(22.1)
Perm	8.8	0.2	-0.3
	(9.2)	(2.3)	(2.5)
RSE	13.9	-27.0	-47.8*
	(92.9)	(21.0)	(21.9)
Temp	1.1	-2.2	-3.3
	(4.3)	(1.9)	(2.0)
WHM	3.2	-5.1	-7.3
	(7.1)	(4.5)	(4.9)
Overall	35.8	-36.2	-70.3
	(170.9)	(37.2)	(37.9)
Include lagged value	X	✓	✓
Industry FE	X	X	✓

Notes:

days of the border closure (where expectations are based on the pattern of RSE arrivals around the 19th of March 2019). Furthermore, we restrict the estimation sample to include only primary-sector-related firms (excluding the 'Other' industry category), and include all monthly firm observations from April 2020 to January 2021.

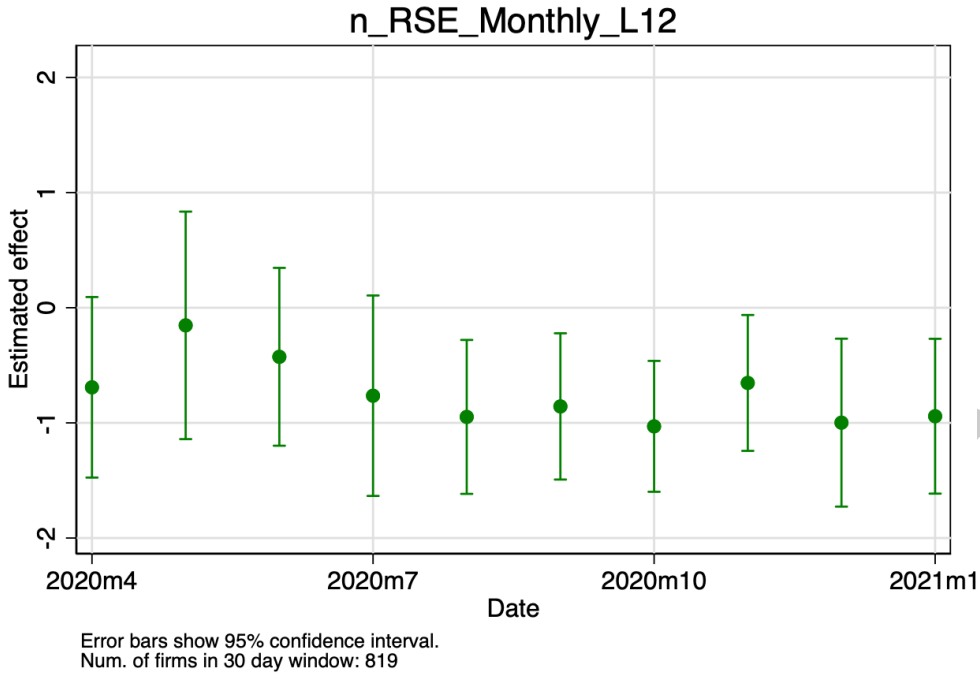
The next sections discuss each of our key variables – employment, wagebill and earnings, and profits. For each, we show the time-varying impacts of the effects. We then present a summary table showing the pooled impact estimated over the entire period.

5.1 Impact of border closure on labour demand

We start by considering the impact of the border closure on employment. Figure 8 plots the coefficient β_t^{g1} – the time-varying impact of having one additional late arrival – on the number of RSEs employed by the firm. We cannot reject a coefficient of -1, equivalent to saying that for every predicted late arrival, the firm had one fewer RSE worker employed. This is consistent with the strict enforcement of the border closure and the highly persistent timing of RSE arrivals at the firm level each year. The estimated coefficient is very stable through January 2021 – firms face a RSE shortage throughout the year.

Given the shortage of RSE workers, did this translate into a lower overall workforce, or were firms able to employ other workers? Figure 9 employs a parallel specification, plotting the impact of each missing RSE worker on the overall workforce and then the workforce split by visa category. The main result from these figures is that firms do not face an overall reduction in employment, despite having fewer RSE workers. The top panel shows that the coefficient is not statistically different than 0, suggesting that each missing RSE worker had no average impact on the total workforce. The bottom panel shows that each missing RSE working was initially replaced by a WHM, and then, from August, by a NZ worker (labelled as visa='NONE'). Firms were able to hire alternative workers in the labour market to replace the missing migrants.

Figure 8: First stage: Impact of each missing RSE on firm employment



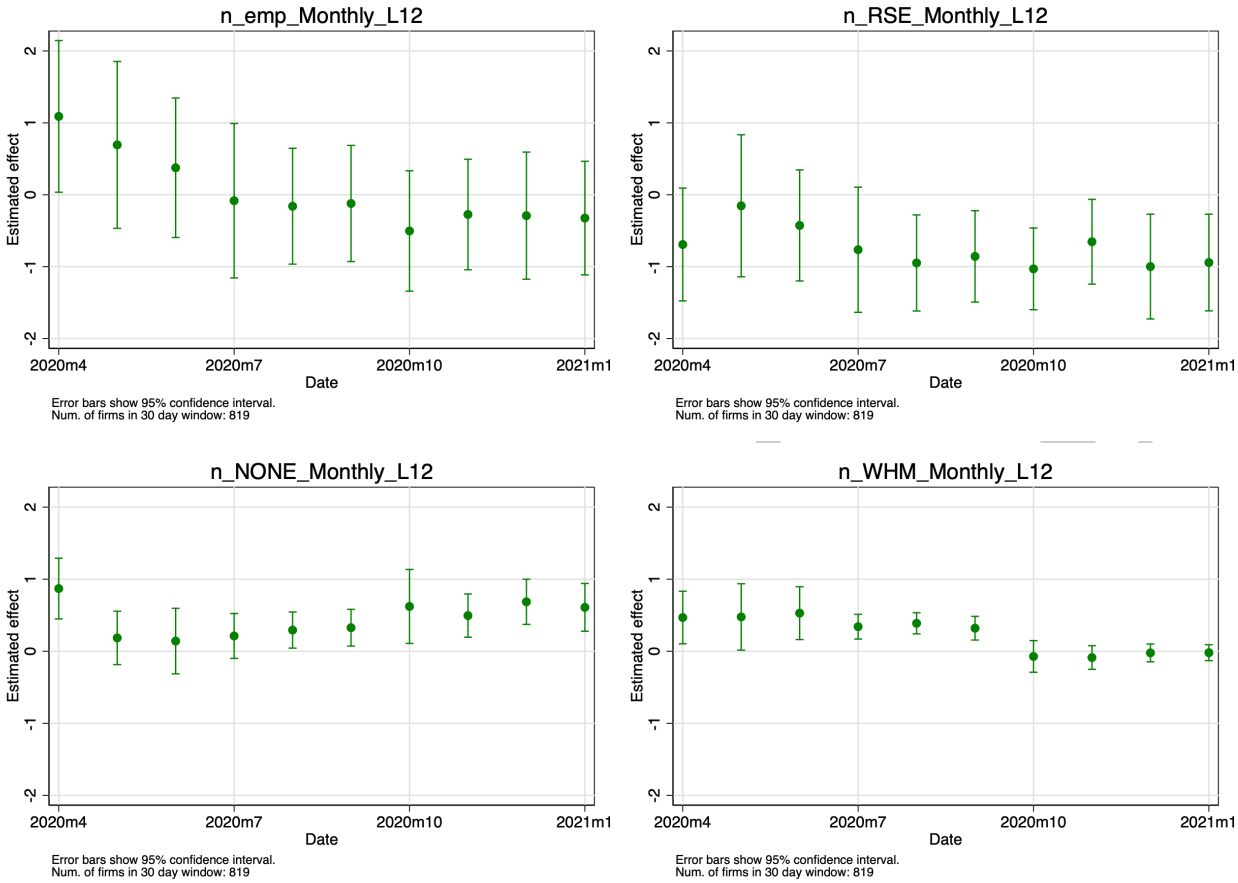
5.2 Average earnings

Despite having missing RSE workers, firms were able to hire alternative workers. We next consider whether this came at a higher cost – perhaps firms needed to pay workers more to attract workers.

We first caution that we observe total wagebill data, which combines hours worked and earnings per hour. An increase in the total earnings per worker could be the result of workers working longer; working harder (if paid by piecerate); being paid more (either a higher wage or higher piecerate); or a change in the selection of workers (for example, people who have different skill or effort levels).

We start by looking at the total wagebill of the firm. The top panel of Figure 10 plots the total wagebill, measured in thousands of NZD. We find no change in the overall wagebill at the firm level: it is not the case that firms that were missing RSE workers needed to increase total wagebill (which would present as a positive coefficient in the figures), for example. When we look at the figures per worker, we see a decrease in the wagebill paid

Figure 9: Composition of employment

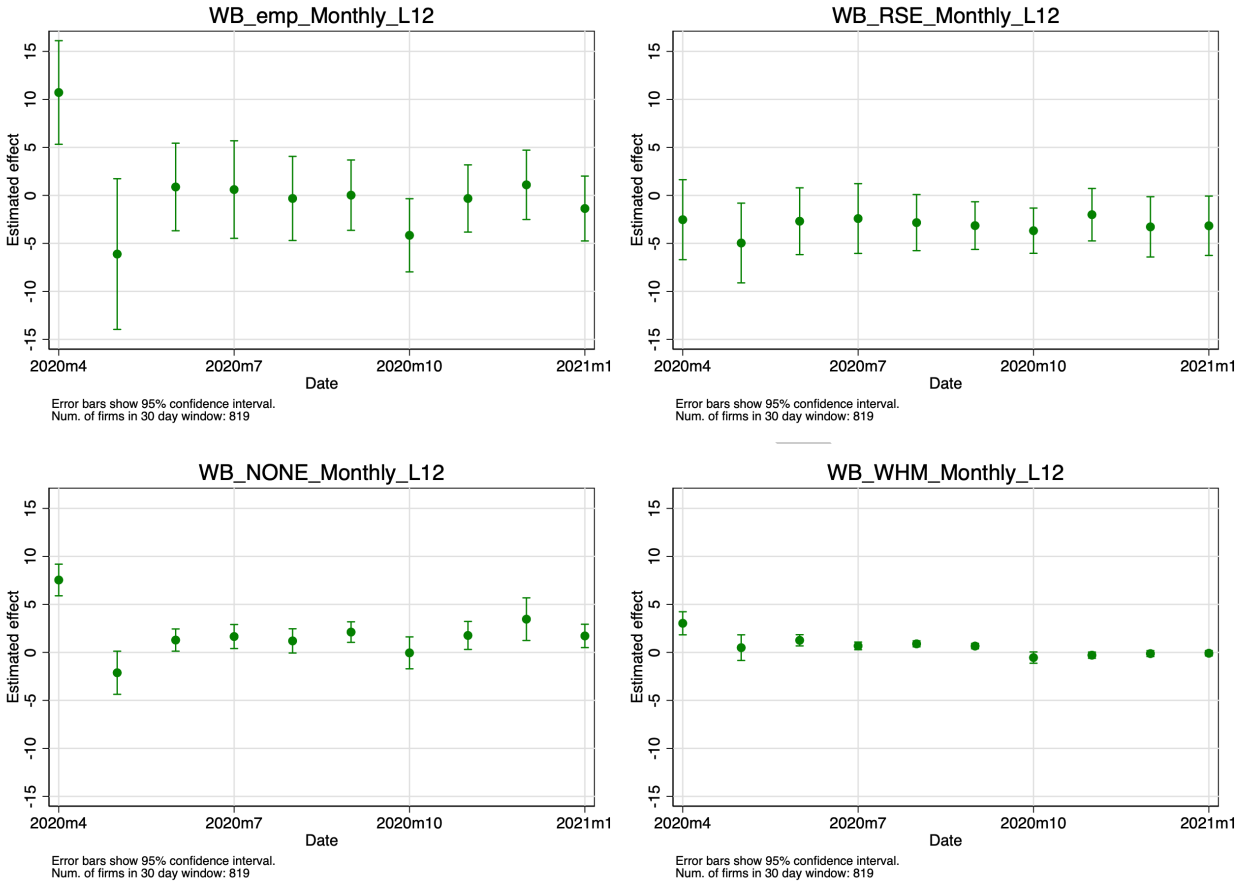


to RSE workers of approximately $3000 per month per missing RSE worker, which lines up very closely with the average earnings per RSE. We see increases in the wagebill paid to WHM and NZ workers as their labour shares increase.

There are several explanations for these results. First, any changes in average wages paid may have occurred at the labour -market, and not the firm, level. For example, if wages increased across the board for agricultural labour due to the shortage of workers, then we would not identify a differential wage effect in firms that were more exposed or less exposed to missing RSE workers. Second, it may be the case that wages did not increase – perhaps due to the specificity of the COVID shock, there were surplus labour available that did not need to be paid more to work. A third explanation, which we will consider in the following section, is that employers may have shifted from hiring labour directly to hiring labour through labour supply services. In this case, labour costs

would be a business expense and not appear in the wagebill directly. We will consider this channel explicitly when we look at firm profit.

Figure 10: Wagebill (NZD(000))

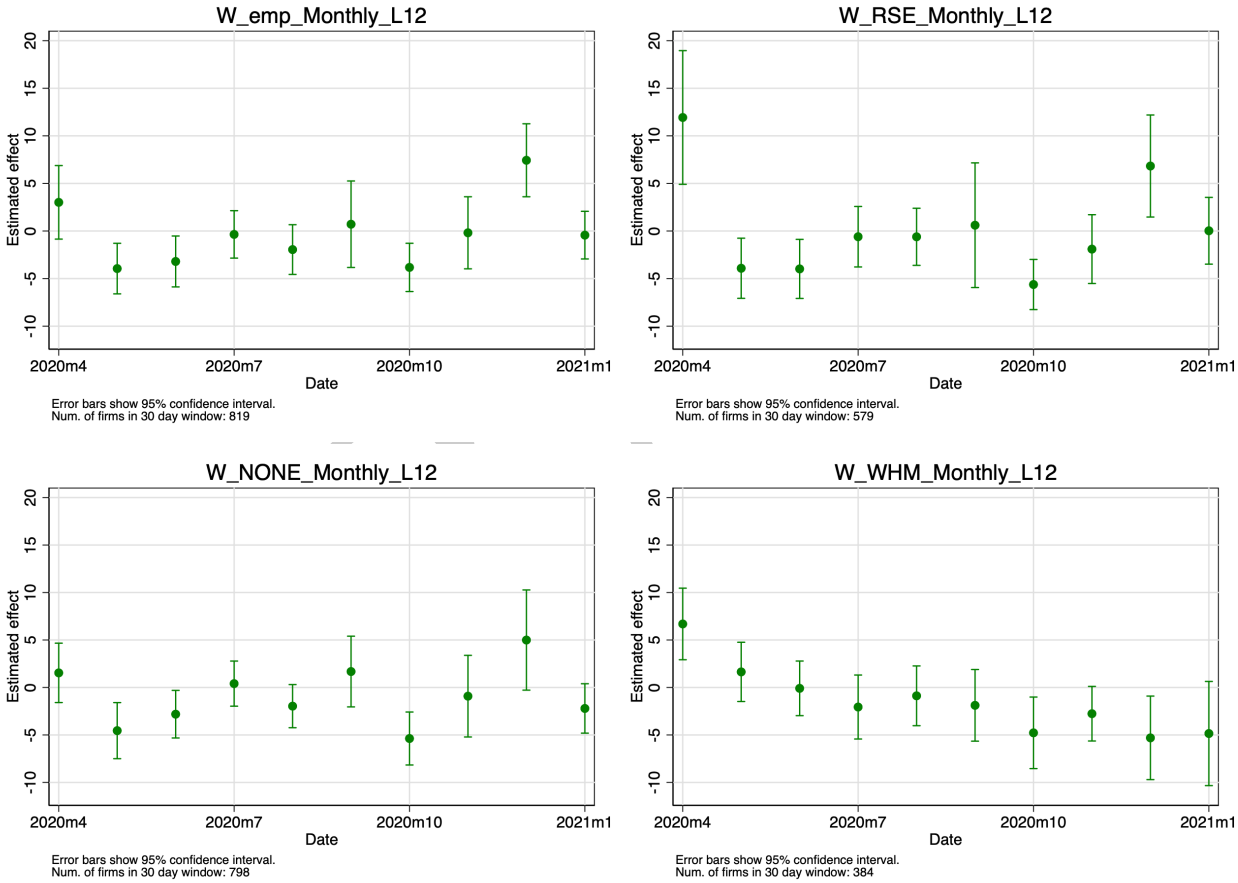


We next consider earnings per worker. Again, due to the reasons outlined above, any changes in this variable may represent either an effort margin (i.e., work harder or longer) or an increase in the amount paid per hour, in firms that are missing RSE workers compared with firms where more of the RSE workers arrived in time. Panel A shows the impact on the average earnings across all workers. For every missing RSE, we find that average earnings decreased immediately after the border closure and lockdown – in May/June 2020 – and then had close to zero impact for the remainder of the period, with the exception of December 2020 (close to the peak period of the 2020-2021 agricultural season) where firms that have missing RSE workers had increased average wage rates. Looking at the composition figures below, the increase in earnings in December 2020 is

due to an increase in earnings for both NZ and RSE workers (by that stage, many WHM had left the country).

Relative average earnings did not increase for firms that had a migrant shortage, consistent with either the wage rate being determined at the labour market level (i.e., not differentially by the firm's specific migrant shortage), no changes in hours or wages, or offsetting effects where e.g., experience workers worked more hours to compensated for newer workers working fewer hours, leaving the average unchanged.

Figure 11: Average earnings per worker (NZD per month)



5.3 Output effects

We now consider whether missing RSE workers lead to lower sales and profit for affected firms. To do this, we construct measures of the net value of firm value added, measured as GST sales less GST expenses. Panel A of Figure 12 plots the impact, per missing RSE, on net sales of the firm. We find no impact on net sales for the first six months after the COVID shock. However, from November 2020, relative net sales decrease. The magnitude of the effect is lower net sales of $50,000 per missing RSE worker from the firm.

Panel B and C repeat the analysis in terms of per employee and per dollar of wagebill. We see a similar pattern: little to no impact of missing migrants in the short-run, but longer-term effects of approximately $100 lower net sales (2% lower net sales per wagebill dollar) in the medium run. These numbers align with Figure 3 showing that there was only an aggregate RSE shortage from October 2020.

What is likely explaining the net sales effects? From Section 4, it appears that the net sales may be lower because of increases in purchases rather than a decrease in sales. One possible explanation is that firms increased their use of labour contracting firms instead of hiring labour directly.

5.4 Pooled analysis

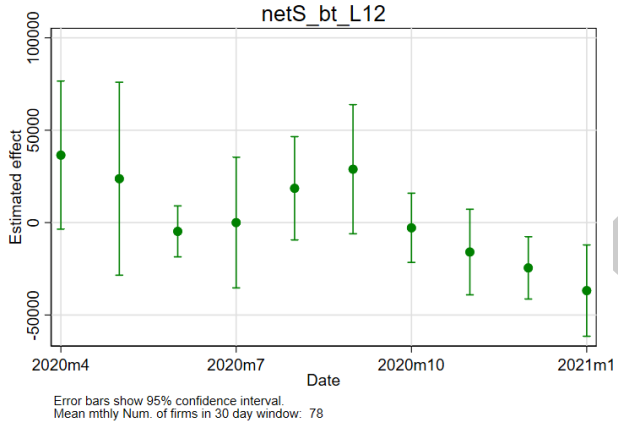
The above sections discussed each of the outcome variables in turn, showing the timing of the impacts. We now present an aggregated pooled effect, estimated over the full sample period from April 2020 to January 2021. To do this, we run the following regression, again at the firm-level, where we estimate one pooled coefficient β^{g1} average over the sample period.

$$\begin{aligned} E_{it}^{g} =& \alpha + \beta^{g1}\text{Number of late arrivals}_i + \beta^{g3}\text{Number of arrivals in window}_i \\ &+ \sum_{h=1}^{5} \gamma^{gh} E_{i,t-12}^{h} + \epsilon_{it}^{g} \end{aligned}$$

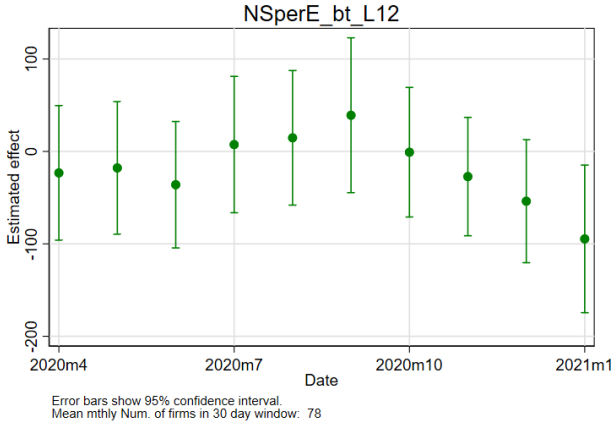
The estimates are shown in Table 5. Column (2) shows the regression coefficient on

Figure 12: Net sales (NZD per month)

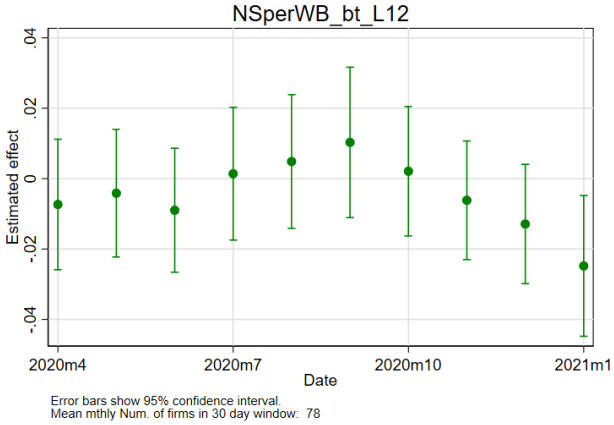
(a) Overall



(b) Per employee



(c) Per dollar of wagebill



β^{g1}, where each row is a separate regression. To aid with converting the regression coefficient into aggregate impacts, we include the baseline value, per firm, in column (1). Column (3) multiplies the regression coefficient, which is measured per late RSE, by the number of late RSE,[31] which is equivalent to yield the average impact at the firm level. Column (4) divides the average impact of the firm by the baseline value to give the implied percentage change.

Starting with Panel A, the employment results. We find that firms were able to fully substitute the missing migrants for other workers: the average firm had 21 fewer RSE, im-

[31]The average number of late RSE in Table 3 is 17.2. Overall, there are 87 firms in the analysis sample which had either late or early arrivals. However, 30 firms do not have any late arrivals and so are dropped from the calculation of average late arrivals, yielding 57 firms. Therefore, the average number of late RSE per affected firm is given by 17.2*87/57 = 26.25.

Table 5: Firm level outcomes: Employment, earnings, and net sales per wagebill

	(1) Baseline (2019)	(2) Regression (b/se)	(3) Avg. firm effect	(4) Percentage change
(A) Employment (number of workers)				
All	272.7	-0.0323	-0.848	-0.311
		0.339		
RSE	77.18	-0.784	-20.58	-26.67
		0.261**		
NZ	157.5	0.436	11.45	7.266
		0.127***		
Working holiday	26.88	0.218	5.723	21.29
		0.0791**		
Other temp	11.11	0.0974	2.557	23.01
		0.0285***		
(B) Monthly earnings (NZD per month)				
All	3522.3	-0.192	-5.040	-0.143
		1.317		
RSE	3636.4	0.152	3.990	0.110
		1.500		
NZ	3804.1	-0.848	-22.26	-0.585
		1.225		
Working holiday	1918.7	-1.278	-33.55	-1.748
		1.421		
Other temp	2613.9	-4.463	-117.2	-4.482
		1.954*		
(C) Net sales per dollar of wagebill				
All	1.514	-0.00457	-0.120	-7.923
		0.00887		

Notes: Each row represents a separate regression. Column (1) gives the baseline average (per firm) in 2019. Column (2) gives the estimated coefficient and standard error from the pooled regression. The coefficient is the coefficient per predicted late RSE. Column (3) converts the regression coefficient to the average firm impact, given that the mean exposure at the firm is 26.25 late RSE. Column (4) gives the implied percentage change. Significance stars in Column (1) indicate statistical significance.

plying that RSE employment declined by 27%, but the missing migrants were replaced by New Zealand workers (with employment increasing by 7%) and working holiday makers (with employment increasing by 21%, which was concentrated in the initial months on the pandemic).

Panel B considers average monthly earnings. We estimate small, economically insignificant effects on average wages, measured as average earnings per employee, in exposed firms compared to non-exposed firms. We estimate a change of 5 NZD (off a base of 3522 NZD per month).

Panel C considers the average productivity effects of the change in the composition of the firm's labour force. We find suggestive evidence of a decrease in productivity, with affected firms receiving 8% lower sales per dollar spent on wagebill. However, this result is statistically imprecise and is concentrated in the 2020/2021 agricultural season rather than an immediate impact in March 2020.

Overall, our results point to a situation where the migrant shock had limited economic impact at the firm level: firms were able to substitute towards alternative workers, did not increase wages to do so, but may have faced longer-term productivity losses as a consequence of the changed composition of the labour force.

5.5 Discussion

Our findings suggest that the NZ horticulture and viticulture labour market was able to adjust to the closure of the border and the absence of approximately 25% of the expected autumn arrivals of migrants. We find that firms where migrants did not arrive in time substituted the missing migrants initially for working holiday makers and then later for NZ workers. Average earnings per worker did not change. There is some evidence that firms faced lower sales in the subsequent agricultural season, perhaps suggesting that the aggregate labour shortages became more prominent at the time of harvesting, although we caution that our identification of these further-out events is less sharp as firms would have been expecting the second cohort of RSE arrivals and our identification focuses on firms most exposed to delayed March arrivals.

One important caveat to our results is that we are able to identify only relative, and not absolute, impacts. We compare firms that have fewer missing RSE workers to firms where their RSE workers arrived in time. Some adjustments, such as higher wages, may have occurred at the level of the labour market and not the firm. In this case, we would not find a firm-level impact on wages as both firms pay a higher wage, despite the wage increasing for the sector as a whole.

A second caveat is to consider whether these results apply more broadly than just during the case of COVID. COVID was an unexpected aggregate shock to the world, and likely affected much more than just labour demand and supply. We address this concern in several ways in our analysis. First, we are comparing firms in the same primary sector, so any common impact of COVID is similar for firms both with and without migrants. We focus on firms in the primary sector, where a high proportion of production is exported. These are sectors that faced (relatively) less of a demand shock due to COVID. A second consideration is that the COVID shock also had an uncertain time horizon. Our results on changing labour demand may reflect firms making only short-run decisions, rather than longer-run decisions such as increased mechanization. Likewise, on the labour supply front, NZ workers may have expected the shock to be temporary and so may not respond in the same way as if the labour demand shock were a permanent shock, especially if the work involved relocating. Additionally, while the border closure also affected the arrival of other temporary labour such as working-holiday makers, COVID did affect the NZ hospitality and tourism industries, a common employer of working holiday makers, potentially increasing the labour supply of working holiday makers in the country.

6 Conclusion

We study the impact of a sudden reduction in temporary agricultural workers, resulting from the unanticipated March 2020 border closure, on New Zealand firms. We construct exposure measures, at the firm level, by examining firm hiring patterns and linking employee data to immigration records.We identify firms that were expecting workers but the workers did not arrive before the border closure and compare these firms to other firms

where the workers arrived just before the border closure.

Our paper has four key results. First, we estimate that the border closure reduced employment of RSE by 27%. Second, despite the reduction of RSE, firms did not face a change in actual employment numbers: they were able to hire a combination of New Zealand and working holiday makers to substitute for the missing migrants. Third, we find no change in average earnings per employee. We estimate an economically (and statistically) insignificant reduction of NZD $5 per month for the average employee. This result suggests that affected firms did not adjust wages related to less affected firms to attract the additional workers. Fourth, we estimate that productivity, proxied by net sales per dollar of wagebill, fell by 8%, but caution that this result is not statistically significant.

Our results sugggest that NZ firms were somewhat resilient to the border closure – despite facing a large reduction of migrant workers, firms were able to employ other workers and did not increase wages to do so. These results paint a somewhat different picture than the strong media attention on the labour shortage arising from the border closure. One possible way to reconcile our results with the broader media debate is that despite being able to substitute missing RSE workers with domestic workers, there were additional productivity costs of doing so. Our negative productivity effects are concentrated in the latter time period, closer to the 2020/2021 agricultural season, which may suggest that the prolonged impact of fewer migrant workers led to increasing economic costs over time. The fact that there was strong employer demand to bring RSEs into the country in January 2021, despite the higher costs (paying the direct costs of MIQ as well as wages while workers were in MIQ) suggests that firms found value in employing RSE workers over other available workers.

We plan to extend the analysis in the paper in several ways. First, we presented suggestive evidence from a broader sample covering all firms in the sector that the overall productivity effect, measured by a reduction in net sales per employee, may be driven by an increase in firm purchases. We will extend this analysis to our smaller estimation sample of treatment and comparison firms. Second, it will be important to understand if there are specific margins that firms are adjusting on other than the labour force. We plan to explore complementary data sources, such as agricultural and trade data, to complement

the GST-based productivity measures. Finally, a limitation of the current analysis is that our estimates abstract from any sector-wide and economy-wide implications of the border closure. For example, if wage rates are adjusting at the broader labour market level rather than the firm level, then both more- and less- exposed firms would face the same wage rate change, but our estimation strategy would not find a differential impact on wage rates. We plan to explore variation across regions to investigate aggregate impacts of the COVID shock.

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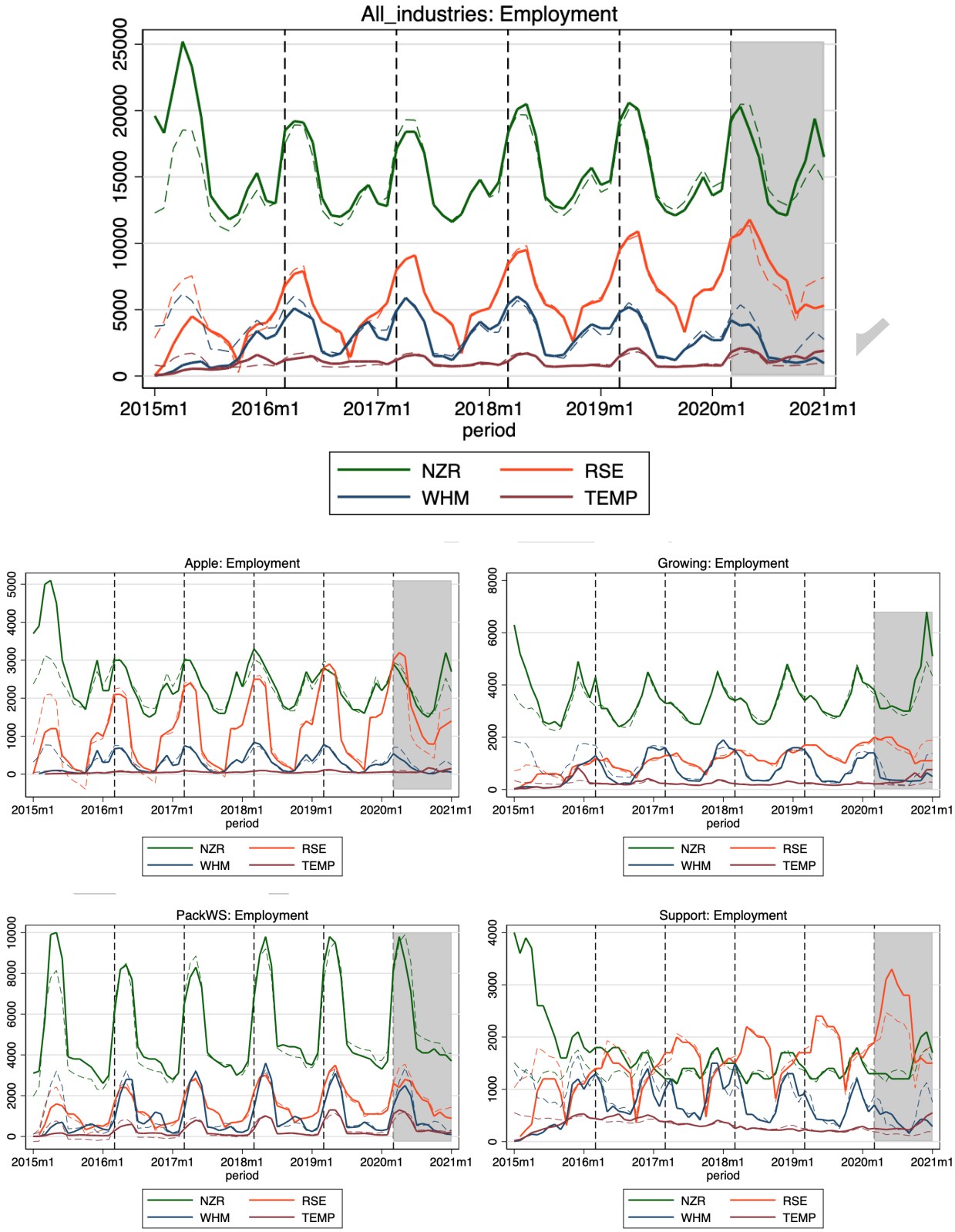
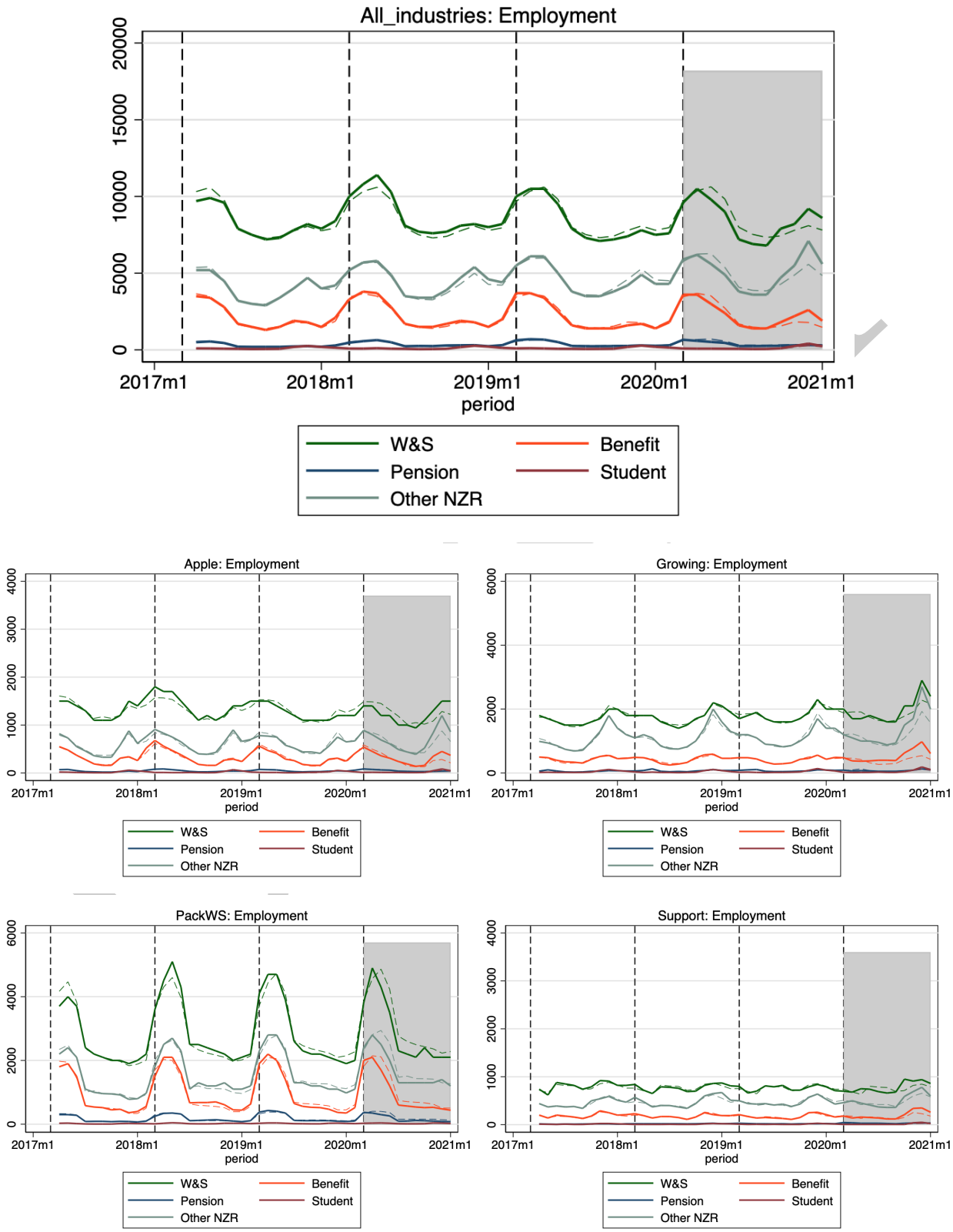
Appendix Table 1: Arrival Cohorts by industry

Industry	March_arrival_cohort	November_arrival_cohort	ratio
Apple	26522	41380	0.640
Growing	18429	30132	0.610
Other	8750	10119	0.860
PackWS	48750	21042	2.320
Support	28146	34460	0.820

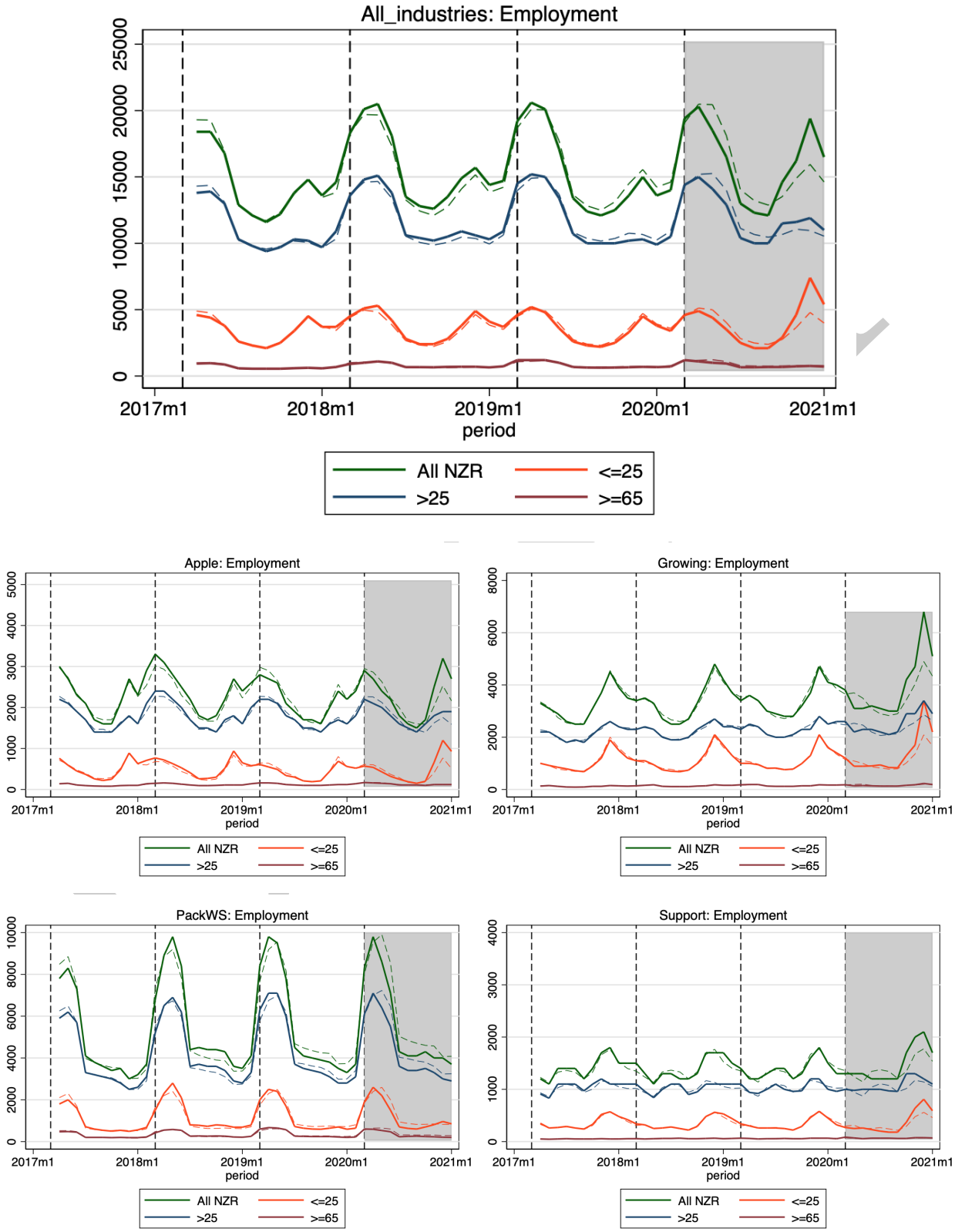
Appendix Figure 1: Employment by type



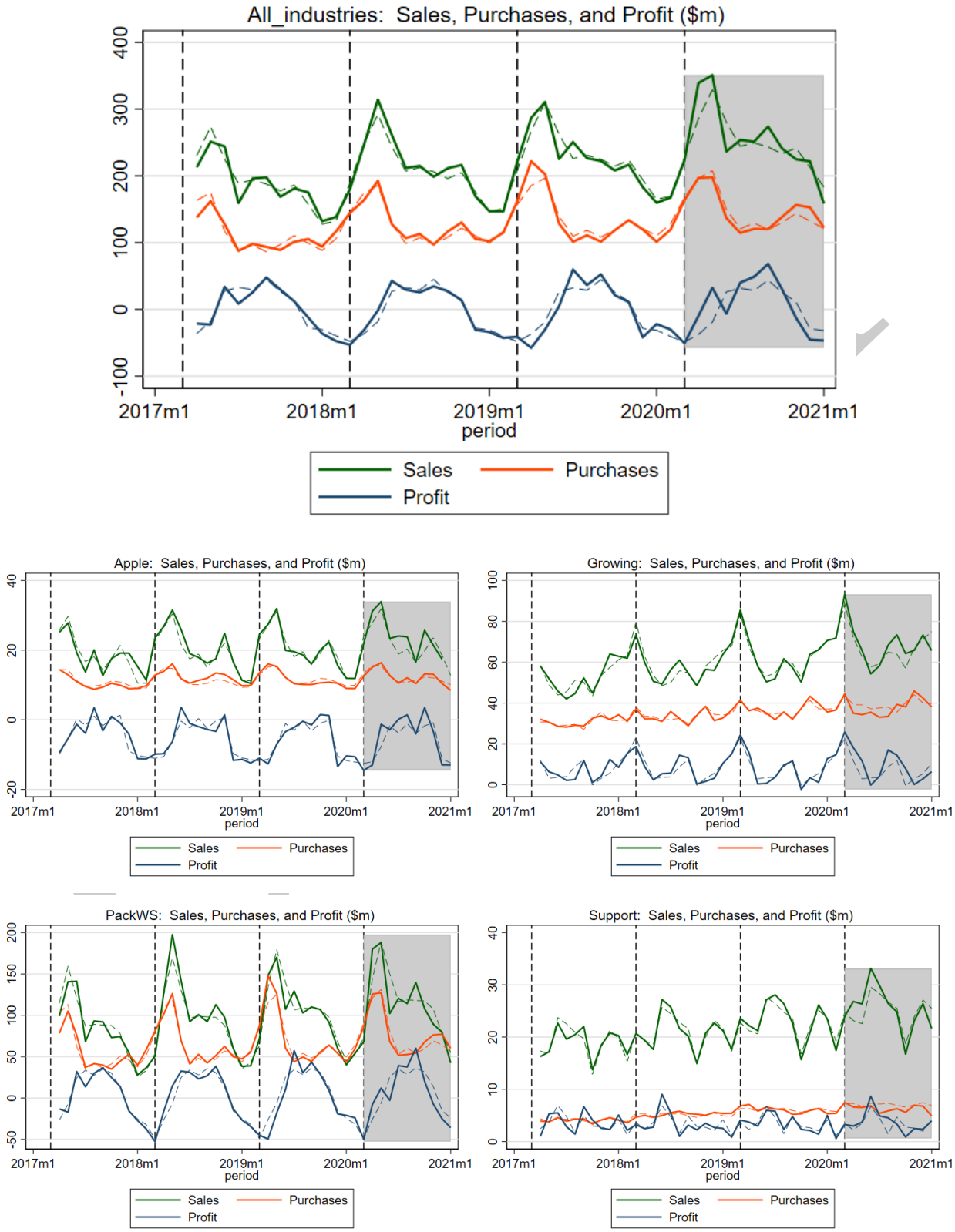
Appendix Figure 2: NZ employment by previous status



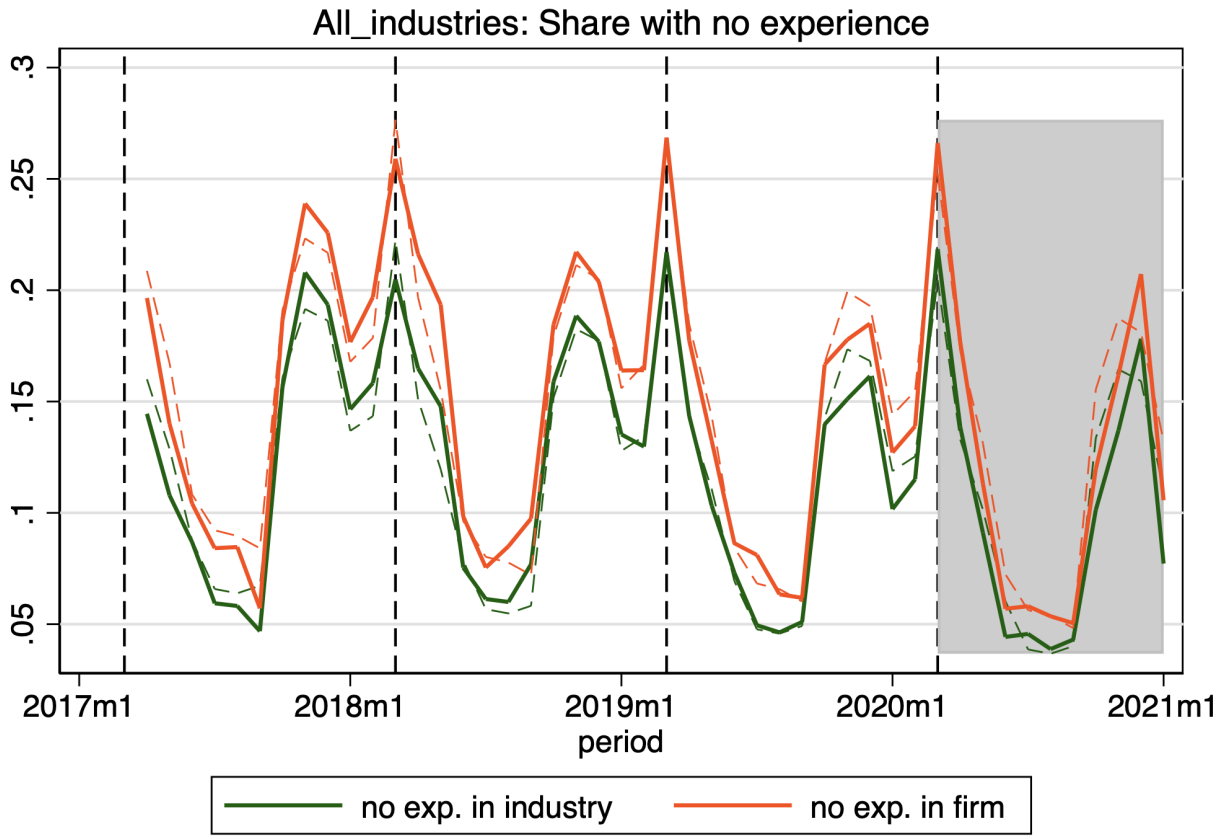
Appendix Figure 3: NZ employment by age



Appendix Figure 4: Sales, Purchases, and Profit (NZD(m) per month)

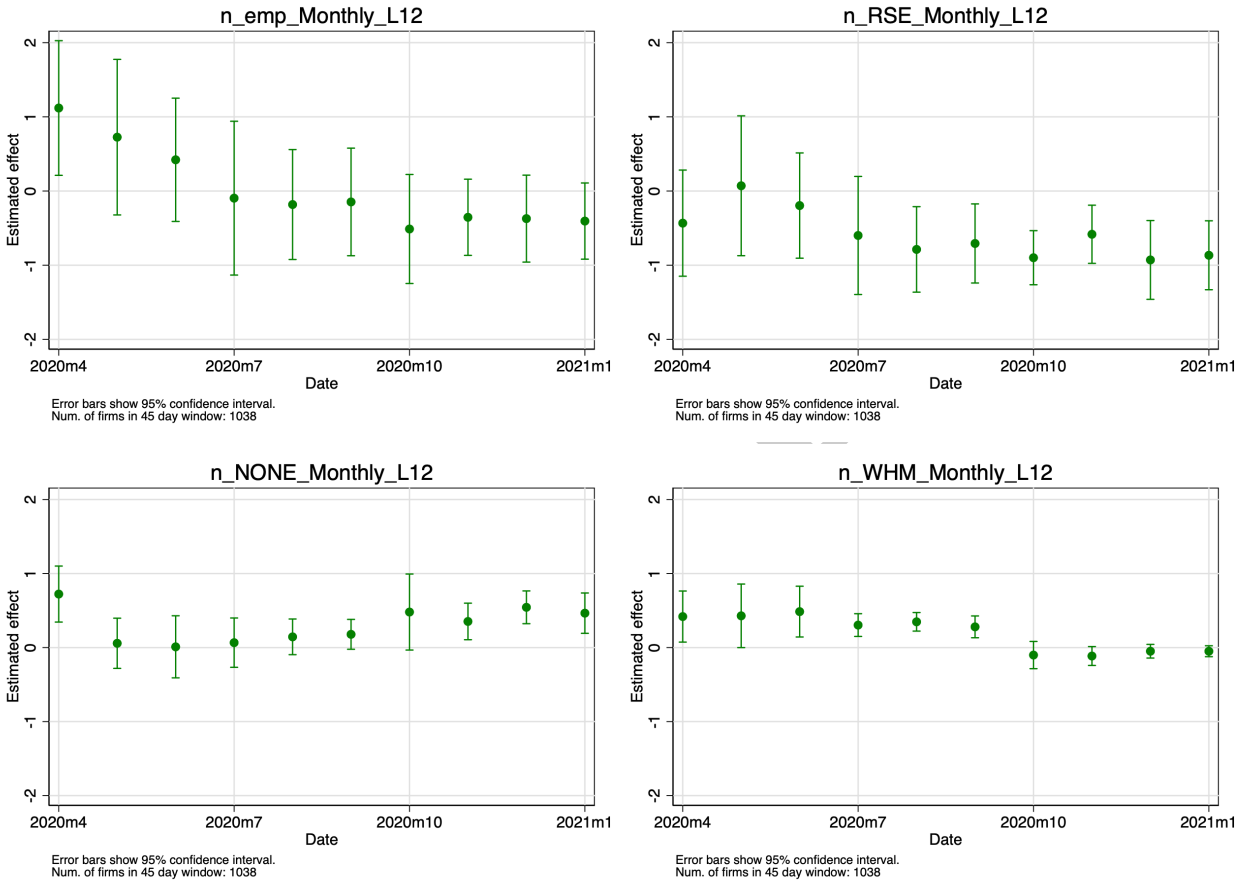


Appendix Figure 5: Share of workers without industry or firm experience

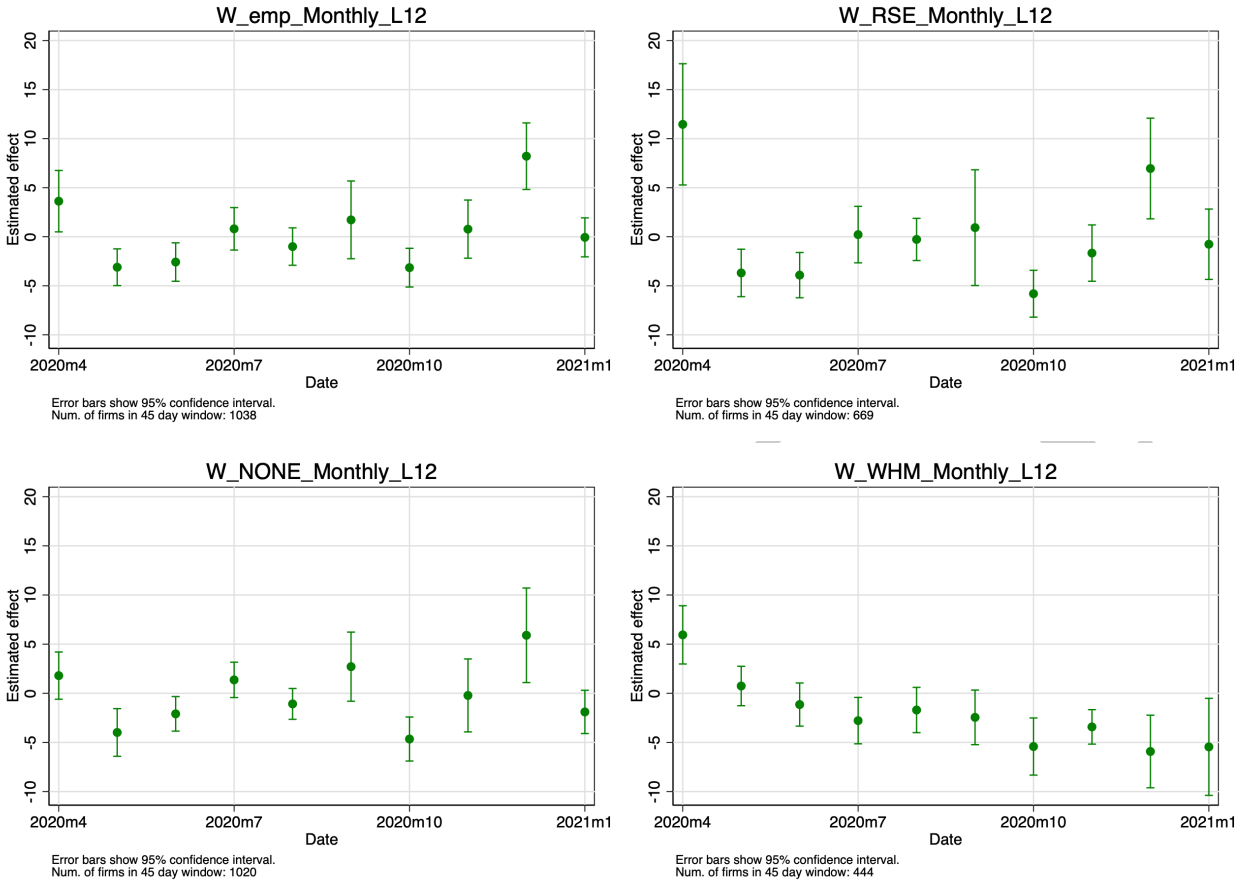


A Robustness: 45 day window

Appendix Figure 6: Composition of employment - 45 day window



Appendix Figure 7: Average earnings (NZD per month) - 45 day window



Appendix Figure 8: Wagebill (NZD(000) per month) - 45 day window