Disaster Recovery and Resilience

Shared Inquiry Program 2020

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THE IMPACTS OF NATURAL DISASTERS ON MAIN-STREET RETAIL AND SERVICES IN REGIONAL AUSTRALIA

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REGIONAL AUSTRALIA INSTITUTE

University of South Australia

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Executive summary

This study examined historic changes in the mix of main-street retail and service businesses in urban centres across regional Australia since 2006, and the impact of natural disasters on the evolutionary process. We focused primarily on the indirect effects of droughts, floods and fires. Following the outbreak of the COVID-19 pandemic, study scope was expanded to include potential impacts of the pandemic on these same sectors and businesses.

We utilized data from the Census over the period 2006-16 to examine how the mix of main-street retail services has evolved during this period across 176 mid-sized urban areas in Australia with populations between 5,000 and 50,000, as per the 2016 Census. We limited our attention to sub-sectors within the following two broad industry sectors, as defined per the 1-digit ANZSIC scheme: Retail Trade (G), and Accommodation and Food Services (H). Growth across sectors and sub-sectors was measured in terms of change in total number of jobs in the sector, total number of hours worked in a single week by all individuals employed in that sector, and total wages paid in a single week to all individuals employed in that sector. The incidence and intensity of droughts and floods was measured using data from the Bureau of Meteorology, and the incidence and intensity of bush fires was measured using data from the Water and Landscape Dynamics group at the Australian National University. To quantify the impacts of the COVID-19 pandemic, additional historic employment data was sourced from the Labour Force Survey conducted by the ABS, up to and including August 2020.

We summarise the key findings in Table 1. We find that growth has varied across different sectors and sub-sectors. Figure 1 plots change in net employment across these same sectors and sub-sectors, for both mid-sized and larger urban areas, over the periods 2006-11 and 2011-16. The food and beverage services sub-sector has been the fastest growing sub-sector. while the accommodation sub-sector has declined rapidly after 2011. Some retail sub-sectors have grown over time, namely motor vehicle and motor vehicle parts retailing, fuel retailing, and food retailing, but growth has been slow when compared to the broader economy. Other retail sub-sectors, such as furniture, floor coverings, houseware and textile goods retailing, electrical and electronic goods retailing, and recreational goods retailing, have declined sharply since 2011. The recent decline in these sub-sectors, and others such as accommodation, are concurrent with the emergence of online retail and rental platforms that have disrupted traditional businesses in these sub-sectors, and are likely reflective of broader structural changes in the economy brought about by technological advances.

To illustrate the impacts of natural disasters on this baseline evolutionary process, we use the example of a prototypical regional town with a total employed workforce of 20,000 individuals in 2006, and we simulate the impacts of different natural disasters on jobs growth across different sub-sectors over time based on our findings, as shown in Figure 2. In particular, we simulate five counterfactual scenarios of interest: (1) the town is completely unaffected by any natural disasters, including the COVID-19 pandemic; (2) the town is impacted by severe bush fires in the period 2006-11, such that on average roughly 10 per cent of the town's corresponding natural resource management (NRM) region is affected each year during this 5-year period (comparable in scale to the 2019–20 Australian bushfire season); (3) the town is impacted by severe droughts in the period 2006-11, such that on average roughly 20 per cent of the town's corresponding NRM region is in a state of drought each year during this 5-year period (comparable in scale to the Millennium drought); (4) the town is impacted by floods in the period 2006-11, such that the water level during this period was 1 metre higher than the historic average (comparable in scale to the 2010-11 floods in Queensland and the 2019 floods in Darwin); and (5) the town is impacted by the COVID-19 pandemic, adopting lockdown measures similar to elsewhere in the country.

The impacts of natural disasters are found to vary across sub-sectors. Interestingly, we do not always find that natural disasters have a negative impact on growth. In some cases, they are found to increase growth, due potentially to increased economic activity associated with reconstruction and rehabilitation. Analogous findings have been reported elsewhere in the literature. For example, Fomby et al. (2011) found that floods have a positive and statistically significant cumulative impact on GDP growth across both agricultural and non-agricultural sectors within developing countries.

In general, we find the impacts of droughts to be the greatest in terms of both the magnitude of impact, and the spread across different sub-sectors. Droughts have a negative impact on the economy as a whole, as well as specific sub-sectors, such as fuel retailing, due to a potential decline in the use of agricultural machinery, and recreational goods retailing, due to a potential decline in tourism. In some cases, droughts can also have positive impacts. For example, we find that droughts can increase growth in hardware, building and garden supplies retailing and clothing, footware and personal accessory retailing, due to potential relief and rehabilitation activities.

Compared to droughts, the impacts of other natural disasters are limited to fewer sub-sectors. In particular, bush fires increase growth in the fuel retailing sub-sector, due to a potential increase in demand to assist with evacuation and fire-fighting activities. Similarly, floods increase growth in the clothing, footware and personal accessory retailing sub-sector and the pharmaceutical and other store-based retailing, due to potential relief and rehabilitation activities. Across other sectors, the impacts frequently follow a V-shape or an inverted V-shape, where there is a disruption in growth in the sub-sector following the natural disaster, and the pattern reverses itself over the succeeding time period.

Similar to bush fires and floods, the impacts of the pandemic to date have also been limited to fewer sub-sectors. The motor vehicle and motor vehicle parts retailing sub-sector and the food and beverage services sub-sector have been the worst hit, losing more than 20 per cent of jobs due to the pandemic as of August 2020. This is not surprising, as these sub-sectors have been severely impacted by lockdown measures. Across other sub-sectors, the impacts of the pandemic have followed a V-shape, such that the number of jobs declined immediately following the onset of the pandemic, but year-on-year growth had returned mostly back to normal by August 2020. However, unlike droughts, floods and fires, the pandemic has not been localized or limited to specific regions, but has impacted all parts of the country. Consequently, the impacts have been greater at a national scale.

In conclusion, we find that the impacts of natural disasters on main-street retail and services sectors in regional Australia have been marginal in most cases, with deeper negative impacts usually limited to a few sub-sectors. Broader structural changes in the economy, brought on by technological advances such as the emergence of online retail and rental services, appear to have had a greater impact on the evolutionary process. This has resulted in the decline of multiple retail sub-sectors as well as the accommodation sub-sector. Concurrently, the food and beverage services sector has grown rapidly, and other evidence indicates that jobs growth in regional Australia is “expected to be driven mainly by the health care and social assistance industry”, and to a lesser extent, education and training (RAI, 2018). This will likely change the character of main-streets in regional Australia, as retail outlets and places of accommodation are gradually replaced by these new service centres.

From a policy standpoint, local leaders could ease this disruption through the design of appropriate employment support, retraining and upskilling programs that help those displaced in the retail and accommodation sub-sectors find gainful employment in growing sectors, such as food and beverage services and health care and social assistance. Additionally, local leaders could help revitalise main-streets by supporting existing and new

placemaking initiatives that generate further economic activity in these growing sectors. This could include improvements in street infrastructure, such as wider footpaths, al fresco dining options, public art installations, more trees, better lighting, etc., that support businesses in these sectors, as well as the organisation of local events such as Sunday Streets and Farmers' Markets that offer consumers access to the services that they most desire.

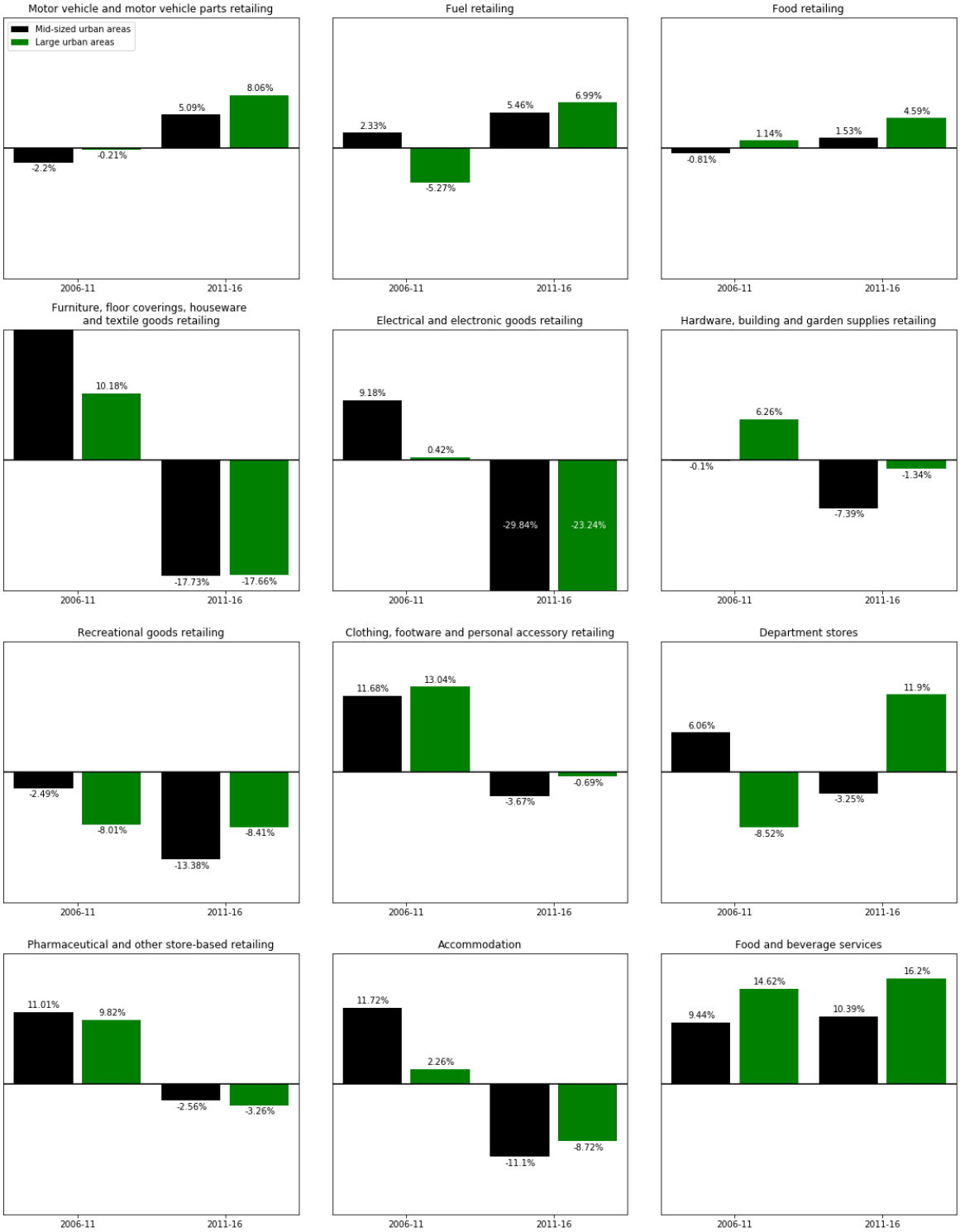

Figure 1: *Changes in the number of jobs across different industrial sectors and sub-sectors over time across mid-sized and large urban areas in Australia*

Table 1: *Summary of natural disaster impacts on main-street retail and services in regional Australia*

Industry sector	Baseline pattern of growth	Impacts of natural disasters			
		Droughts	Bush fires	Floods	COVID-19
Entire economy	Slow growing				
Retail trade					
Motor vehicle and motor vehicle parts retailing	Slow growing	-	-	-	Negative
Fuel retailing	Slow growing	Negative	Positive	-	-
Food retailing	Slow growing	-	-	-	-
Furniture, floor coverings, houseware and textile goods retailing	Fast declining	-	-	-	-
Electrical and electronic goods retailing	Fast declining	-	-	-	-
Hardware, building and garden supplies retailing	Slow declining	Positive	-	-	-
Recreational goods retailing	Fast declining	Negative	-	-	-
Clothing, footware and personal accessory retailing	Unclear	Positive	-	Positive	-
Department stores	Unclear	-	-	-	-
Pharmaceutical and other store-based retailing	Unclear	-	-	Positive	-
Accommodation and food services					
Accommodation	Fast declining	-	-	-	-
Food and beverage services	Fast growing	-	-	-	Negative

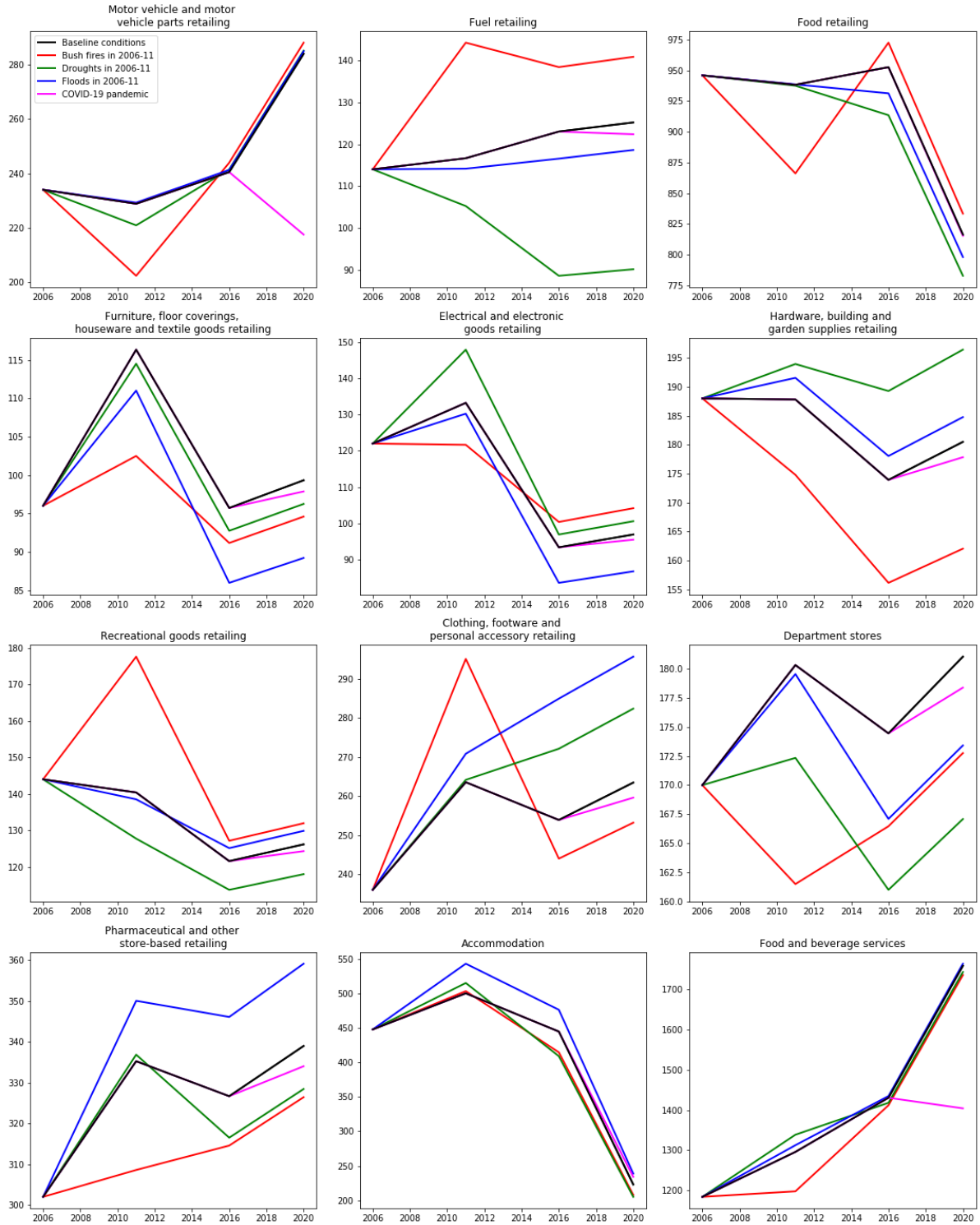

Figure 2: *Counterfactual analysis of growth in number of jobs across different main-street retail and service industries for a regional town with a total employed workforce of 20,000 individuals in 2006*

1. Aims and objectives

Natural disasters, such as droughts, floods and fires, impact economic activity directly through their effects on agriculture and related activities, and indirectly through multiplier effects on other sectors of the economy. For example, in their examination of the broader social impacts of drought on regional communities in New South Wales, Alston et al. (2004) find that impacts include "serious erosion of income for farms and small businesses, increasing rural poverty, increased workloads (both on-farm and off), the need to seek alternative income, health (including mental health) and welfare issues, problematic service access, overload on service providers, declining educational access and particular issues for women and men on farms, business operators, the aged, young people and children." Direct effects of natural disasters on agriculture and related activities has been studied extensively (e.g. Van Dijk et al., 2013), but indirect effects have not attracted as much attention.

This study has been undertaken in response to Regional Australia Institute's (RAI) project briefs developed as part of the 2020 Intergovernmental Shared Inquiry Program. In particular, this study attempts to answer the research question: **How is the business mix evolving in rural communities? Is the business mix evolving differently in places affected by disasters?**

This study focuses primarily on the indirect effects of droughts, floods and fires on non-farm retail and service businesses in regional towns across Australia. Given the unprecedented scale of impact of the ongoing COVID-19 pandemic on economic activity across all industrial sectors, including non-farm retail and service businesses, we have expanded our study objectives to discuss what our findings imply for the resilience and recovery of these businesses during and after the pandemic.

This research will aim specifically to answer the following five research questions:

1. How has the mix of main-street retail and service businesses in urban centres across regional Australia evolved over time?

2. What has been the net effect of natural disasters, namely droughts, floods and fires, on the evolutionary process?

3. How have these effects varied across different sub-sectors within the broader retail and services sector?

4. How have these effects varied across different natural disasters? Is there a difference in business response to droughts, floods and fires?

5. How are these effects likely to compare and contrast with the potential impacts of the COVID-19 pandemic?

The remainder of this report is structured as follows: Section 2 reviews previous research that has examined the impacts of natural disasters on different industrial sectors. Section 3 examines how the mix of main-street retail and service businesses in urban centres across regional Australia evolved over the period 2006-16. Section 4 describes our approach to measuring the incidence and intensity of droughts, floods and fires. Section 5 brings these different datasets together to examine the impacts of different natural disasters on main-street retail and services across regional Australia. Section 6 extrapolates our findings to discuss how businesses are likely to be impacted by the ongoing pandemic in the long term.

2. Review of impacts of natural disasters on main-street retail

Natural disasters, such as droughts, floods and fires, impact economic activity directly through their effects on agriculture and related activities, and indirectly through multiplier effects on other sectors of the economy. These indirect impacts are potentially more severe in small and mid-sized urban areas in regional Australia. As Levantis (2001) writes, "Expenditure by farm families in country towns across Australia is an important source of income for many nonfarm businesses. Service industries like retail and wholesale trade, transport and storage, finance and machinery repairs are all affected by farmers' spending patterns… Generally, the greater the reliance of a town's economy on expenditure by farmers, the lower the population growth in those towns." Consequently, reductions in farming incomes and, by association, farmers' spending patterns, as arising from the impacts of natural disasters on the agricultural sector, are likely to have negative ramifications for other sectors of the local economy in these regions, and these ramifications are expected to be particularly deleterious for smaller towns.

As mentioned previously, the direct effects of natural disasters on agriculture and related activities has been studied extensively (e.g. Van Dijk et al., 2013). More generally, the cumulative impacts of natural disasters on all economic activity, as measured through changes in GDP and related indicators, have also attracted considerable attention (e.g. Kousky, 2014). However, studies that have focused specifically on measuring and quantifying the indirect effects of natural disasters on one or more spheres of economic activity, other than the agricultural sector, are rarer in the literature.

Quantitative studies that have sought to measure these indirect impacts have typically used one of two approaches. The first stream of literature has compared economic outcomes in areas impacted by natural disasters against comparable areas that were not impacted. Some studies within this stream have relied on primary data collection exercises. For example, Edwards et al. (2009) conducted a CATI survey of 8,000 respondents in regional and remote Australia to assess the economic and financial impacts of drought. Respondents were sampled from both areas and industrial sectors that were and were not directly affected by the drought. However, the study did not find a clear link between drought and financial hardship for those employed in non-agricultural sectors.

More frequently though, studies within this stream have relied on analyses of secondary data, usually collected by government agencies such as the ABS and their counterparts in other jurisdictions, due primarily to the lower costs of undertaking such studies (see, for example, Fomby et al., 2011; Hsiang, 2010; Leiter et al., 2009; Loayza et al., 2009; Ewing et al., 2003; for a comprehensive review of this body of work, the reader is referred to Kousky, 2014). For the same reason, this is the approach adopted by the present study as well. Consequently, our research hypotheses and analyses are necessarily constrained by the information that is available in existing datasets, and the approach does not offer the same degree of flexibility as would be afforded by a primary data collection exercise.

Most of these studies find that the impact of natural disasters on the retail sector is negative and statistically significant, though they may disagree in terms of quantifying the magnitude of this impact. For example, in their analysis of employment growth and stability in Fort Worth, US before and after a 2000 tornado, Ewing et al. (2003) found that the retail trade sector experienced a significant decline in employment growth of 4.7 per cent in the post-tornado period. In their analysis of the impacts of different natural disasters on real output growth across 94 countries over the period 1961-2005, Loayza et al. (2012) find that only floods have a statistically significant negative impact on the growth of services, including but not limited to the retail trade sector, and the impact is worse in developing countries than developed countries. In their analysis of the impacts of increasing surface temperatures on economic output across 28 Caribbean-basin countries, Hsiang (2010) find that an increase

in surface temperatures by 1°C decreased total domestic output in the wholesale, retail, restaurants and hotels sector by 6.1 per cent, almost an order of magnitude greater than the corresponding impact on the agriculture, hunting and fishing, where total domestic output is predicted to decline by 0.8 per cent for the same change in surface temperatures.

The study by Fomby et al. (2011) is an interesting outlier among this body of work. The study examines GDP growth across both agricultural and non-agricultural sectors in response to four types of natural disasters: droughts, floods, earthquakes, and storms. Consistent with other studies in the literature, they find that droughts and, to a lesser extent, storms have a negative cumulative impact on growth in non-agricultural sectors across developing countries. In particular, droughts lower cumulative growth across these sectors and countries by 1.98 percentage points. However, they find that floods have a positive and statistically significant cumulative impact on GDP growth across both agricultural and non-agricultural sectors within these countries. “This may indicate that the potentially beneficial impact of floods on land productivity emerges in the subsequent harvesting cycle” (ibid.), with spillover effects on other sectors. However, the authors do not find any statistically significant impacts of natural disasters on the non-agricultural sector in developed countries.

A parallel stream of literature has tried to quantify the indirect effects of natural disasters through simulations using models of national and/or regional economies that explicitly model interdependencies between different sectors and regions of economic activity. Input-Output (IO) models and Computable General Equilibrium (CGE) models are perhaps the two most popular modelling paradigms used by these studies. For example, Pérez and Hurlé (2009) used an IO model of the Ebro region in Spain with 26 industry sectors to infer the indirect effects of the 2005 drought in the region. Similarly, Horridge et al. (2005) used a CGE model of the Australian economy with 38 industry sectors and 45 regions to simulate the direct and indirect effects of the Australian drought of 2002–2003.

While the IO model framework has low data requirements and is relatively easy to operationalise, it relies on a number of restrictive assumptions about economic activity. For example, IO models assume that each industry has a fixed input structure with no substitutability between inputs, changes in commodity prices are assumed to have no impacts on intermediate and consumer demand, and unlimited labour and capital are assumed to be available (Gretton, 2013). Consequently, IO models are at risk of overestimating these indirect impacts (Ding et al., 2011), and we do not employ them for the purposes of our analyses.

CGE models attempt to overcome some of these limitations to the IO model by, for example, allowing for more flexible patterns of input substitution, incorporating the effects of changes in price on intermediate and consumer demand, and including resource constraints. However, CGE models have significantly greater data requirements and require considerable effort to operationalise. In light of the high cost of building and operating a CGE model, we leave them as a tool for other future research on the subject.

3. The evolution of main-street retail in regional Australia

In this section, we utilize data from the Census over the period 2006-16 to examine how the mix of main-street retail services has evolved during this period across regional Australia, and how it compares to trends across metropolitan areas. Throughout this study, we limit our attention to the following two industry sectors, as defined per the 1-digit Australian and New Zealand Standard Industrial Classification (ANZSIC) scheme: Retail Trade (G), and Accommodation and Food Services (H). It is assumed that these two sectors comprise the majority of main-street retail and service businesses in most urban centres.

We examine how employment characteristics have varied within these sectors across 211 urban centres and localities (UCLs), as defined by the Australian Statistical Geography Standard (ASGS). Note that the geographical boundaries of UCLs have changed over time. We use the 2016 boundaries to define each UCL in our sample, and we use appropriate correspondences provided by the ASGS to ensure that the same geographic units are being compared over time. We define mid-sized urban areas as having populations between 5,000 and 50,000, and large-sized urban areas as having populations greater than 50,000, as per the 2016 Census. We have 176 mid-sized urban areas and 28 large urban areas in our sample, such that the former represent regional Australia and the latter represent metropolitan Australia.

We characterise employment in each industry sector and sub-sector in terms of the following three measures: (1) total number of jobs in the sector; (2) total number of hours worked in a single week by all individuals employed in that sector; and (3) total wages paid in a single week to all individuals employed in that sector. Unless otherwise noted, all data has been sourced from the 2006, 2011 and 2016 Censuses. Below, we summarise the major findings from our analysis:

1. The Retail Trade sector has declined in all urban areas between 2006 and 2016, though the decline has been greater in mid-sized urban areas than larger metropolitan areas, and the decline has accelerated after 2011.

    a. Food retailing; motor vehicle and motor vehicle parts retailing; and fuel retailing have all seen some growth during this period across regional Australia, though at a slower rate than other sectors of the broader economy.

    b. Number of jobs and hours worked in other store-based retailing have declined across regional Australia, and growth in total wages has been significantly lower than other sectors of the economy.

        i. Electrical and electronic goods retailing; furniture, floor coverings, houseware and textile goods retailing; and, to a lesser extent, hardware, building and garden supplies retailing; and recreational goods retailing are the worst performing sub-sectors within other store-based retailing across regional Australia.

        ii. For clothing, footware and personal accessory retailing; and pharmaceutical and other store-based retailing; number of jobs has increased across regional Australia, but hours worked have declined and growth in total wages has been average.

        iii. Department store retailing has seen substantial growth in total wages, and modest growth in number of jobs and hours worked.

2. The Accommodation and Food Services sector has grown across all urban areas between 2006 and 2016, though the growth has been slower in mid-sized urban areas than larger metropolitan areas, and the difference in growth rates has increased after 2011.

    a. For the accommodation sub-sector in regional Australia, number of jobs and hours worked have declined, and the decline has accelerated after 2011; total wages have grown, but at rates well below average.

    b. For the food and beverage services sub-sector in regional Australia, number of jobs has grown significantly, but growth in hours worked and total wages has been average.

In the sub-sections that follow, we discuss these trends with respect to each of the three measures of employment in greater detail.

3.1 Number of jobs

Table 2 enumerates the distribution of jobs within the Retail Trade and Accommodation and Food Services sectors and sub-sectors as a proportion of total employment for the 180 mid-sized urban areas in our sample over time. We have included all 2-digit sub-sectors within the Retail Trade and Accommodation and Food Services sectors. We have also included all 3-digit sub-sectors within the other store-based retailing 2-digit sub-sector. Given the emphasis of this study on retail mix, it is useful to decompose this sub-sector further. Note that the proportion of total jobs in the following three sub-sectors is less than 0.1 per cent, and we exclude them from any further analyses: Other store-based retailing, nfd at the 3-digit sector level; and Non-store retailing and retail commission-based buying and/or selling; and Accommodation and food services, nfd at the 2-digit sector level. Figure 3 plots the same information enumerated in Table 2 for these remaining sectors and sub-sectors. Figure 4 plots change in net employment across these same sectors and sub-sectors, for both mid-sized and larger urban areas, over the periods 2006-11 and 2011-16.

The proportion of total jobs in the Retail Trade sector in mid-sized urban areas has declined by 1.79 percentage points, from 13.48 per cent in 2006 to 11.69 per cent in 2016. This is not significantly different from the corresponding decline of 1.59 percentage points for large urban areas, from 12.83 per cent in 2006 to 11.24 per cent in 2016. In general, there has been a decline in the Retail Trade sector everywhere. Net employment in the sector over the period 2006-16 has declined by 3.85 per cent in mid-sized urban areas and 0.55 per cent in large urban areas. As shown in Figure 4, the decline has accelerated over the period 2011-16, potentially reflecting the rise of e-commerce and e-retail platforms during this period.

Within the Retail Trade sector, at the 2-digit ANZSIC code level, food retailing and other store-based retailing comprise the major sub-sectors. The proportion of total jobs in food retailing across mid-sized urban areas has only declined marginally, from 4.73 per cent in 2006 to 4.40 per cent in 2016, and net employment in the sector has actually increased during this period by 0.36 per cent. However, the corresponding proportion in other store-based retailing has declined more significantly, from 6.34 per cent in 2006 to 5.33 per cent in 2016, and net employment in the sector has also declined during this period by 4.80 per cent. The other 2-digit sub-sectors within Retail Trade, namely motor vehicle and motor vehicle parts retailing and fuel retailing, have remained stable in terms of their proportion of total employment, and net employment within these sub-sectors has grown by 1.49 per cent and 3.89 per cent over the period 2006-16, respectively.

Table 2: *Different industrial sectors and sub-sectors in terms of proportion of total number of jobs across mid-sized and large urban areas in Australia*

Industry sector	Mid-sized urban areas			Large urban areas		
	2006	2011	2016	2006	2011	2016
Retail trade	13.48%	12.64%	11.69%	12.83%	11.90%	11.24%
Retail trade, nfd	0.64%	0.58%	0.37%	0.67%	0.56%	0.31%
Motor vehicle and motor vehicle parts retailing	1.17%	1.06%	1.07%	1.01%	0.92%	0.96%
Fuel retailing	0.57%	0.50%	0.49%	0.36%	0.31%	0.33%
Food retailing	4.73%	4.40%	4.40%	3.94%	3.64%	3.69%
Other store-based retailing	6.34%	6.08%	5.33%	6.80%	6.41%	5.90%
Other store-based retailing, nfd	0.06%	0.05%	0.02%	0.07%	0.05%	0.02%
Furniture, floor coverings, houseware and textile goods retailing	0.48%	0.48%	0.35%	0.57%	0.57%	0.45%
Electrical and electronic goods retailing	0.61%	0.57%	0.37%	0.78%	0.70%	0.52%
Hardware, building and garden supplies retailing	0.94%	0.86%	0.75%	0.76%	0.73%	0.70%
Recreational goods retailing	0.72%	0.63%	0.53%	0.71%	0.59%	0.53%
Clothing, footware and personal accessory retailing	1.18%	1.19%	1.12%	1.41%	1.45%	1.39%
Department stores	0.85%	0.76%	0.71%	1.03%	0.84%	0.90%
Pharmaceutical and other store-based retailing	1.51%	1.55%	1.47%	1.48%	1.48%	1.38%
Non-store retailing and retail commission-based buying and/or selling	0.03%	0.03%	0.04%	0.05%	0.06%	0.06%
Accommodation and food services	8.17%	8.29%	8.56%	7.32%	7.41%	8.00%
Accommodation and food services, nfd	0.00%	0.00%	0.02%	0.01%	0.01%	0.02%
Accommodation	2.24%	2.17%	1.90%	1.61%	1.45%	1.28%
Food and beverage services	5.92%	6.12%	6.64%	5.70%	5.96%	6.70%

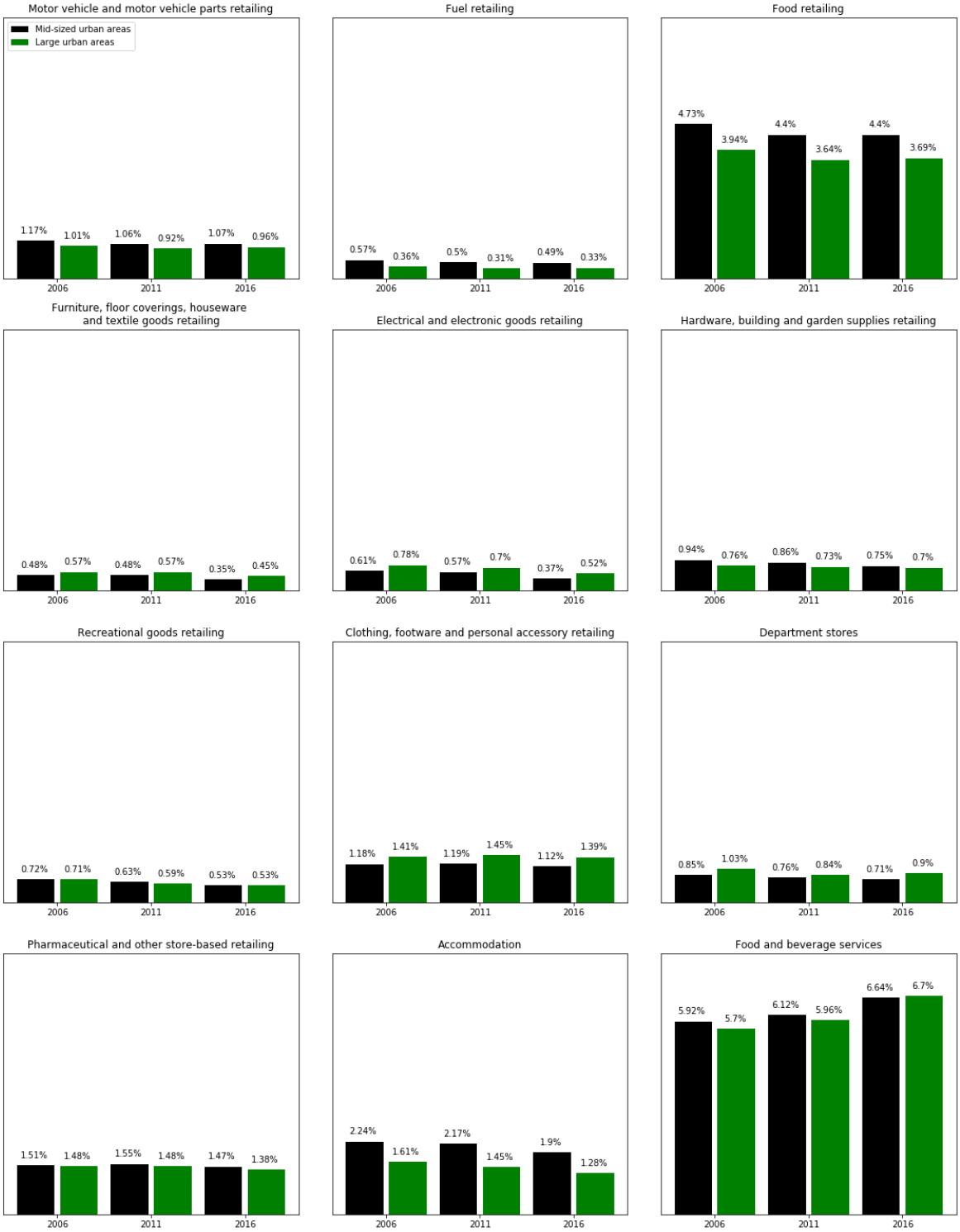

Figure 3: *Proportion of jobs across different sub-sectors in mid-sized and large urban areas in Australia*

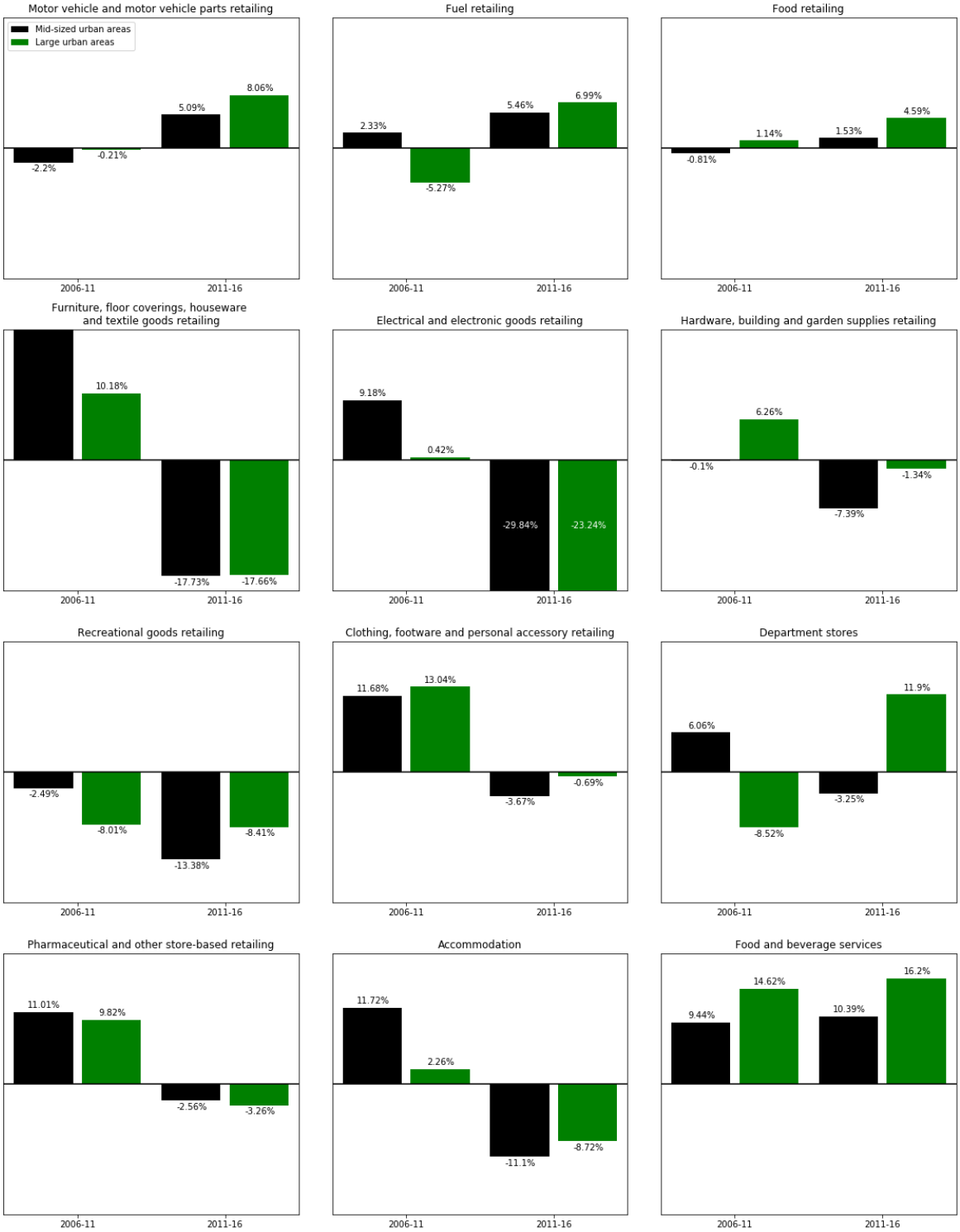

Figure 4: *Changes in the number of jobs across different industrial sectors and sub-sectors over time across mid-sized and large urban areas in Australia*

Within other store-based retailing, at the 3-digit ANZSIC code level, proportion of total employment has stayed more or less consistent for clothing, footware and personal accessory retailing and pharmaceutical and other store-based retailing. Net employment in both sub-sectors increased initially between 2006 and 2011 by roughly 11 per cent, before declining between 2011 and 2016 by roughly 4 per cent. In contrast, proportion of total employment has declined for furniture, floor coverings, houseware and textile goods retailing; electrical and electronic goods retailing; and department stores. However, net employment in these three sub-sectors increased initially between 2006 and 2011, before declining between 2011 and 2016. Finally, proportion of total employment has also declined for hardware, building and garden supplies retailing and recreational goods retailing. Net employment in both sectors has been in decline since 2006, but the decline has accelerated after 2011.

In contrast to the Retail Trade sector, the proportion of total jobs in the Accommodation and Food Services sector in mid-sized urban areas has increased marginally by 0.39 percentage points, from 8.17 per cent in 2006 to 8.56 per cent in 2016. This is a little less than the corresponding increase of 0.68 percentage points for large urban areas, from 7.32 per cent in 2006 to 8.00 per cent in 2016. In general, there has been growth in the Accommodation and Food Services sector everywhere. Net employment in the sector over the period 2006-16 has increased by 6.72 per cent in mid-sized urban areas and 11.72 per cent in large urban areas. However, as shown in Figure 4, while the food and beverage services sub-sector has continued to grow steadily over this period, the accommodation sub-sector has been in decline since 2011, and these trends hold for both mid-sized and large urban areas. The recent decline in the accommodation sub-sector could potentially be reflective of the rise of the online short-term rental market, as facilitated by platforms such as Airbnb.

3.2 Hours worked

For each of the industrial sectors and sub-sectors of interest, Table 3 enumerates the total number of hours worked in a single week by all individuals employed in that sector or sub-sector. Hours worked in the Retail Trade sector have been in steady decline in mid-sized urban areas, having contracted by 9.51 per cent between 2006 and 2011, and 9.10 per cent between 2011 and 2016.

Within the Retail Trade sector, at the 2-digit ANZSIC code level, the trends are more interesting. Hours worked in the motor vehicle and motor vehicle parts retailing; fuel retailing; and food retailing sub-sectors declined sharply between 2006 and 2011, before partially rebounding between 2011 and 2016. However, the other store-based retailing sub-sector has been in steady decline throughout this period, and is the primary determinant of the overall decline in the Retail Trade sector.

Within other store-based retailing, at the 3-digit ANZSIC code level, only the department store retailing sub-sector has seen growth in hours worked between 2006 and 2016. All other sub-sectors have declined during this period, with electrical and electronic goods retailing; and furniture, floor coverings, houseware and textile goods retailing being the sub-sectors that performed the worst.

Hours worked in the Accommodation and Food Services sector in mid-sized urban areas has grown marginally, but at a much slower pace when compared the growth in large urban areas. This growth has largely been led by the food and beverage services sub-sector, which has grown by 9.38 per cent between 2011 and 2016 across mid-sized urban areas. In contrast, the accommodation sub-sector has been in steady decline since 2006, with hours worked shrinking by 3.03 per cent between 2006 and 2011, and by 4.83 per cent between 2011 and 2016.

Table 3: *Changes in the total number of hours worked per week across different industrial sectors and sub-sectors over time across mid-sized and large urban areas*

Industry sector	**Change in total number of hours worked per week over 2006-11**		**Change in total number of hours worked per week over 2011-16**	
	Mid-sized urban areas	**Large urban areas**	**Mid-sized urban areas**	**Large urban areas**
Retail trade	-9.51%	-1.69%	-9.10%	-3.45%
Retail trade, nfd	-24.29%	-14.23%	13.77%	-40.79%
Motor vehicle and motor vehicle parts retailing	-25.03%	-5.71%	11.75%	8.20%
Fuel retailing	-43.73%	-16.58%	24.67%	2.72%
Food retailing	-15.89%	-1.82%	17.95%	4.74%
Other store-based retailing	-12.88%	-1.36%	-13.48%	-7.24%
Furniture, floor coverings, houseware and textile goods retailing	-20.06%	-4.66%	-13.36%	-18.38%
Electrical and electronic goods retailing	-22.57%	-8.04%	-32.54%	-24.39%
Hardware, building and garden supplies retailing	-25.77	-2.76%	1.20%	-5.15%
Recreational goods retailing	-45.54%	-19.62%	30.36%	-11.57%
Clothing, footware and personal accessory retailing	-19.43%	4.66%	4.98%	-0.50%
Department stores	-21.87%	-16.82%	28.27%	14.16%
Pharmaceutical and other store-based retailing	-18.23%	3.92%	-1.75%	-2.61%
Accommodation and food services	0.59%	9.36%	0.78%	7.36%
Accommodation	-3.03%	2.25%	-4.83%	-12.61%
Food and beverage services	-3.83%	10.37%	9.38%	12.13%
Entire economy	4.80%	8.59%	0.59%	3.58%

Table 4: *Changes in total weekly incomes paid to all employees working in different industrial sectors and sub-sectors over time across mid-sized and large urban areas*

Industry sector	**Change in total weekly incomes paid to all employees over 2006-11**		**Change in total weekly incomes paid to all employees over 2011-16**	
	Mid-sized urban areas	**Large urban areas**	**Mid-sized urban areas**	**Large urban areas**
Retail trade	19.12%	22.93%	8.73%	13.95%
Retail trade, nfd	57.03%	22.84%	11.73%	-27.48%
Motor vehicle and motor vehicle parts retailing	28.13%	20.91%	24.43%	28.29%
Fuel retailing	33.85%	21.75%	51.65%	23.34%
Food retailing	22.30%	26.29%	21.32%	25.03%
Other store-based retailing	23.83%	23.82%	-0.02%	8.69%
Furniture, floor coverings, houseware and textile goods retailing	39.07%	25.60%	-6.19%	-4.90%
Electrical and electronic goods retailing	43.87%	21.31%	-28.10%	-10.26%
Hardware, building and garden supplies retailing	35.09%	31.46%	6.96%	8.90%
Recreational goods retailing	33.81%	6.61%	9.42%	5.92%
Clothing, footware and personal accessory retailing	39.97%	34.55%	10.54%	17.78%
Department stores	107.75%	13.24%	39.98%	28.56%
Pharmaceutical and other store-based retailing	46.52%	30.12%	13.74%	14.51%
Accommodation and food services	34.22%	33.48%	16.50%	23.90%
Accommodation	55.70%	27.26%	2.24%	5.10%
Food and beverage services	33.23%	36.98%	24.64%	29.38%
Entire economy	30.26%	34.71%	20.71%	22.99%

3.3 Wages paid

For each of the industrial sectors and sub-sectors of interest, Table 4 enumerates total wages paid in a single week to all individuals employed in that sector or sub-sector. Consistent with the other indicators, wages paid in the Retail Trade sector have grown at a much slower pace than the entire economy. Between 2006 and 2016, wages paid in the Retail Trade sector grew by 13.93 per cent across mid-sized urban areas, compared to a corresponding growth rate of 25.49 per cent for the entire economy.

Within the Retail Trade sector, at the 2-digit ANZSIC code level, wages paid across mid-sized urban areas in motor vehicle and motor vehicle parts retailing; fuel retailing; and food retailing have grown at relatively the same rate as other parts of the economy. However, wages paid within the other store-based retailing sub-sector have only grown by 11.91 per cent between 2006 and 2016 across mid-sized urban areas, and have been the primary determinant of slow growth in the broader Retail Trade sector.

Within other store-based retailing, at the 3-digit ANZSIC code level, across mid-sized urban areas, wages paid in department store retailing have grown significantly above the average for the entire economy. Wages paid in clothing, footware and personal accessory retailing; and pharmaceutical and other store-based retailing have grown at roughly the same rate as the entire economy. Finally, wages paid in all other sub-sectors have grown at rates below those for the entire economy, with electrical and electronic goods retailing; and furniture, floor coverings, houseware and textile goods retailing being the sub-sectors that performed the worst.

Wages paid in the Accommodation and Food Services sector in mid-sized urban areas have grown marginally faster than the entire economy in these areas between 2006 and 2016. Wages paid in the accommodation sub-sector grew very rapidly between 2006 and 2011, and stayed relatively steady between 2011 and 2016. In contrast, wages paid in the food and beverage services sub-sector have grown steadily at marginally above the average rate of wage growth for the entire economy.

4. Natural disasters in regional Australia

In this section, we discuss how we measure the incidence and intensity of droughts, floods and bush fires, and we describe our data sources.

4.1 Droughts

There are numerous ways to understand and define drought depending on who is impacted and the extent and intensity. Depending on who is affected droughts are typically categorised into four groups; meteorological, hydrological, agricultural and socioeconomic (Mishra and Singh, 2010).

- Meteorological droughts are defined by rainfall alone and are described by the extent and severity of deficiencies compared with average or historical levels across a given region.
- Agricultural drought is defined by the impact of water shortages on the ability to produce crops. This is often affected by seasonal deficiencies where agricultural production systems are dependent on rainfall at particular times of year.
- Hydrological drought is defined by changes surface and ground water levels
- Socioeconomic drought is defined by the ability of water resource systems to meet socio-economic demands.

The Bureau of Meteorology (BoM) define drought relative to historical averages and break the intensity of the water deficiency up into severity classes based on percentiles relative to this historical average (Table 5).

The BoM produces several products relative to understanding the state of drought across the country. These include monthly and annual drought summary reports on the climate generally with information about the status of rainfall and any anomalies. These summary report include information relevant to the four categories of drought mentioned earlier and provide useful information and contextualisation of drought conditions but do not provide spatially explicit quantitative information on the extent and severity of water deficiencies.

More relevant for mapping and quantifying spatial distributions of water deficiencies, they also produce daily, monthly and annual water balance data as a part of the National Water Accounts (Bom, 2013) called the Australian Landscape Water Balance (BoM, 2020a). Relevant layers within this dataset include precipitation and soil moisture that provide spatially explicit, nationally consistent data on these variables at 5 km resolution. Available within these datasets are actual amounts of precipitation and soil moisture as well as relative comparisons with historical averages that are categorised into the classes from Table 1.

Table 5: *BoM rainfall deficiency classes (BoM, 2020a)*

Category	Definition
Lowest on record	Lowest since records began
Severe deficiency	Lowest 5%
Serious deficiency	Lowest 5 – 10%
Very much below average	Lowest 10
Below average	Lowest 10 – 30%

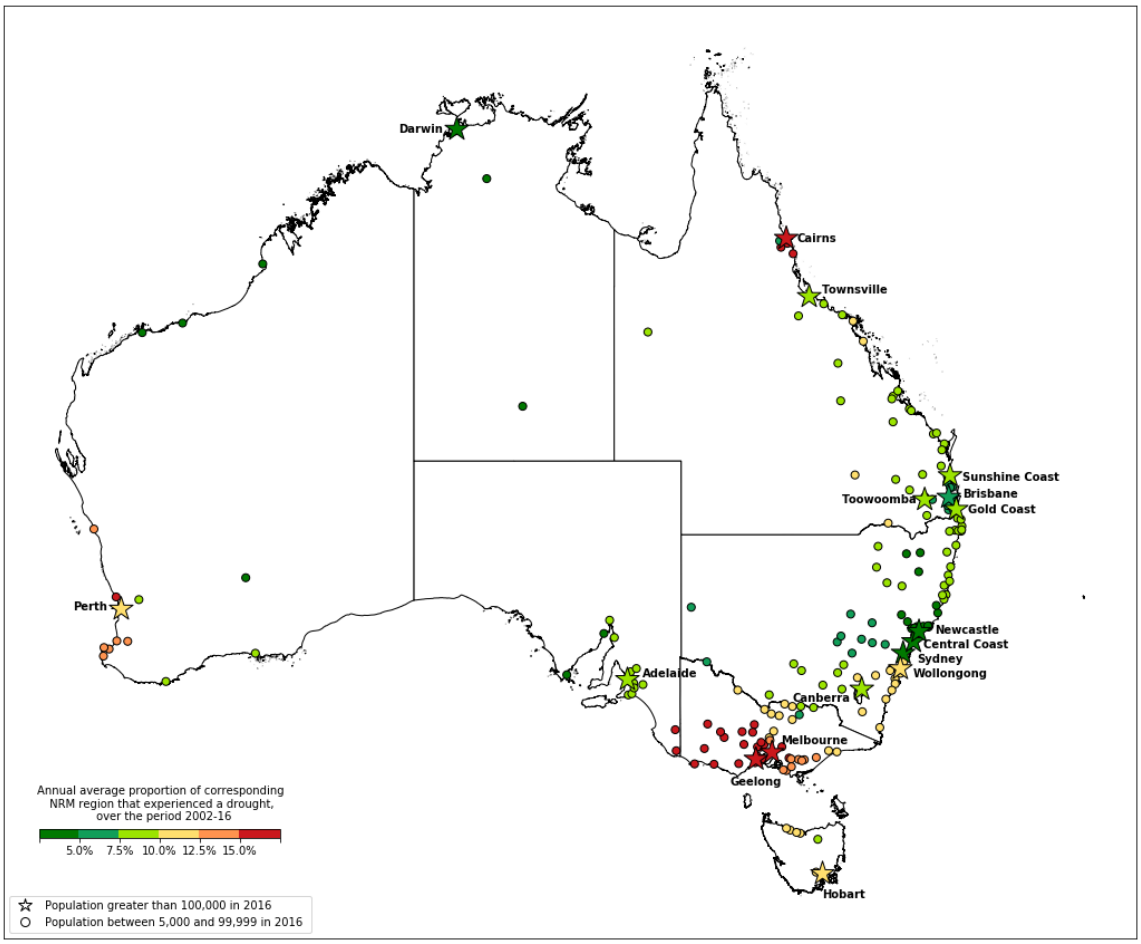

Figure 5: *Incidence of drought across UCLs over the period 2002-16, measured in terms of the annual average proportion of the corresponding NRM where rainfall was in the historic bottom 10 percentile*

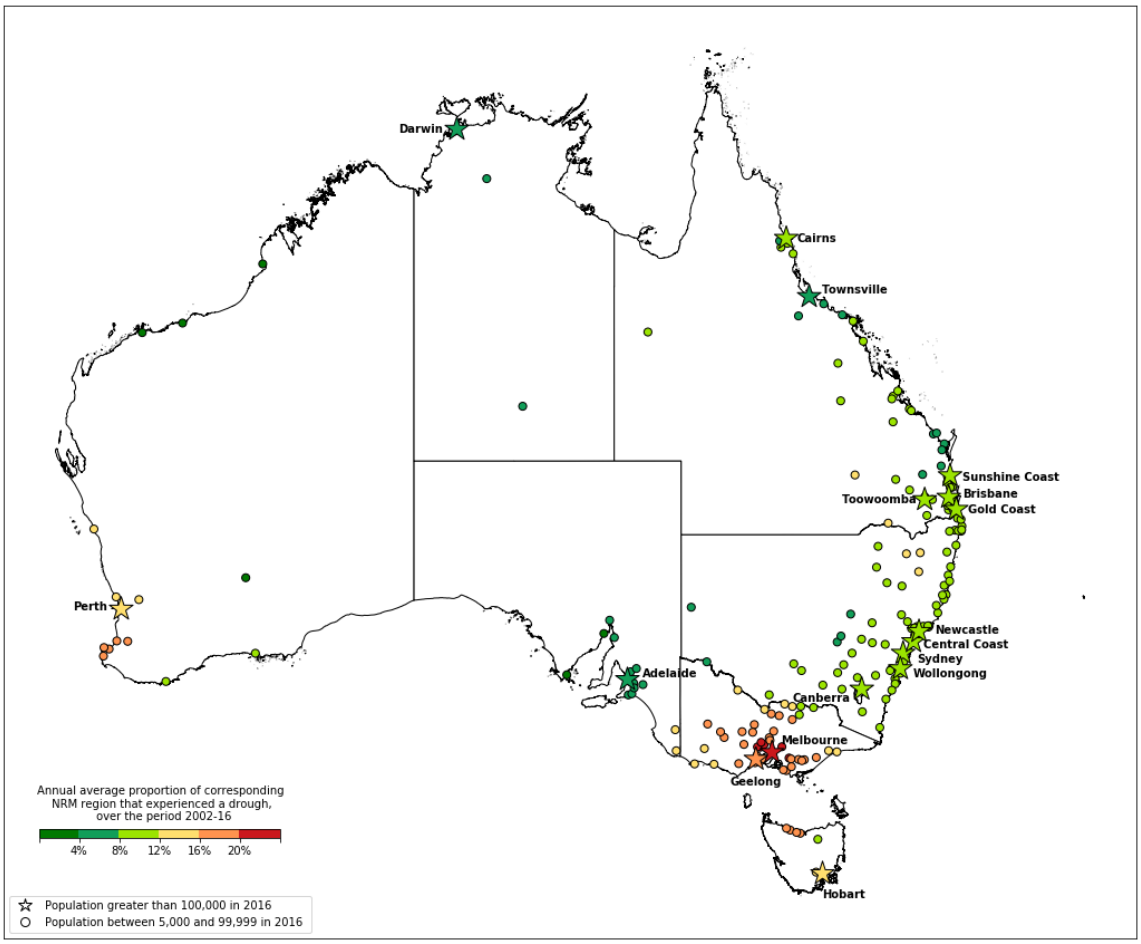

Figure 6: *Incidence of drought across UCLs over the period 2002-16, measured in terms of the annual average proportion of the corresponding NRM where soil moisture was in the historic bottom 10 percentile*

The temporal range of these datasets extends from 2000 to 2019. These datasets enable spatially explicit quantification of the extent (defined by the area of the drought) and the severity (defined according to the BoM rainfall deficiency classes, Table 1). The spatial and temporal nature of the datasets allow for the metrics to be calculated and summarised for regions relevant to different Urban Centres and Localities (UCLs). The regions used to summarise rainfall and soil moisture deficiencies can include geopolitical boundaries (e.g. local government areas or natural resource management regions (NRM)) or natural boundaries (e.g. catchments or IBRA regions). We use NRMs as our geographic unit of analysis for inferring the incidence and intensity of drought, and we use appropriate correspondences to match this data to the scale of individual UCLs.

For each UCL in our sample, over the time period 2002-16, we calculated the annual average proportion of the corresponding NRM that experienced a drought. We compared four different definitions of drought:

1. Rainfall in that year is in the lowest 10 per cent of the historical average;
2. Rainfall in that year is in the lowest 30 per cent of the historical average;
3. Soil moisture in that year is in the lowest 10 per cent of the historical average; and
4. Soil moisture in that year is in the lowest 30 per cent of the historical average;

We found each of these measures to be highly correlated (pairwise correlations in the range 0.8-0.9). For example, Figure 5 and Figure 6 plot the incidence of drought across UCLs over the period 2002-16, as measured in terms of rainfall and soil moisture, respectively. The overlap between the two measures is apparent from a visual comparison of the two maps. Ultimately, we decided to measure drought for a particular UCL over a particular time period in terms of the proportion of the corresponding NRM where soil moisture in a given year was in the historic bottom 10 percentile, averaged over all years within that time period.

Figure 7 plots the historic distribution of this measure, averaged over NRMs corresponding to all UCLs in our sample. As is apparent from the plot, 2002, 2006 and 2019 were particularly bad drought years across the country.

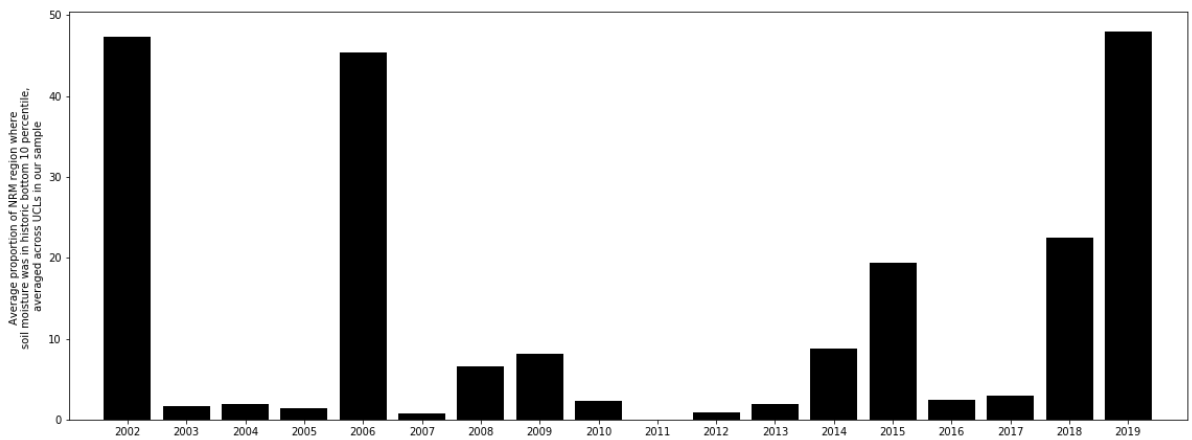

Figure 7: *Proportion of NRM region in a given year where soil moisture was in the historic bottom 10 percentile, averaged over NRM regions corresponding to all UCLs in our sample, shown over the period 2002-19*

4.2 Floods

Historical information on floods across Australia has been collected since the late 19th century. Strategically placed measurement stations can collect a range of water metrics relating to watercourse level and discharge, storage levels and water chemistry. While this data has typically been collected and held by individual jurisdictions, the BoM have recently produced the Water Data Online tool (Bom, 2020b), an online portal which collates water flow data and other metrics from the lead water agencies and other organisations within each jurisdiction.

There are approximately 6000 individual measurement stations across Australia available within the portal. Each measurement station is defined geographically as a point location along a water course or storage facility and time series data from each station can be downloaded individually for analysis. The time period over which data is available for each measurement station varies depending on how long stations have been operational.

We opted to use the Water Data Online portal for the analysis data because it provides spatially explicit point source data on water levels that can be spatially associated with the different UCLs over the relevant time period. This data does not provide a measure of the spatial extent of the flooding or the extent of destruction resulting from the flood. However, it does provide consistent information on the locations of flooding and the relative amount of flooding in terms of water level and discharge.

A subset of the measurement stations was extracted from the total based on their proximity to relevant UCLs. Measurement stations within the area of the UCLs (226 stations), or within a 5 km radius of the UCL (an additional 243 stations), were included in the subset for further analysis, giving a total of 469 stations. The 5 km radius was chosen to capture measurement stations that are physically outside the boundaries of UCLs but placed on watercourses that travel through or are in close proximity to the UCLs. This selection resulted in 146 UCLs being represented by measurement stations from the total 213 in this study. It was assumed that flooding was negligible in the UCLs that were not represented with flood measurement stations.

For each water measurement station in our sample we calculated the mean water level from the historical record and the mean water level for each year between 2000 and 2016. This was used to calculate the maximum annual average deviation of water level for each of the UCLs across this time period. Figure 8 plots incidence of floods across the UCLs between 2000 and 2016, and Figure 9 and Figure 10 show the annual average deviation of water for Brisbane and Darwin between 2000 and 2019. As is clear from the latter plots, the data is able to capture the incidence of floods in Brisbane in 2010-11 and in Darwin in 2019. The map in Figure 8 further shows the data is able to capture the higher incidence of floods in towns located along the Murray river along the border between New South Wales and Victoria, such as Mildura – Buronga, Yarrawonga - Mulwala and Corowa – Wahgunyah.

A higher level and more detailed analysis looking at daily water level and discharge peaks may be possible from this data. However, due to the time constraints of this project and the limitations of data access within the Water Data Online portal, annual maximums were chosen for our analysis.

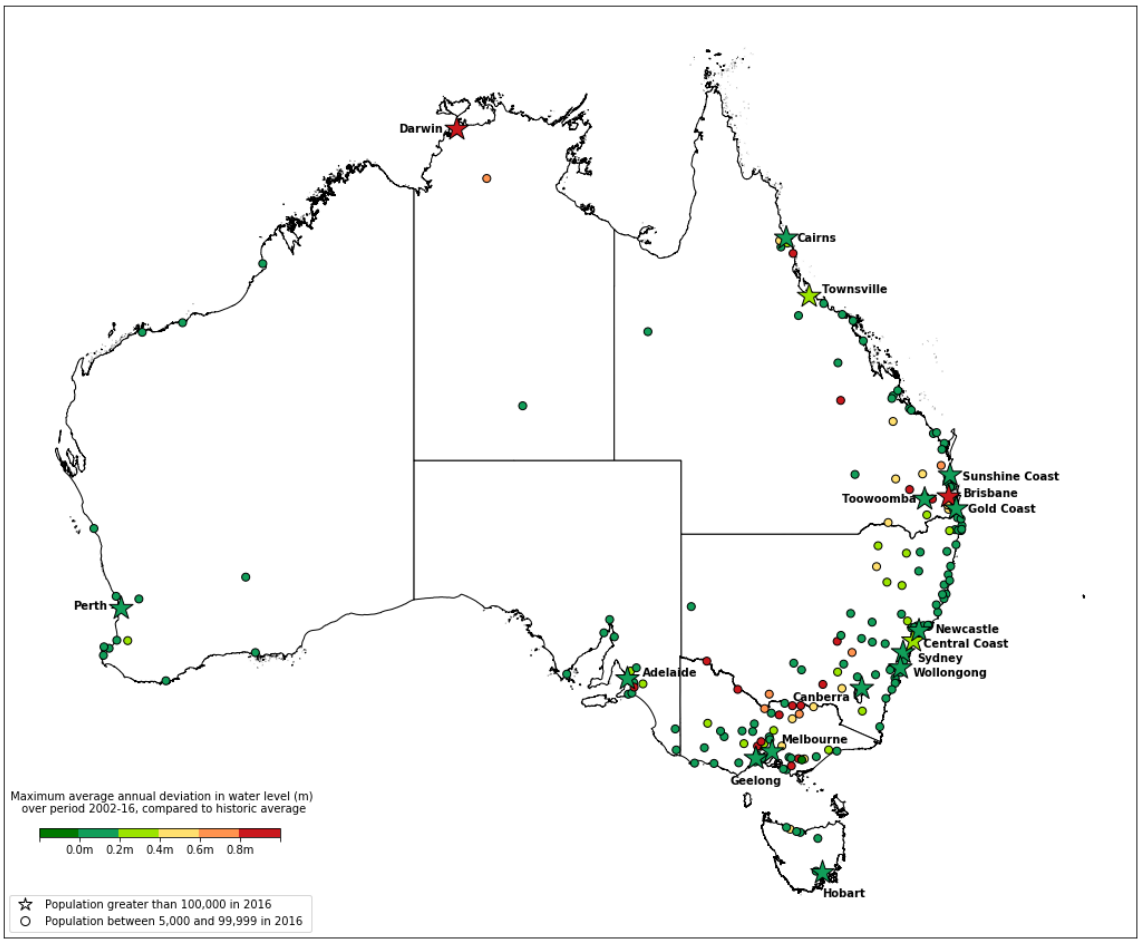

Figure 8: *Incidence of flood across UCLs over the period 2002-16, measured in terms of the maximum average annual deviation in water level (m) during this period, compared to the historic average*

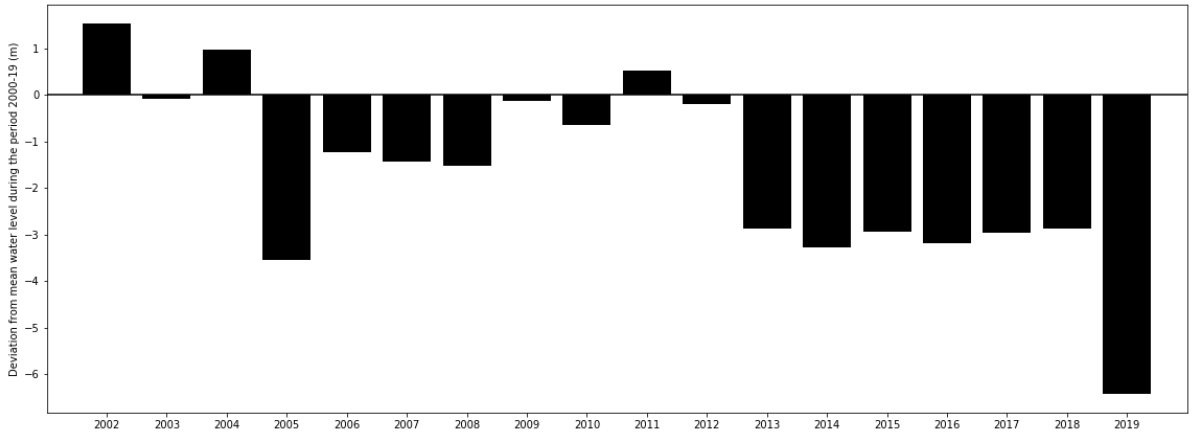

Figure 9: *Average annual deviation in water level (m) during this period, compared to the historic average, for Brisbane*

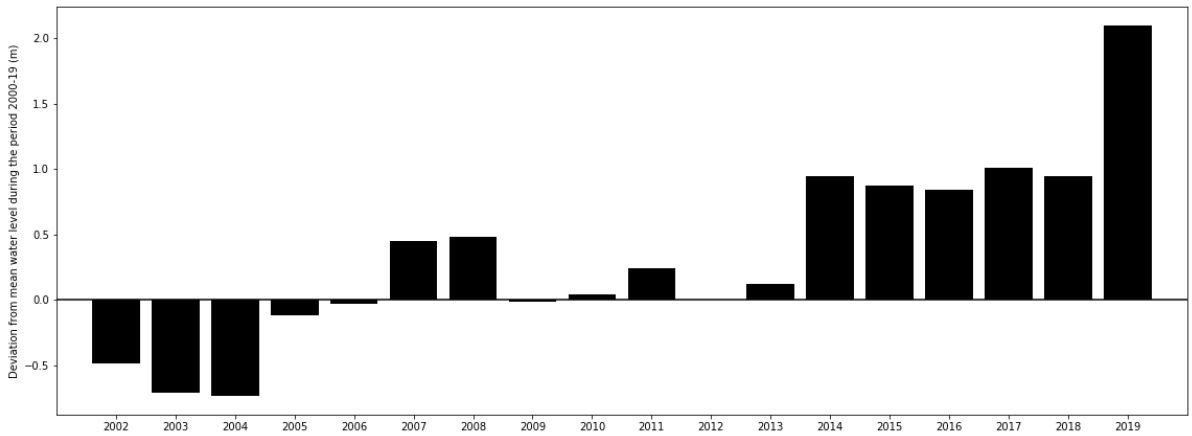

Figure 10: *Average annual deviation in water level (m) during this period, compared to the historic average, for Darwin*

4.3 Fires

Bushfire events have historically been reported in terms of area burnt, property destroyed and lives lost. These assessments are very event specific and do not provide spatially explicit detail about where the fire occurred or quantitative information on the intensity. Partly in response to this a number of initiatives have been developed to map fire occurrence and intensity at a national extent.

The availability of satellites with thermal infrared sensors capable of mapping fire events has led to the development of a number of products that provide national coverage on the temporal and spatial occurrence of bushfires as well as measures of fire intensity. Geoscience Australia has developed a bushfire monitoring system called Digital Earth Australia Hotspots (Geoscience Australia, 2020) that collates image data from a series of different satellites and provides it free of charge through an interactive webpage. This provides real time updates of fire occurrence and intensity (measured simply as temperature) across the country.

While the data presented in the interactive webpage provides valuable information on fire events it is not in a format that is easy to access for spatial mapping and analysis. However, the Water and Landscape Dynamics (WALD) group at the Australian National University have developed a number of products that provide annual summaries of both fire occurrence and intensity. These products are available for visualisation through the Australia's Environmental Explorer (Van Dijk & Rahman, 2019) and can easily be downloaded for analysis and modelling. This data is available on an annual basis from 2003 to 2019 at a spatial resolution of 2.5 km.

Additionally, the Moderate Resolution Imaging Spectroradiometer (MODIS) provides a global burnt area product that provides information on the extent of bushfires. As with the Digital Earth Australia Hotspots data the ANU WALD group has developed derived products the provide annual summaries for the Australian continent in a format that is readily accessible for analysis and modelling. This data is available from 2000 to 2019 at a spatial resolution of approximately 500 m.

The combination of these summary datasets developed by the ANU WALD group provide suitable metrics to model and understand the extent and occurrence of fires as well as the intensity. We compared different metrics contained within these datasets, such as burn area, number of hotspots, maximum temperature, etc. As one would expect, there was significant correlation between these different metrics. Ultimately, we decided to measure the incidence and intensity of bush fires for a particular UCL over a particular time period in terms of the proportion of the corresponding NRM that experienced a bush fire in a given year, averaged over all years within that time period.

Figure 11 plots the incidence of bush fires across UCLs over the period 2002-16 based on this metric. Figure 12 plots the historic distribution of this measure, averaged over NRMs corresponding to all UCLs in our sample. As is apparent from the plot, 2019 was the worst year for bush fires in the last two decades.

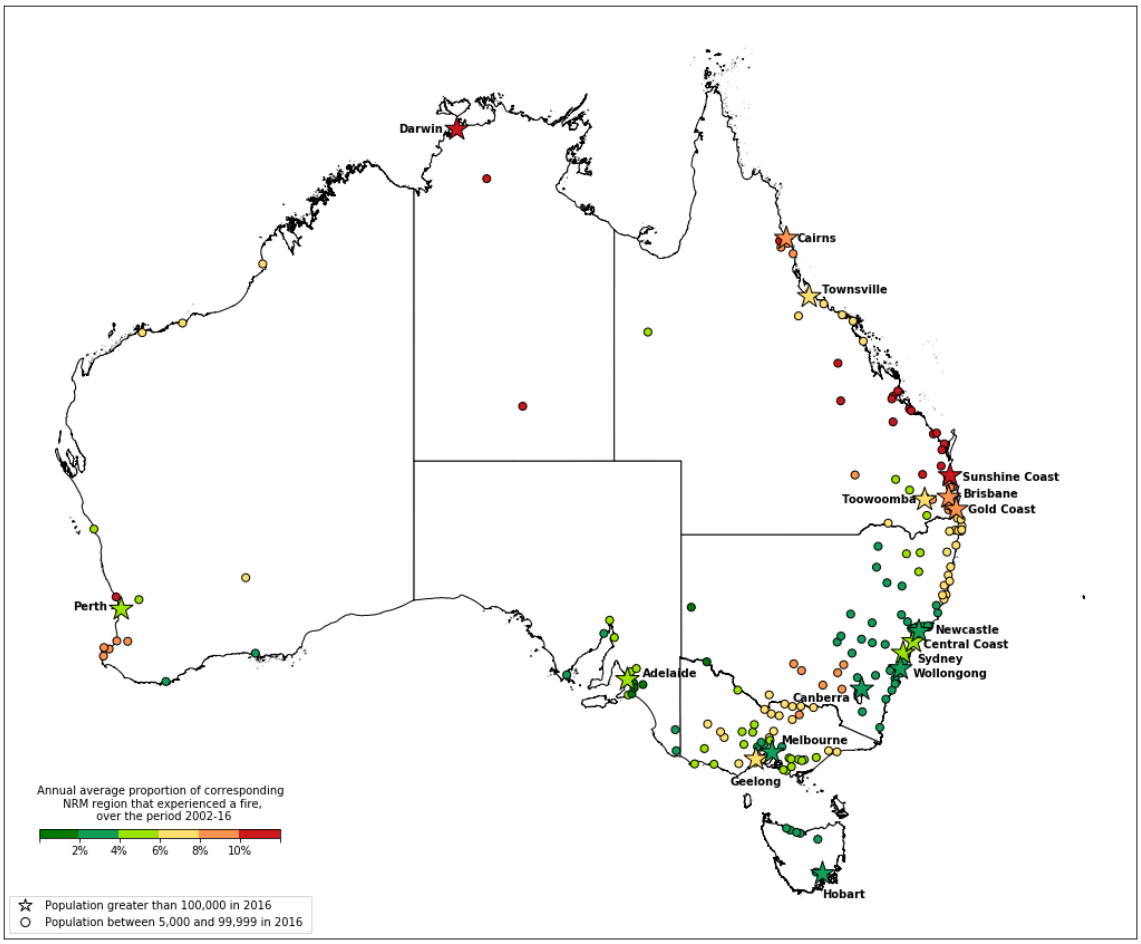

Figure 11: *Incidence of bush fires across UCLs over the period 2002-16, measured in terms of the annual average proportion of the corresponding NRM that experienced a burn*

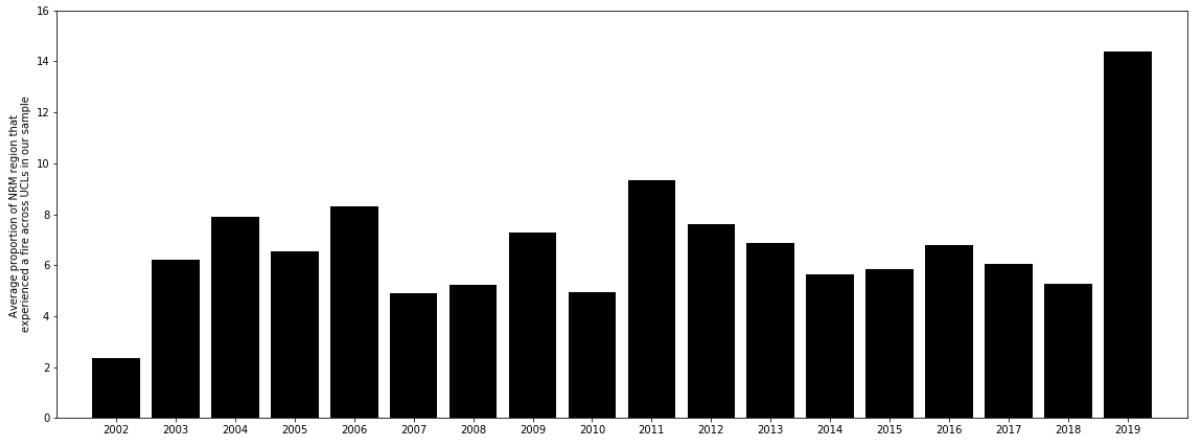

Figure 12: *Proportion of NRM region in a given year that experienced a bush fire, averaged over NRM regions corresponding to all UCLs in our sample, shown over the period 2002-19*

5. Impacts of natural disasters on main-street retail

In this section, we present results from our regression analysis of the impacts of natural disasters on growth across the retail and services sectors and relevant sub-sectors within in regional Australia. We limit our attention to the 16 sectors and sub-sectors that fall within the broader 1-digit Retail Trade and Accommodation and Food Services sectors, where the proportion of total jobs in each (sub-)sector is greater than 0.1 per cent, as identified in Section 3. For reference, we also examine economy-wide growth across all sectors.

As mentioned previously, we use urban centres and localities (UCLs) as our unit of analysis. We limit our attention to 176 UCLs nationwide, as defined by the Australian Statistical Geography Standard (ASGS), with populations between 5,000 and 50,000, as per the 2016 Census. We examine these UCLs over the time period 2006-16, using information from the datasets described in previous sections. For each UCL in our sample, we examine how growth has varied across different sub-sectors that fall within the broader Retail Trade and Accommodation and Food Services sectors. For each sub-sector, we limit our attention to UCLs with growth rates between -200 and 200 per cent, to control for outliers. Consequently, the sample size is not always the same across our regressions.

Growth is quantified in terms of the following three sector and sub-sector specific measures, described in greater detail in Section 3, and these are our dependent variables of interest: (1) total number of jobs in the sector; (2) total number of hours worked in a single week by all individuals employed in that sector; and (3) total wages paid in a single week to all individuals employed in that sector. work

For each dependent variable in our analysis, we employ the following general model specification:

$$\Delta y_{ijt} = \mu_t + \alpha_1 \mathrm{drought}_{i(t-1)} + \alpha_2 \mathrm{drought}_{it} + \alpha_1 \mathrm{fire}_{i(t-1)} + \alpha_2 \mathrm{fire}_{it} + \gamma x_{ijt} + \rho \sum_k w_{ik} f(\Delta y_{kjt}) + \varepsilon_{ijt} \quad (1)$$

The dependent variable of interest is denoted Δy_{ijt}, and represents rate of growth in percentage terms with regards to the relevant measure (e.g. number of jobs) for UCL i and sector j over time period t.

Note that our dataset contains two distinct 5-year observation periods: 2006-11 and 2011-16. The parameter μ_t denotes fixed effects specific to time period t, and captures short-term deviations specific to particular time periods. For example, as noted in Section 3, decline in the retail sector has accelerated after 2011, due to the emergence of online retail. The μ_t parameter would capture such effects specific to a particular time period, but applicable to all urban areas in the sample for that year.

The impacts of natural disasters are captured through the variables $\mathrm{drought}_{it}$ and fire_{it}, equal to the annual average proportion of the NRM region that UCL i belongs to that experienced a drought or fire, respectively, over time period t. Note that our regressions include lagged effects for each of these variables as well, to examine how natural disasters in preceding time periods may impact growth in the present time period.

The variable x_{ijt} denotes control variables other than time and natural disasters that are hypothesized to have a significant effect on growth in the retail and services sectors. They include a combination of population-related factors, such as size and population density; location-specific factors, such as distance to nearest capital city, and whether or not a UCL

is on the coastline; and economy-specific factors, such as economy-wide growth and size of the specific sector at the start of the time period.

Given the spatial nature of our data, and the positive spill over effects frequently received by the local economies of smaller urban areas situated in close proximity to major urban areas (e.g. Bosworth and Venhorst, 2018), we employ a spatial lag in our model specification, such that the value of the dependent variable in a particular urban area during a given time period depends on the corresponding values of the same variable in surrounding urban areas during that same time period. The parameter ρ captures the direction and magnitude of effect exerted by neighbouring areas, and the variable w_{ik} denotes the degree of connectivity between the urban areas i and k. There are many different ways in which w_{ik} might be constructed (for a comprehensive review of these different methods, see, for example, Anselin, 2013). In our case, we constructed distance-based weights based on the well-known gravity model, where the degree of connectivity between two urban areas is inversely proportional to the square of the physical distance separating these areas. We assumed further that urban areas that are more than 1000 km apart do not exert any influence on each other (i.e. $w_{ik} = 0$ for these areas i and k). The weights are normalized such that $\sum_k w_{ik} = 1$ for any urban area i.

Finally, the variable ε_{ijt} is the residual term that captures the average effect of all other variables not included in our regression, and can be thought of as white noise. We assume that ε_{ijt} is independently and identically distributed with variance σ^2 across all urban areas and time periods, where σ is a model parameter to be estimated. We are implicitly assuming that the noise in our data is not temporally correlated. In other words, we assume that random shocks at each time point in our data do not propagate to future time points. Relatedly, we are also assuming that the noise in our data is not spatially correlated, and that any spatial correlation is captured through the spatial lag variable.

All models were estimated through the PySal library (Rey and Anselin, 2010) in Python using an implementation of maximum likelihood estimation for regression equations with spatial lag. The estimation results for our final specifications are reported in Tables 7-23. Each table reports estimation results for a single sector or sub-sector across our three measures of growth, i.e. number of jobs, number of hours worked and total weekly incomes paid. A comparison across these different measures serves as a robustness check for our empirical findings.

We summarise the results as follows:

1. **Economy-wide effects**

    a. Droughts in preceding time periods have a negative impact on growth in the present time period.

    b. The impact of bush fires and floods is not found to be statistically significant.

2. **Retail trade**

    a. Droughts in the preceding time period and bush fires in the current time period have a positive impact on growth in motor vehicle and motor vehicle parts retailing, due potentially to regeneration activities following the natural disaster. The impact of floods is not found to be statistically significant.

    b. Droughts in the preceding time period have a negative impact on growth in fuel retailing, due to potential reductions in the use of agricultural machinery. Interestingly, bush fires in the present time period have a positive impact on

growth in fuel retailing, due to potential increases in travel relating to evacuation and fire-fighting in the region. The impact of floods is not found to be statistically significant.

c. Droughts in current time periods have a negative impact on growth in recreational goods retailing. Bush fires in current time periods have a positive impact on number of jobs in the sub-sector, whereas bush fires in preceding time periods have a negative impact on the same, due potentially to an increased demand for recreational goods that can assist with fire-fighting activities during the bush fire period, and a decline in the same following the bush fires. The impact of floods is not found to be statistically significant.

d. Droughts and floods in preceding time periods, and bush fires in current time periods, have a positive impact on growth in clothing, footwear and personal accessory retailing, due potentially to regeneration activities following the natural disaster. However, bush fires in the preceding time period have a negative impact on growth, due potentially to more long-term effects on retail in the region and/or a rebound effect following the bush fire.

e. Droughts in preceding time periods have a weak positive impact on growth in furniture, floor coverings, houseware & textile goods retailing; and hardware, building and garden supplies retailing. The impact of bush fires and floods on these sectors is not found to be statistically significant.

f. Droughts and bush fires in preceding time periods, and floods in current time periods, have a positive impact on growth in pharmaceutical and other store-based retailing.

g. Droughts and floods in current time periods have a positive impact on growth in electrical and electronic goods retailing. The impact of bush fires on the sector is not found to be statistically significant.

h. The impacts of droughts, bush fires and floods on other sub-sectors within the Retail Trade sector are found to be ambiguous.

3. **Accommodation and food services**

a. Bush fires in the preceding time period have a negative impact on growth in the accommodation sub-sector. Floods in the current time period have a positive impact, due to potential displacement of local residents, but floods in the preceding time period have a negative impact, due likely to a return to normal activity following the natural disaster. The impact of droughts is not found to be statistically significant.

b. Bush fires in the current time period have a negative impact on growth in the food and beverage services sub-sector, due to potential disruption in tourism and other related activities, but bush fires in the preceding time period have a positive impact, again due to a likely return to normal activity. The impact of floods is found to be the opposite: floods in the current time period have a positive impact on growth, due potentially to increased demand from displaced local residents, but floods in the preceding time period have a negative impact, due to a return to normal activity. The impact of droughts on the sector is not found to be statistically significant.

Table 6: *Estimation results of linear regression of economy-wide growth in different employment measures across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	272.323	0.00	284.435	0.00	363.810	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-6.449	0.00	-5.351	0.01	-10.477	0.00
Population effects						
Population (1,000s)	0.415	0.49	1.053	0.04	1.775	0.00
Logarithm of population	-27.636	0.00	-29.324	0.00	-36.026	0.00
Population density (per km^2)	-0.020	0.00	-0.020	0.00	-0.026	0.00
Location effects						
Coastal city	4.012	0.02	3.723	0.05	4.100	0.07
Logarithm of distance to nearest capital city	-3.864	0.00	-3.660	0.00	-4.178	0.00
Spatial lag	0.291	0.00	0.335	0.00	0.343	0.00
Economic effects						
Growth in measure across all sectors in UCL during same period	0.003	0.01	0.000	0.04	0.000	0.33
Baseline value of measure in (sub-)sector at start of period	-	-	-	-	-	-
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.442	0.38	0.441	0.42	0.254	0.70
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.390	0.36	-0.393	0.40	-0.096	0.86
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	-0.233	0.04	-0.228	0.06	-0.229	0.11
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.021	0.83	0.024	0.82	0.029	0.83
Annual average deviation from mean water level in the 4 years preceding current period (m)	-0.814	0.51	-0.843	0.52	-0.394	0.80
Annual average deviation from mean water level during current period (m)	0.805	0.44	0.784	0.49	0.746	0.58
Summary statistics						
Number of observations	352		352		352	
R-squared	0.359		0.338		0.370	
Adjusted R-squared	0.305		0.265		0.297	

Table 7: *Estimation results of linear regression of employment growth in 1-digit retail trade across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	68.733	0.01	7.774	0.77	109.699	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-2.150	0.09	4.009	0.00	-1.089	0.55
Population effects						
Population (1,000s)	1.658	0.00	0.554	0.16	1.689	0.00
Logarithm of population	-7.973	0.01	-1.687	0.59	-11.804	0.00
Population density (per km^2)	-0.001	0.66	-0.001	0.65	-0.003	0.27
Location effects						
Coastal city	1.457	0.20	1.368	0.26	2.161	0.15
Logarithm of distance to nearest capital city	-1.744	0.01	-1.817	0.01	-2.877	0.00
Spatial lag	-0.041	0.36	0.005	0.93	0.035	0.48
Economic effects						
Growth in measure across all sectors in UCL during same period	0.962	0.00	0.796	0.00	0.770	0.00
Baseline value of measure in (sub-)sector at start of period	-0.020	0.00	0.000	0.23	0.000	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-0.066	0.84	-0.154	0.65	-0.239	0.57
Annual average proportion of corresponding NRM region that experienced a fire during current period	0.133	0.62	0.180	0.53	0.174	0.62
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.078	0.26	0.043	0.57	0.003	0.98
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.052	0.42	0.041	0.55	-0.034	0.69
Annual average deviation from mean water level in the 4 years preceding current period (m)	-0.350	0.65	-0.112	0.89	0.533	0.60
Annual average deviation from mean water level during current period (m)	-0.256	0.70	-0.375	0.59	0.046	0.96
Summary statistics						
Number of observations	352		352		352	
R-squared	0.796		0.715		0.729	
Adjusted R-squared	0.795		0.715		0.728	

Table 8: *Estimation results of linear regression of employment growth in 2-digit retail trade, nfd across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	319.806	0.00	-69.737	0.94	920.345	0.08
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-27.447	0.00	-14.457	0.76	-22.688	0.41
Population effects						
Population (1,000s)	6.079	0.00	7.154	0.39	14.104	0.00
Logarithm of population	-37.511	0.00	23.315	0.82	-111.968	0.06
Population density (per km^2)	-0.009	0.27	-0.065	0.32	0.038	0.34
Location effects						
Coastal city	5.066	0.30	-21.027	0.60	-9.495	0.69
Logarithm of distance to nearest capital city	-0.190	0.95	-18.991	0.40	2.890	0.84
Spatial lag	0.126	0.07	-0.035	0.67	-0.017	0.83
Economic effects						
Growth in measure across all sectors in UCL during same period	0.761	0.00	0.545	0.62	1.385	0.01
Baseline value of measure in (sub-)sector at start of period	-1.681	0.00	-0.129	0.02	-0.007	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-2.687	0.05	-15.896	0.16	-19.390	0.00
Annual average proportion of corresponding NRM region that experienced a fire during current period	2.315	0.04	14.057	0.14	17.878	0.00
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.524	0.08	-0.321	0.90	2.857	0.05
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.136	0.62	0.225	0.92	-1.823	0.18
Annual average deviation from mean water level in the 4 years preceding current period	-3.495	0.29	3.702	0.89	-2.438	0.88
Annual average deviation from mean water level during current period (m)	-0.290	0.92	7.290	0.75	-1.604	0.91
Summary statistics						
Number of observations	352		333		347	
R-squared	0.354		0.037		0.121	
Adjusted R-squared	0.346		0.037		0.121	

Table 9: *Estimation results of linear regression of employment growth in 2-digit motor vehicle and motor vehicle parts retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	9.910	0.90	67.327	0.60	463.360	0.02
Time effects						
2006-11	-	-	-	-	-	-
2011-16	13.101	0.00	38.444	0.00	8.598	0.39
Population effects						
Population (1,000s)	2.349	0.00	2.145	0.09	5.434	0.01
Logarithm of population	-4.612	0.63	-10.066	0.50	-53.851	0.02
Population density (per km^2)	0.005	0.43	0.009	0.35	0.004	0.80
Location effects						
Coastal city	-7.289	0.07	-2.625	0.67	8.974	0.34
Logarithm of distance to nearest capital city	2.663	0.22	-5.468	0.10	-0.813	0.88
Spatial lag	-0.002	0.98	-0.064	0.42	0.013	0.87
Economic effects						
Growth in measure across all sectors in UCL during same period	1.248	0.00	1.170	0.00	0.865	0.00
Baseline value of measure in (sub-)sector at start of period	-0.402	0.00	-0.007	0.02	-0.001	0.01
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.998	0.33	-1.294	0.42	1.995	0.42
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.647	0.45	2.131	0.11	-2.488	0.23
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.502	0.03	0.361	0.30	-0.256	0.64
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.196	0.35	-0.043	0.89	0.120	0.81
Annual average deviation from mean water level in the 4 years preceding current period	1.174	0.64	1.012	0.79	0.820	0.89
Annual average deviation from mean water level during current period (m)	-0.825	0.70	-2.927	0.37	-0.384	0.94
Summary statistics						
Number of observations	348		343		347	
R-squared	0.340		0.272		0.119	
Adjusted R-squared	0.340		0.271		0.119	

Table 10: *Estimation results of linear regression of employment growth in 2-digit fuel retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	-210.626	0.13	-697.972	0.01	-304.793	0.39
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-9.154	0.19	44.588	0.00	25.164	0.15
Population effects						
Population (1,000s)	0.741	0.50	-1.455	0.46	2.245	0.41
Logarithm of population	31.076	0.05	77.513	0.01	36.981	0.35
Population density (per km^2)	-0.026	0.02	-0.041	0.04	-0.038	0.16
Location effects						
Coastal city	3.446	0.58	3.568	0.76	-10.189	0.51
Logarithm of distance to nearest capital city	-2.986	0.42	3.016	0.66	8.822	0.34
Spatial lag	0.048	0.53	0.022	0.78	-0.148	0.07
Economic effects						
Growth in measure across all sectors in UCL during same period	0.692	0.00	0.552	0.06	0.908	0.02
Baseline value of measure in (sub-)sector at start of period	-1.845	0.00	-0.068	0.00	-0.006	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-1.257	0.47	-0.573	0.86	7.866	0.07
Annual average proportion of corresponding NRM region that experienced a fire during current period	2.693	0.07	2.099	0.44	-2.012	0.58
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	-0.904	0.02	-0.061	0.93	-2.379	0.01
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.516	0.14	-0.052	0.94	-0.223	0.80
Annual average deviation from mean water level in the 4 years preceding current period	-2.793	0.51	3.415	0.68	-5.334	0.62
Annual average deviation from mean water level during current period (m)	-2.754	0.45	-7.255	0.35	0.934	0.93
Summary statistics						
Number of observations	348		320		337	
R-squared	0.223		0.205		0.164	
Adjusted R-squared	0.222		0.205		0.153	

Table 11: *Estimation results of linear regression of employment growth in 2-digit food retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	111.948	0.01	40.872	0.43	112.699	0.06
Time effects						
2006-11	-	-	-	-	-	-
2011-16	4.675	0.02	14.178	0.00	13.083	0.00
Population effects						
Population (1,000s)	3.339	0.00	3.136	0.00	3.652	0.00
Logarithm of population	-11.869	0.01	-4.813	0.42	-12.661	0.06
Population density (per km^2)	-0.002	0.47	-0.006	0.15	-0.002	0.71
Location effects						
Coastal city	2.404	0.19	1.332	0.57	1.100	0.68
Logarithm of distance to nearest capital city	-2.529	0.02	-2.172	0.11	-1.426	0.35
Spatial lag	-0.031	0.60	0.029	0.67	-0.059	0.36
Economic effects						
Growth in measure across all sectors in UCL during same period	0.857	0.00	0.658	0.00	0.872	0.00
Baseline value of measure in (sub-)sector at start of period	-0.159	0.00	-0.006	0.00	0.000	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.698	0.19	1.047	0.12	0.406	0.59
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.429	0.33	-0.860	0.12	-0.343	0.58
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	-0.005	0.96	-0.217	0.14	0.020	0.90
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.022	0.84	0.030	0.82	-0.106	0.48
Annual average deviation from mean water level in the 4 years preceding current period	-1.612	0.20	-0.878	0.59	-2.093	0.24
Annual average deviation from mean water level during current period (m)	-0.655	0.54	0.536	0.70	0.264	0.86
Summary statistics						
Number of observations	352		352		352	
R-squared	0.581		0.462		0.516	
Adjusted R-squared	0.581		0.461		0.515	

Table 12: *Estimation results of linear regression of employment growth in 2-digit other store-based retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	84.126	0.01	-19.482	0.61	188.749	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-9.343	0.00	3.363	0.08	-11.321	0.00
Population effects						
Population (1,000s)	2.009	0.00	0.780	0.12	2.764	0.00
Logarithm of population	-9.639	0.01	1.323	0.76	-20.567	0.00
Population density (per km^2)	0.001	0.59	0.000	0.99	-0.003	0.52
Location effects						
Coastal city	1.805	0.21	3.604	0.03	3.469	0.14
Logarithm of distance to nearest capital city	-2.437	0.00	-3.456	0.00	-4.090	0.00
Spatial lag	-0.098	0.05	-0.030	0.61	-0.031	0.61
Economic effects						
Growth in measure across all sectors in UCL during same period	1.073	0.00	0.865	0.00	0.909	0.00
Baseline value of measure in (sub-)sector at start of period	-0.041	0.00	-0.001	0.09	0.000	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-0.394	0.33	-0.608	0.21	-0.597	0.38
Annual average proportion of corresponding NRM region that experienced a fire during current period	0.310	0.36	0.361	0.37	0.073	0.90
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.171	0.05	0.258	0.02	0.233	0.12
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.036	0.66	0.048	0.62	-0.057	0.67
Annual average deviation from mean water level in the 4 years preceding current period	1.069	0.27	0.600	0.61	0.262	0.87
Annual average deviation from mean water level during current period (m)	0.253	0.76	1.358	0.17	-0.716	0.61
Summary statistics						
Number of observations	352		352		352	
R-squared	0.754		0.595		0.620	
Adjusted R-squared	0.754		0594		0.620	

Table 13: *Estimation results of linear regression of employment growth in 3-digit furniture, floor coverings, houseware & textile goods retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	600.121	0.00	-176.787	0.53	452.552	0.09
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-21.228	0.02	1.253	0.93	-30.443	0.03
Population effects						
Population (1,000s)	9.530	0.00	4.868	0.09	6.980	0.01
Logarithm of population	-64.151	0.00	15.161	0.64	-48.103	0.12
Population density (per km^2)	0.003	0.81	0.027	0.18	0.013	0.53
Location effects						
Coastal city	2.390	0.75	-1.754	0.89	4.721	0.69
Logarithm of distance to nearest capital city	-12.082	0.01	-4.927	0.49	-10.010	0.15
Spatial lag	0.229	0.00	0.061	0.44	-0.047	0.55
Economic effects						
Growth in measure across all sectors in UCL during same period	1.176	0.00	0.889	0.01	1.500	0.00
Baseline value of measure in (sub-)sector at start of period	-1.943	0.00	-0.063	0.00	-0.003	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.147	0.95	4.778	0.17	-1.570	0.64
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.984	0.59	-3.636	0.21	0.023	0.99
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.210	0.66	1.300	0.09	0.285	0.70
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.120	0.79	-0.195	0.78	-0.960	0.16
Annual average deviation from mean water level in the 4 years preceding current period	-3.879	0.46	-1.622	0.84	8.777	0.27
Annual average deviation from mean water level during current period (m)	-6.499	0.14	2.419	0.76	0.898	0.89
Summary statistics						
Number of observations	346		327		341	
R-squared	0.303		0.113		0.201	
Adjusted R-squared	0.273		0.110		0.199	

Table 14: *Estimation results of linear regression of employment growth in 3-digit electrical and electronic goods retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	202.226	0.09	-45.017	0.77	1025.333	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-30.719	0.00	-7.909	0.28	-40.036	0.02
Population effects						
Population (1,000s)	6.004	0.00	4.031	0.01	12.967	0.00
Logarithm of population	-28.566	0.04	-1.971	0.91	-126.533	0.00
Population density (per km^2)	0.008	0.35	0.002	0.85	0.024	0.30
Location effects						
Coastal city	-11.276	0.03	-0.263	0.97	-11.629	0.40
Logarithm of distance to nearest capital city	3.482	0.27	-0.727	0.84	-3.991	0.62
Spatial lag	-0.128	0.09	-0.162	0.05	-0.066	0.40
Economic effects						
Growth in measure across all sectors in UCL during same period	1.464	0.00	0.781	0.00	2.213	0.00
Baseline value of measure in (sub-)sector at start of period	-1.216	0.00	-0.029	0.00	-0.002	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.592	0.70	1.381	0.44	0.769	0.85
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.375	0.76	-0.383	0.80	0.113	0.97
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.113	0.73	-0.018	0.96	0.684	0.43
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.569	0.06	0.765	0.03	-0.164	0.84
Annual average deviation from mean water level in the 4 years preceding current period	-4.704	0.19	-0.070	0.99	-3.217	0.74
Annual average deviation from mean water level during current period (m)	-3.622	0.24	7.255	0.04	-4.596	0.57
Summary statistics						
Number of observations	350		329		339	
R-squared	0.384		0.158		0.270	
Adjusted R-squared	0.374		0.145		0.269	

Table 15: *Estimation results of linear regression of employment growth in 3-digit hardware, building and garden supplies retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	11.520	0.90	189.696	0.24	412.040	0.02
Time effects						
2006-11	-	-	-	-	-	-
2011-16	1.407	0.77	18.299	0.03	-0.583	0.95
Population effects						
Population (1,000s)	3.615	0.00	5.504	0.00	7.345	0.00
Logarithm of population	-2.900	0.79	-20.197	0.28	-46.662	0.02
Population density (per km^2)	0.005	0.46	0.005	0.66	-0.020	0.17
Location effects						
Coastal city	4.514	0.29	11.414	0.12	18.834	0.02
Logarithm of distance to nearest capital city	-0.890	0.72	-11.047	0.01	-5.592	0.24
Spatial lag	0.117	0.11	-0.049	0.53	0.049	0.51
Economic effects						
Growth in measure across all sectors in UCL during same period	0.943	0.00	1.108	0.00	0.992	0.00
Baseline value of measure in (sub-)sector at start of period	-0.825	0.00	-0.033	0.00	-0.002	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-0.744	0.54	-1.384	0.51	1.843	0.43
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.324	0.75	0.357	0.84	-2.142	0.27
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.469	0.08	0.459	0.32	0.253	0.62
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.143	0.57	-0.098	0.82	0.554	0.24
Annual average deviation from mean water level in the 4 years preceding current period	1.114	0.70	3.954	0.43	0.626	0.91
Annual average deviation from mean water level during current period (m)	1.226	0.62	-4.842	0.26	-3.225	0.50
Summary statistics						
Number of observations	352		347		352	
R-squared	0.257		0.218		0.236	
Adjusted R-squared	0.251		0.216		0.234	

Table 16: *Estimation results of linear regression of employment growth in 3-digit recreational goods retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	206.535	0.03	741.103	0.25	1421.192	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-15.012	0.00	80.154	0.02	-29.011	0.17
Population effects						
Population (1,000s)	4.897	0.00	9.098	0.13	17.024	0.00
Logarithm of population	-23.918	0.03	-83.279	0.25	-143.776	0.00
Population density (per km^2)	-0.002	0.77	-0.071	0.13	-0.025	0.43
Location effects						
Coastal city	12.988	0.00	56.772	0.04	61.745	0.00
Logarithm of distance to nearest capital city	-4.430	0.07	-23.155	0.16	-40.918	0.00
Spatial lag	-0.143	0.06	-0.062	0.45	-0.083	0.30
Economic effects						
Growth in measure across all sectors in UCL during same period	1.012	0.00	0.672	0.37	1.158	0.01
Baseline value of measure in (sub-)sector at start of period	-1.119	0.00	-0.051	0.13	-0.006	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-1.945	0.10	14.235	0.08	3.298	0.53
Annual average proportion of corresponding NRM region that experienced a fire during current period	2.973	0.00	-7.572	0.26	1.818	0.68
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.357	0.17	-0.149	0.93	1.301	0.26
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.460	0.05	2.138	0.17	-3.193	0.00
Annual average deviation from mean water level in the 4 years preceding current period	4.574	0.11	-10.659	0.58	-1.730	0.89
Annual average deviation from mean water level during current period (m)	-2.124	0.38	15.558	0.33	-3.078	0.78
Summary statistics						
Number of observations	350		328		350	
R-squared	0.312		0.087		0.173	
Adjusted R-squared	0.301		0.082		0.169	

Table 17: *Estimation results of linear regression of employment growth in 3-digit clothing, footware and personal accessory retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	141.150	0.11	108.626	0.49	156.066	0.32
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-8.699	0.05	27.128	0.00	-16.018	0.06
Population effects						
Population (1,000s)	2.659	0.00	2.961	0.06	2.504	0.08
Logarithm of population	-13.778	0.17	-13.965	0.44	-12.768	0.48
Population density (per km^2)	0.000	0.97	-0.003	0.79	-0.010	0.43
Location effects						
Coastal city	2.988	0.45	16.048	0.02	8.315	0.24
Logarithm of distance to nearest capital city	-5.842	0.01	-8.546	0.04	-10.307	0.01
Spatial lag	-0.137	0.06	0.067	0.38	-0.029	0.70
Economic effects						
Growth in measure across all sectors in UCL during same period	1.273	0.00	1.017	0.00	1.210	0.00
Baseline value of measure in (sub-)sector at start of period	-0.293	0.00	-0.012	0.01	-0.001	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-1.929	0.08	-1.607	0.42	-4.209	0.04
Annual average proportion of corresponding NRM region that experienced a fire during current period	1.835	0.05	2.471	0.14	4.129	0.01
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.631	0.01	0.911	0.04	0.430	0.32
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.014	0.95	0.285	0.48	0.206	0.61
Annual average deviation from mean water level in the 4 years preceding current period	9.918	0.00	-5.081	0.31	1.885	0.71
Annual average deviation from mean water level during current period (m)	2.063	0.37	4.443	0.29	-2.149	0.61
Summary statistics						
Number of observations	352		345		350	
R-squared	0.412		0.186		0.257	
Adjusted R-squared	0.409		0.182		0.257	

Table 18: *Estimation results of linear regression of employment growth in 3-digit department stores across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	-231.838	0.09	-349.108	0.41	-885.504	0.37
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-6.734	0.33	40.735	0.06	-58.779	0.25
Population effects						
Population (1,000s)	2.340	0.06	1.027	0.76	3.290	0.69
Logarithm of population	25.088	0.11	42.091	0.38	135.972	0.22
Population density (per km^2)	-0.003	0.79	-0.010	0.75	-0.083	0.27
Location effects						
Coastal city	-7.355	0.24	-16.831	0.36	8.805	0.84
Logarithm of distance to nearest capital city	2.692	0.45	-10.087	0.34	-33.806	0.19
Spatial lag	0.255	0.00	0.132	0.11	0.211	0.01
Economic effects						
Growth in measure across all sectors in UCL during same period	1.034	0.00	0.742	0.12	1.433	0.13
Baseline value of measure in (sub-)sector at start of period	-0.673	0.00	-0.034	0.01	-0.006	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.175	0.92	2.525	0.65	-3.733	0.77
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.702	0.63	-0.115	0.98	2.095	0.84
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.075	0.84	1.272	0.30	0.770	0.78
Annual average proportion of corresponding NRM region that experienced a drought during current period	-0.256	0.47	-0.361	0.73	-3.776	0.14
Annual average deviation from mean water level in the 4 years preceding current period	-2.829	0.50	4.771	0.73	-10.239	0.72
Annual average deviation from mean water level during current period (m)	-1.288	0.72	-16.198	0.23	-3.532	0.89
Summary statistics						
Number of observations	343		303		326	
R-squared	0.248		0.086		0.111	
Adjusted R-squared	0.220		0.079		0.088	

Table 19: *Estimation results of linear regression of employment growth in 3-digit pharmaceutical and other store-based retailing across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	191.057	0.00	188.753	0.04	615.523	0.00
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-5.947	0.04	15.288	0.00	-13.761	0.09
Population effects						
Population (1,000s)	4.553	0.00	4.844	0.00	8.504	0.00
Logarithm of population	-20.673	0.00	-22.350	0.03	-65.304	0.00
Population density (per km^2)	-0.002	0.58	-0.003	0.72	-0.013	0.24
Location effects						
Coastal city	1.212	0.63	1.612	0.70	9.161	0.16
Logarithm of distance to nearest capital city	-1.613	0.28	-5.269	0.03	-8.530	0.03
Spatial lag	-0.006	0.93	-0.047	0.54	-0.090	0.23
Economic effects						
Growth in measure across all sectors in UCL during same period	0.979	0.00	0.720	0.00	0.911	0.00
Baseline value of measure in (sub-)sector at start of period	-0.513	0.00	-0.017	0.00	-0.001	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.017	0.98	2.381	0.04	-0.832	0.65
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.501	0.41	-1.738	0.08	1.101	0.48
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.054	0.73	-0.087	0.74	0.658	0.10
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.006	0.97	0.069	0.77	-0.562	0.13
Annual average deviation from mean water level in the 4 years preceding current period	2.226	0.20	0.849	0.76	2.971	0.51
Annual average deviation from mean water level during current period (m)	4.114	0.01	2.850	0.24	1.337	0.73
Summary statistics						
Number of observations	352		352		352	
R-squared	0.538		0.273		0.325	
Adjusted R-squared	0.538		0.273		0.325	

Table 20: *Estimation results of linear regression of employment growth in 1-digit accommodation and food services across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	-96.469	0.01	-198.960	0.00	-98.106	0.10
Time effects						
2006-11	-	-	-	-	-	-
2011-16	4.055	0.03	7.790	0.00	-0.111	0.97
Population effects						
Population (1,000s)	0.320	0.40	-0.422	0.38	0.311	0.56
Logarithm of population	10.507	0.01	20.554	0.00	8.351	0.22
Population density (per km^2)	0.004	0.16	0.008	0.05	0.011	0.02
Location effects						
Coastal city	-1.476	0.38	-1.628	0.48	-1.810	0.51
Logarithm of distance to nearest capital city	1.310	0.18	2.175	0.11	2.882	0.07
Spatial lag	-0.040	0.46	-0.054	0.36	-0.038	0.48
Economic effects						
Growth in measure across all sectors in UCL during same period	1.108	0.00	1.264	0.00	1.403	0.00
Baseline value of measure in (sub-)sector at start of period	-0.030	0.00	-0.001	0.00	0.000	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-0.043	0.93	-0.130	0.84	0.270	0.72
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.168	0.67	-0.026	0.96	-0.679	0.28
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	0.048	0.64	0.227	0.11	0.019	0.91
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.165	0.09	0.017	0.90	0.133	0.38
Annual average deviation from mean water level in the 4 years preceding current period	0.134	0.91	-0.384	0.81	-3.100	0.09
Annual average deviation from mean water level during current period (m)	1.321	0.18	0.962	0.47	0.261	0.87
Summary statistics						
Number of observations	352		352		352	
R-squared	0.672		0.599		0.687	
Adjusted R-squared	0.672		0.597		0.687	

Table 21: *Estimation results of linear regression of employment growth in 2-digit accommodation across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	-298.736	0.00	-164.677	0.29	-487.099	0.05
Time effects						
2006-11	-	-	-	-	-	-
2011-16	-13.648	0.01	-0.858	0.91	-12.584	0.33
Population effects						
Population (1,000s)	-1.585	0.05	-0.895	0.47	-2.314	0.24
Logarithm of population	30.814	0.01	18.079	0.31	41.810	0.14
Population density (per km^2)	0.018	0.02	0.010	0.40	0.045	0.02
Location effects						
Coastal city	-5.423	0.23	-3.979	0.58	-17.269	0.14
Logarithm of distance to nearest capital city	7.499	0.00	3.360	0.44	12.306	0.07
Spatial lag	0.056	0.42	0.023	0.76	-0.045	0.53
Economic effects						
Growth in measure across all sectors in UCL during same period	1.565	0.00	1.553	0.00	3.261	0.00
Baseline value of measure in (sub-)sector at start of period	-0.073	0.01	-0.003	0.03	0.000	0.08
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	-1.345	0.28	-3.567	0.08	-3.920	0.22
Annual average proportion of corresponding NRM region that experienced a fire during current period	0.680	0.52	2.092	0.21	2.824	0.29
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	-0.111	0.69	0.099	0.82	0.363	0.60
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.134	0.60	-0.578	0.15	0.989	0.13
Annual average deviation from mean water level in the 4 years preceding current period	0.061	0.98	-17.373	0.00	-2.632	0.73
Annual average deviation from mean water level during current period (m)	8.330	0.00	6.891	0.09	-1.891	0.77
Summary statistics						
Number of observations	352		350		351	
R-squared	0.405		0.239		0.402	
Adjusted R-squared	0.402		0.239		0.404	

Table 22: *Estimation results of linear regression of employment growth in 2-digit food and beverage services across UCLs*

Explanatory variable	**Number of jobs**		**Hours worked**		**Total weekly wages**	
	est	**p-val**	**est**	**p-val**	**est**	**p-val**
Constant	1.726	0.97	-97.408	0.05	-27.525	0.65
Time effects						
2006-11	-	-	-	-	-	-
2011-16	8.029	0.00	17.667	0.00	7.084	0.03
Population effects						
Population (1,000s)	1.561	0.00	1.208	0.04	1.622	0.01
Logarithm of population	-0.464	0.92	9.756	0.09	2.306	0.74
Population density (per km^2)	0.001	0.64	0.001	0.78	0.004	0.37
Location effects						
Coastal city	-0.362	0.84	-0.298	0.89	1.530	0.57
Logarithm of distance to nearest capital city	0.465	0.66	-0.090	0.94	0.893	0.58
Spatial lag	0.109	0.05	0.049	0.45	0.055	0.35
Economic effects						
Growth in measure across all sectors in UCL during same period	0.928	0.00	0.849	0.00	1.084	0.00
Baseline value of measure in (sub-)sector at start of period	-0.060	0.00	-0.002	0.00	0.000	0.00
Natural disaster effects						
Annual average proportion of corresponding NRM region that experienced a fire in the 4 years preceding current period	0.337	0.51	1.257	0.05	0.567	0.46
Annual average proportion of corresponding NRM region that experienced a fire during current period	-0.466	0.28	-1.024	0.05	-0.862	0.18
Annual average proportion of corresponding NRM region that experienced a drought in the 4 years preceding current period	-0.007	0.95	0.081	0.55	-0.018	0.92
Annual average proportion of corresponding NRM region that experienced a drought during current period	0.161	0.12	0.041	0.75	-0.131	0.40
Annual average deviation from mean water level in the 4 years preceding current period	-0.323	0.79	-0.569	0.71	-3.021	0.10
Annual average deviation from mean water level during current period (m)	0.658	0.53	0.768	0.55	2.683	0.09
Summary statistics						
Number of observations	352		352		352	
R-squared	0.589		0.503		0.583	
Adjusted R-squared	0.580		0.502		0.583	

6. Implications for the COVID-19 pandemic

To understand how the potential impact of the ongoing COVID-19 pandemic might compare with these past natural disasters, we undertake additional analysis to examine the effects of the pandemic on economic activity across different industrial sectors. If we can identify the effects of previous natural disasters on the evolution of non-farm retail and service businesses in urban centres across regional Australia based on the analyses described in the previous section, we can extrapolate some of these findings based on this additional analysis to discuss how businesses are likely to be impacted by the ongoing pandemic.

The ABS releases monthly and quarterly updates of the civilian labour force derived from the Labour Force Survey component of the Monthly Population Survey. The latest versions of these datasets contain information up to and including August 2020. The monthly data offers some information on the spatial distribution of labour force status, but it does not decompose this information by industry sectors. The quarterly releases from the ABS offer some information on the distribution of labour force status across different 1 and 2-digit ANZSIC sectors. However, this information is available at a national level only.

We summarise the key findings from our analysis as follows:

1. **Economy-wide effects**

    a. Employment losses peaked in May 2020, with total employment declining by 735,000 nationally and 205,000 in regional Australia, compared to May 2019. The economy has since shown some signs of recovery. As of August 2020, the pandemic has resulted in a loss of roughly 600,000 jobs nationally and 140,000 jobs in regional Australia.

    b. The cumulative impact of the pandemic on year-on-year jobs growth as of August 2020 is estimated to be -3.5 per cent in regional Australia. Full-time jobs declined by 4.0 per cent compared to August 2019, while part-time jobs increased by 1.8 per cent, indicating that some of the full-time jobs lost in regional Australia have been replaced by part-time employment arrangements.

2. **Retail trade**

    a. The reduction in jobs in the Retail Trade sector due directly to the pandemic is estimated to be 2.2 per cent as of August 2020.

    b. Number of jobs in Fuel Retailing declined the most immediately following the onset of the pandemic, by 29.0 per cent in May 2020 compared to May 2019. However, the sub-sector had almost entirely recovered by August 2020, with number of jobs being 1.8 per cent less than August 2019.

    c. Year-on-year change in number of jobs in Motor Vehicle and Motor Vehicle Parts Retailing was -11.4 per cent in May 2020 and an even higher -20.2 per cent by August 2020. Unlike most other sectors, Motor Vehicle and Motor Vehicle Parts Retailing has not shown any signs of recovery.

    d. The impact of the pandemic on Food Retailing appears to have been marginal in comparison. While the number of jobs declined immediately following the onset of the pandemic, year-on-year growth had returned mostly back to normal by August 2020.

e. Number of jobs in Other Store-Based Retailing declined by 9.6 per cent in May 2020 compared to May 2019. However, the sub-sector had almost entirely recovered by August 2020, with the cumulative impact of the pandemic on reduction in jobs estimated to be 1.5 per cent.

3. Accommodation and food services

a. The reduction in jobs in the Accommodation and Food Services sector due directly to the pandemic is estimated to be 17.9 per cent, or 170,000 jobs, as of August 2020.

b. Both the Accommodation sub-sector and the Food and Beverage Services sub-sectors declined by nearly 30 per cent in May 2020, compared to May 2019.

c. However, the Accommodation sub-sector was in decline prior to the onset of the pandemic, shrinking by 13 – 23 per cent in preceding months. In fact, by August 2020, the sub-sector had only contracted by 11.7 per cent compared to August 2019, less than the average year-on-year change before the pandemic, indicating that the pandemic may in fact have resulted in marginal growth in the sub-sector.

d. In contrast, the Food and Beverage Services sub-sector was growing steadily prior to the onset of the pandemic at roughly 5 per cent per year, and the pandemic is estimated to have cost roughly 21 per cent in jobs growth in the sub-sector as of August 2020.

Section 6.1 reviews information from the monthly ABS releases to examine economy-wide impacts of the pandemic across regional and metropolitan Australia. Section 6.2 reviews information from the quarterly ABS release to examine sector-specific impacts of the pandemic nationwide.

6.1 Impacts across regional and metropolitan Australia

The monthly releases from the ABS offer some information on the spatial distribution of labour force status. While this data is not available at the scale of a single UCL, it makes a distinction between Greater Capital Statistical Areas (GCSAs) and other parts of the country. In our analyses, we use the term 'GCSAs' to include Greater Sydney, Greater Melbourne, Greater Brisbane, Greater Adelaide, Greater Perth, Greater Hobart and the Australian Capital Territory. The term 'Regional' is used to denote all other remaining parts of the country. Unfortunately, this data is not available at the level of individual industrial sectors.

Figure 13 plots year-on-year change in employment across different spatial aggregations over the first eight months of 2020, to control for seasonal fluctuations in employment. Figure 14 plots percentage change for the same measures. Employment losses peaked in May 2020, with total employment declining by 735,000 nationally and 205,000 in regional Australia, compared to May 2019. The economy has since shown some signs of recovery. Year-on-year decline in employment has been smaller in succeeding months. For example, in August 2020, total number of jobs declined by 332,000 nationally and 83,000 in regional Australia, compared to August 2019. In the 12 months prior to the COVID-19 outbreak, i.e. from April 2019 – March 2020, average monthly year-on-year employment growth was 271,000 jobs nationally and 57,000 jobs in regional Australia. Combing these two measures, we can conclude that the pandemic has resulted in a loss of roughly 600,000 jobs nationally and 140,000 jobs in regional Australia as of August 2020.

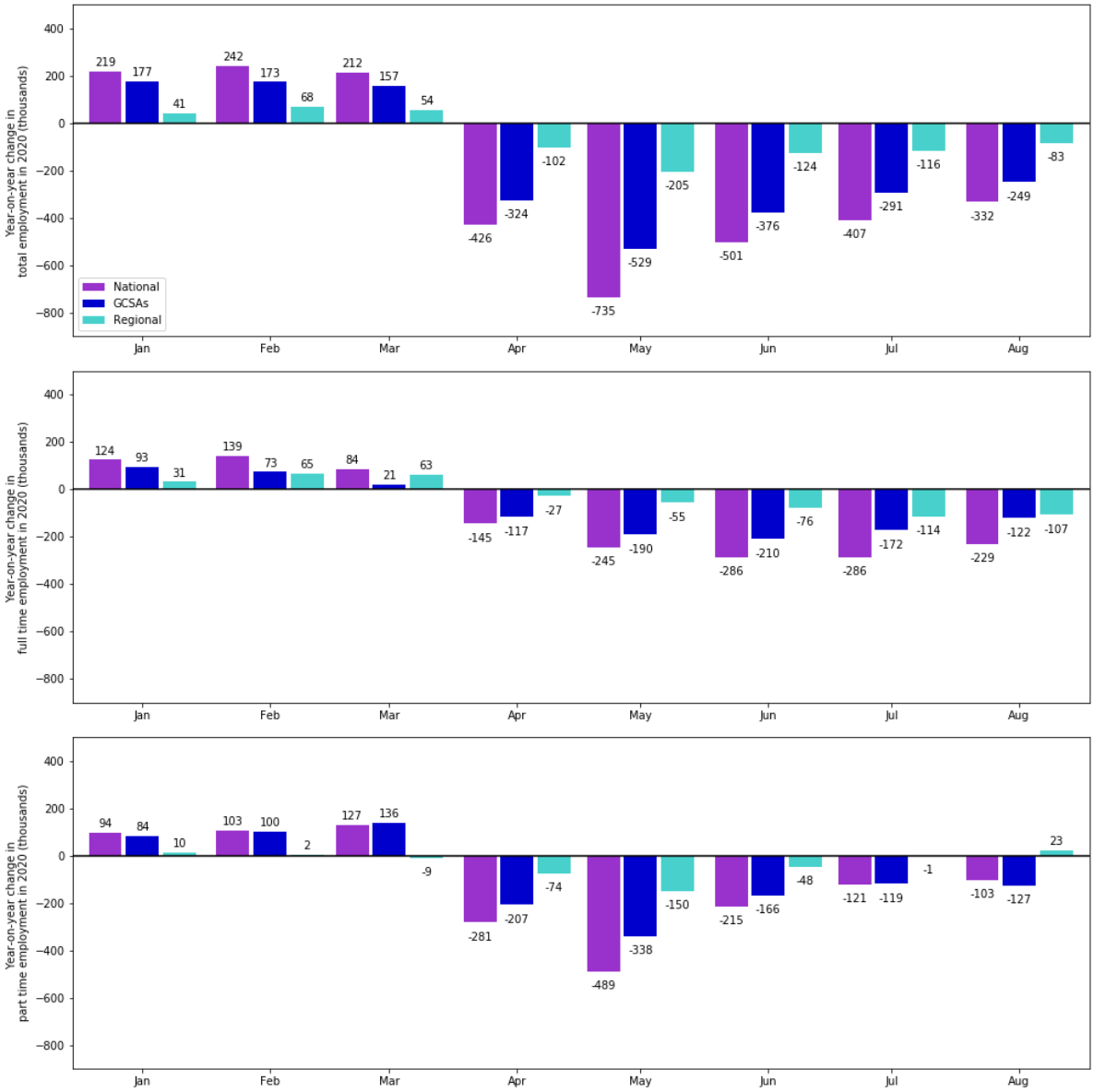

Figure 13: *Net change in total employment, full-time employment and part-time employment nationally, across GCSAs, and across regional Australia, in 2019-20, compared to the same month in 2018-19*

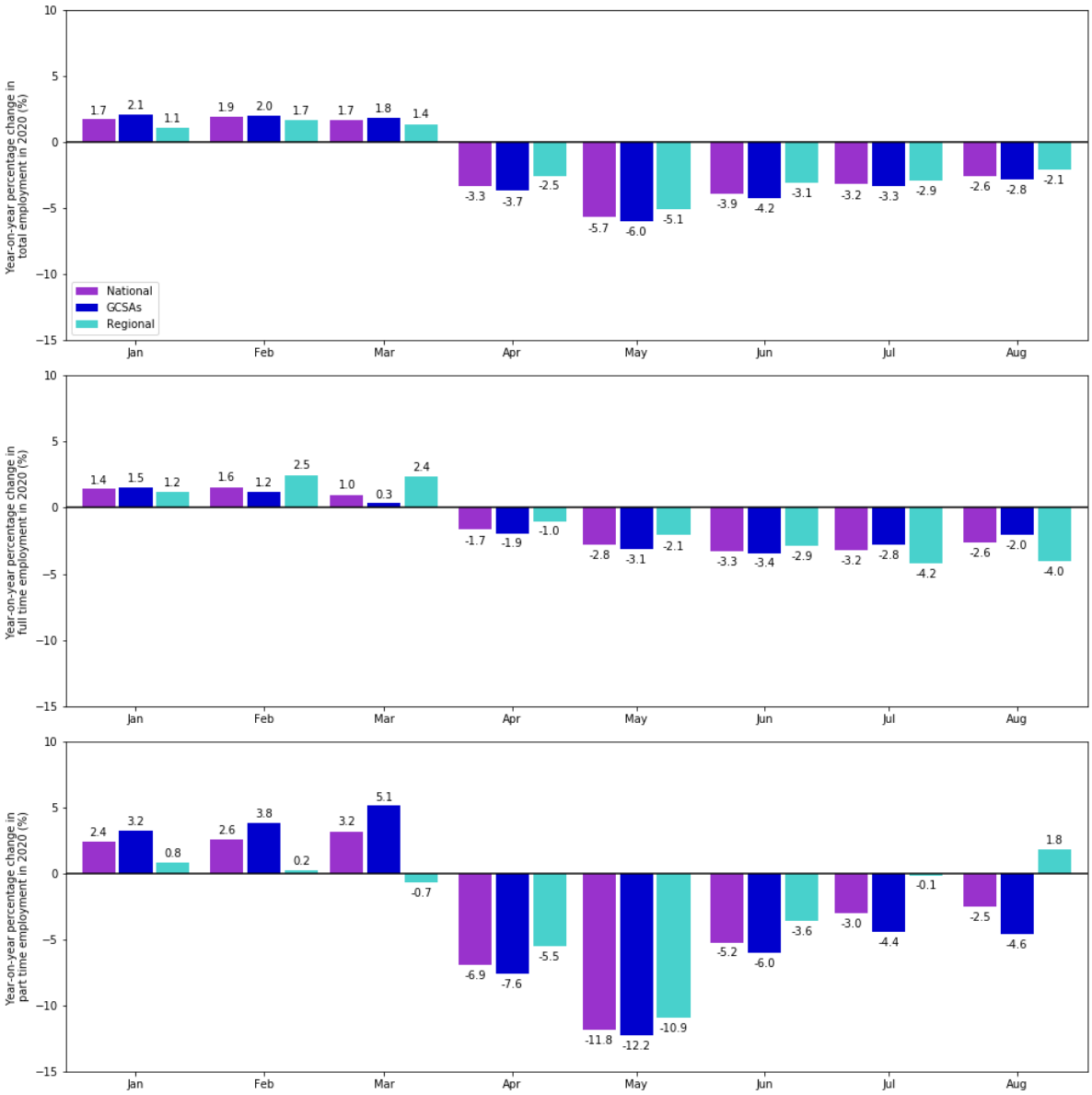

Figure 14: *Percentage change in total employment, full-time employment and part-time employment nationally, across GCSAs, and across regional Australia, in 2019-20, compared to the same month in 2018-19*

Table 23: *Estimated impact of the COVID-19 pandemic on economy-wide jobs growth across metropolitan and regional Australia*

Industry sector	Average year-on-year jobs growth in the 12 months preceding pandemic	Year-on-year jobs growth in August 2020	Estimated cumulative impact of pandemic on year-on-year jobs growth, as of August 2020
Nationwide	2.15%	-2.59%	-4.74%
Greater Capital Statistical Areas (GCSAs)	2.47%	-2.82%	-5.29%
Regional Australia	1.46%	-2.08%	-3.54%

Table 23 summarises the estimated cumulative impact of the COVID-19 pandemic on jobs growth in percentage terms. Had the pandemic not happened, assuming that employment growth would be the same as that during the 12-month period from April 2019 – March 2020 preceding the outbreak, total number of jobs in regional Australia would have grown by 1.5 per cent. In reality, total number of jobs in regional Australia had declined by 2.1 per cent in August 2020 compared to August 2019. In summary, we conclude that the pandemic has resulted in a net loss of 3.5 per cent in total number of jobs in regional Australia. The impacts of the pandemic are estimated to be greater in the GCSAs, due to the greater incidence of infections and more stringent lockdown measures. Following the same procedure, we estimate that the pandemic has resulted in a net loss of 5.3 per cent in total number of jobs across GCSAs.

Interestingly, while the initial impact on part-time employment has been much more severe than on full-time employment, the former has also been quicker to recover. At the peak of the pandemic in May 2020, full-time employment had contracted nationally by 2.8 per cent while part-time employment had contracted nationally by 11.8 per cent. By August 2020, year-on-year decline in full-time and part-time employment was more or less comparable nationally. In regional Australia, year-on-year change in the number of part-time jobs was in fact positive in August 2020, growing by 1.8 per cent compared to August 2019, and significantly higher than corresponding changes in the months prior to the COVID-19 outbreak. However, year-on-year change in the number of full-time jobs was still negative in August 2020, declining by 4.0 per cent compared to August 2019, when in the months preceding the pandemic full-time employment had grown by 1.2 - 2.5 per cent. In summary, it appears that a fraction of the full-time jobs lost in regional Australia due to the pandemic have been replaced by part-time employment arrangements.

6.2 Impacts across industrial sectors and sub-sectors

The quarterly releases from the ABS offer some information on the distribution of labour force status across different 1 and 2-digit ANZSIC sectors. However, this information is available at a national level only. Figure 15 and Figure 16 plot the net change and percentage change in employment, respectively, across different industrial sectors in 2019-20, compared to the same month in 2018-19.

The Retail Trade sector shrunk by 114,000 jobs, or 8.8 per cent, in May 2020 compared to May 2019. By August 2020, the sector had recovered slightly, with number of jobs declining by a much smaller 36,000, or 2.8 per cent, when compared to August 2019. However, given that the sector has been in steady decline much before the onset of the pandemic, contracting by 0.6 per cent year-on-year in the 12 months preceding the pandemic (see Table 24), the reduction in jobs due directly to the pandemic is more likely to be closer to 2.2 per cent as of August 2020.

Table 24: *Estimated impact of the COVID-19 pandemic on nationwide jobs growth across different industrial sectors and sub-sectors*

Industry sector	Average year-on-year jobs growth in the 12 months preceding pandemic	Year-on-year jobs growth in August 2020	Estimated cumulative impact of pandemic on year-on-year jobs growth, as of August 2020
Retail trade	-0.59%	-2.82%	-2.23%
Motor vehicle and motor vehicle parts retailing	4.25%	-20.18%	-24.43%
Fuel retailing	0.44%	-1.82%	-2.26%
Food retailing	-3.79%	-3.90%	-0.11%
Other store-based retailing	0.93%	-0.55%	-1.48%
Accommodation and food services	2.46%	-15.48%	-17.94%
Accommodation	-15.87%	-11.69%	4.18%
Food and beverage services	5.30%	-15.93%	-21.23%
Entire economy	2.15%	-2.59%	-4.74%

Figure 17 plots the corresponding percentage change in employment for different sub-sectors within the Retail Trade sector. Number of jobs in Fuel Retailing declined the most immediately following the onset of the pandemic, by 29.0 per cent in May 2020 compared to May 2019, due likely to stringent restrictions on personal movements as required by lockdown measures. However, the sub-sector had almost entirely recovered by August 2020, with number of jobs being 1.8 per cent less than August 2019. Year-on-year change in number of jobs in Motor Vehicle and Motor Vehicle Parts Retailing was -11.4 per cent in May 2020 and an even higher -20.2 per cent by August 2020. Unlike most other sectors and sub-sectors in the economy, Motor Vehicle and Motor Vehicle Parts Retailing has not shown any signs of recovery. In fact, the decline has only appeared to gotten worse over time since the onset of the pandemic. The impact of the pandemic on Food Retailing and Other Store-Based Retailing appears to have been marginal in comparison. While the number of jobs in both sub-sectors declined immediately following the onset of the pandemic, year-on-year growth had returned mostly back to normal by August 2020.

The Accommodation and Food Services sector shrunk by 269,000 jobs, or 29.5 per cent, in May 2020 compared to May 2019, and by 141,000 jobs, or 15.5 per cent, in August 2020 compared to August 2019. However, given that the sector had been growing steadily prior to the onset of the pandemic, roughly adding 20,000 – 30,000 jobs on a year-on-year basis, the reduction in jobs due directly to the pandemic are more likely to be closer to 170,000 as of August 2020, or 17.9 per cent.

Figure 18 plots the corresponding percentage change in employment for different sub-sectors within the Accommodation and Food Services sector. Both the Accommodation sub-sector and the Food and Beverage Services sub-sectors declined by nearly 30 per cent in May 2020, compared to May 2019. However, the Accommodation sub-sector was in decline prior to the onset of the pandemic, shrinking by 13 – 23 per cent in preceding months. In fact, by August 2020, the sub-sector had only contracted by 11.7 per cent compared to August 2019, less than the average year-on-year change before the pandemic, indicating that the pandemic may in fact have resulted in marginal growth in the sub-sector. In contrast, the Food and Beverage Services sub-sector was growing steadily prior to the onset of the pandemic at roughly 5 per cent per year, and the pandemic is estimated to have cost roughly 21 per cent in jobs growth in the sub-sector as of August 2020.

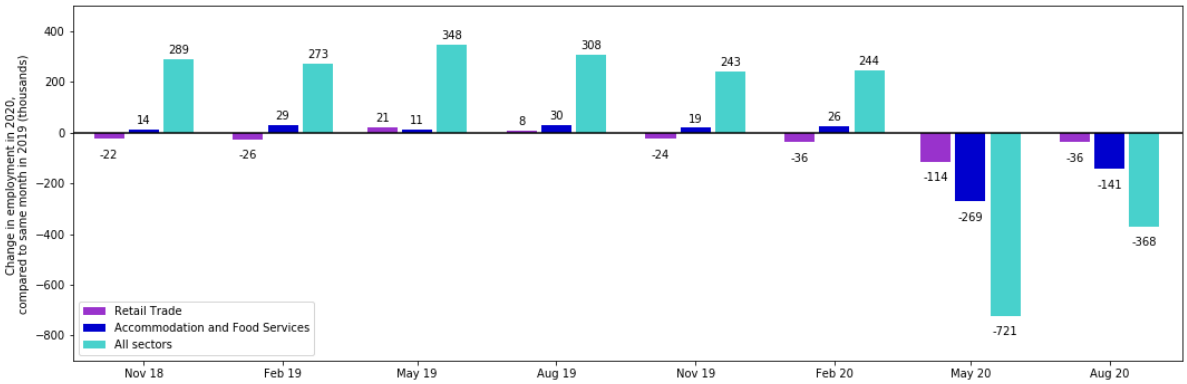

Figure 15: *Net change in total employment across different industrial sectors in 2019-20, compared to the same month in 2018-19*

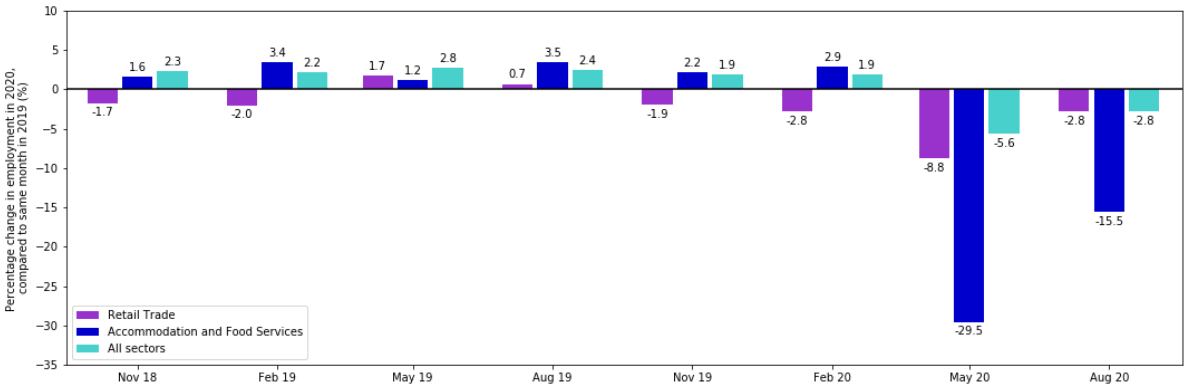

Figure 16: *Percentage change in total employment across different industrial sectors in 2019-20, compared to the same month in 2018-19*

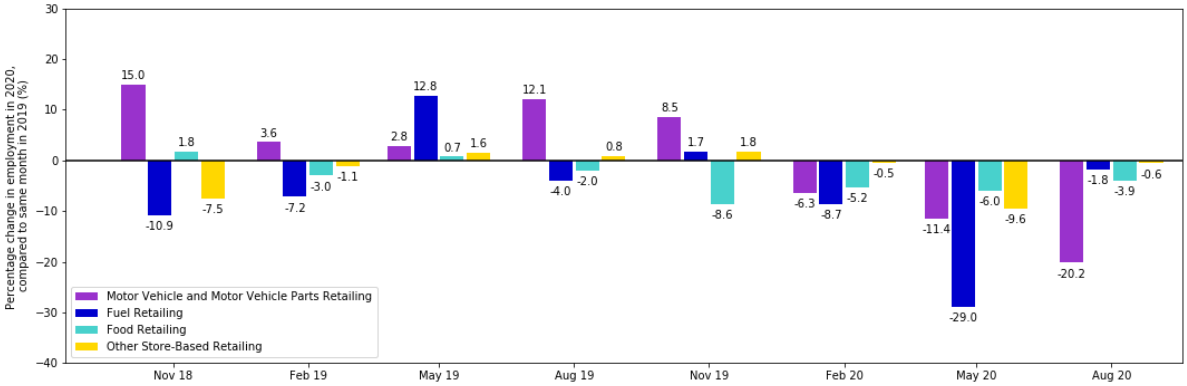

Figure 17: *Net change in total employment across different industrial sub-sectors within the Retail Trade sector in 2019-20, compared to the same month in 2018-19*

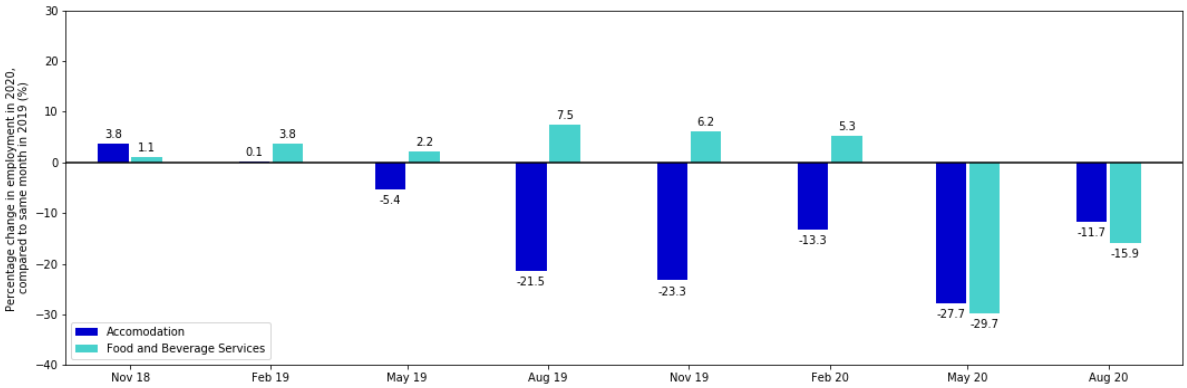

Figure 18: *Percentage change in total employment across different industrial sub-sectors within the Accommodation and Food Services sector in 2019-20, compared to the same month in 2018-19*

7. Conclusions

This study examined historic changes in the mix of main-street retail and service businesses in urban centres across regional Australia since 2006, and the impact of natural disasters on the evolutionary process. We focused primarily on the indirect effects of droughts, floods and fires. Following the outbreak of the COVID-19 pandemic, study scope was expanded to include potential impacts of the pandemic on these same sectors and businesses.

We utilized data from the Census over the period 2006-16 to examine how the mix of main-street retail services has evolved during this period across 176 mid-sized urban areas in Australia with populations between 5,000 and 50,000, as per the 2016 Census. We limited our attention to sub-sectors within the following two broad industry sectors, as defined per the 1-digit ANZSIC scheme: Retail Trade (G), and Accommodation and Food Services (H). Growth across sectors and sub-sectors was measured in terms of change in total number of jobs in the sector, total number of hours worked in a single week by all individuals employed in that sector, and total wages paid in a single week to all individuals employed in that sector. The incidence and intensity of droughts and floods was measured using data from the Bureau of Meteorology, and the incidence and intensity of bush fires was measured using data from the Water and Landscape Dynamics group at the Australian National University. To quantify the impacts of the COVID-19 pandemic, additional historic employment data was sourced from the Labour Force Survey conducted by the ABS, up to and including August 2020.

We summarise the key findings in Table 25. We find that growth has varied across different sectors and sub-sectors (refer to Section 5, and in particular Figure 4, for more details). The food and beverage services sub-sector has been the fastest growing sub-sector. while the accommodation sub-sector has declined rapidly after 2011. Some retail sub-sectors have grown over time, namely motor vehicle and motor vehicle parts retailing, fuel retailing, and food retailing, but growth has been slow when compared to the broader economy. Other retail sub-sectors, such as furniture, floor coverings, houseware and textile goods retailing, electrical and electronic goods retailing, and recreational goods retailing, have declined sharply since 2011. The recent decline in these sub-sectors, and others such as accommodation, are concurrent with the emergence of online retail and rental platforms that have disrupted traditional businesses in these sub-sectors, and are likely reflective of broader structural changes in the economy brought about by technological advances.

To further illustrate our findings, we use the example of a prototypical regional town with a total employed workforce of 20,000 individuals in 2006, and we simulate the impacts of different natural disasters on jobs growth across different sub-sectors over time based on our findings, as shown in Figure 19. In particular, we simulate five counterfactual scenarios of interest: (1) the town is completely unaffected by any natural disasters, including the COVID-19 pandemic; (2) the town is impacted by severe bush fires in the period 2006-11, such that on average roughly 10 per cent of the town's corresponding natural resource management (NRM) region is affected each year during this 5-year period (comparable in scale to the 2019–20 Australian bushfire season); (3) the town is impacted by severe droughts in the period 2006-11, such that on average roughly 20 per cent of the town's corresponding NRM region is in a state of drought each year during this 5-year period (comparable in scale to the Millennium drought); (4) the town is impacted by floods in the period 2006-11, such that the water level during this period was 1 metre higher than the historic average (comparable in scale to the 2010-11 floods in Queensland and the 2019 floods in Darwin); and (5) the town is impacted by the COVID-19 pandemic, adopting lockdown measures similar to elsewhere in the country.

The impacts of natural disasters are found to vary across sub-sectors. Interestingly, we do not always find that natural disasters have a negative impact on growth. In some cases, they are found to increase growth, due potentially to increased economic activity associated with reconstruction and rehabilitation. Analogous findings have been reported elsewhere in the literature. For example, Fomby et al. (2011) found that floods have a positive and statistically significant cumulative impact on GDP growth across both agricultural and non-agricultural sectors within developing countries.

In general, we find the impacts of droughts to be the greatest in terms of both the magnitude of impact, and the spread across different sub-sectors. Droughts have a negative impact on the economy as a whole, as well as specific sub-sectors, such as fuel retailing, due to a potential decline in the use of agricultural machinery, and recreational goods retailing, due to a potential decline in tourism. In some cases, droughts can also have positive impacts. For example, we find that droughts can increase growth in hardware, building and garden supplies retailing and clothing, footware and personal accessory retailing, due to potential relief and rehabilitation activities.

Compared to droughts, the impacts of other natural disasters are limited to fewer sub-sectors. In particular, bush fires increase growth in the fuel retailing sub-sector, due to a potential increase in demand to assist with evacuation and fire-fighting activities. Similarly, floods increase growth in the clothing, footware and personal accessory retailing sub-sector and the pharmaceutical and other store-based retailing, due to potential relief and rehabilitation activities. Across other sectors, the impacts frequently follow a V-shape or an inverted V-shape, where there is a disruption in growth in the sub-sector following the natural disaster, and the pattern reverses itself over the succeeding time period.

Similar to bush fires and floods, the impacts of the pandemic to date have also been limited to fewer sub-sectors. The motor vehicle and motor vehicle parts retailing sub-sector and the food and beverage services sub-sector have been the worst hit, losing more than 20 per cent of jobs due to the pandemic as of August 2020. This is not surprising, as these sub-sectors have been severely impacted by lockdown measures. Across other sub-sectors, the impacts of the pandemic have followed a V-shape, such that the number of jobs declined immediately following the onset of the pandemic, but year-on-year growth had returned mostly back to normal by August 2020. However, unlike droughts, floods and fires, the pandemic has not been localized or limited to specific regions, but has impacted all parts of the country. Consequently, the impacts have been greater at a national scale.

In conclusion, we find that the impacts of natural disasters on main-street retail and services sectors in regional Australia have been marginal in most cases, with deeper negative impacts usually limited to a few sub-sectors. Broader structural changes in the economy, brought on by technological advances such as the emergence of online retail and rental services, appear to have had a greater impact on the evolutionary process. This has resulted in the decline of multiple retail sub-sectors as well as the accommodation sub-sector. Concurrently, the food and beverage services sector has grown rapidly, and other evidence indicates that jobs growth in regional Australia is “expected to be driven mainly by the health care and social assistance industry”, and to a lesser extent, education and training (RAI, 2018). This will likely change the character of main-streets in regional Australia, as retail outlets and places of accommodation are gradually replaced by these new service centres.

From a policy standpoint, local leaders could ease this disruption through the design of appropriate employment support, retraining and upskilling programs that help those displaced in the retail and accommodation sub-sectors find gainful employment in growing sectors, such as food and beverage services and health care and social assistance. Additionally, local leaders could help revitalise main-streets by supporting existing and new

placemaking initiatives that generate further economic activity in these growing sectors. This could include improvements in street infrastructure, such as wider footpaths, al fresco dining options, public art installations, more trees, better lighting, etc., that support businesses in these sectors, as well as the organisation of local events such as Sunday Streets and Farmers' Markets that offer consumers access to the services that they most desire.

Table 25: *Summary of natural disaster impacts on main-street retail and services in regional Australia*

Industry sector	Baseline pattern of growth	Impacts of natural disasters			
		Droughts	Bush fires	Floods	COVID-19
Entire economy	Slow growing				
Retail trade					
Motor vehicle and motor vehicle parts retailing	Slow growing	-	-	-	Negative
Fuel retailing	Slow growing	Negative	Positive	-	-
Food retailing	Slow growing	-	-	-	-
Furniture, floor coverings, houseware and textile goods retailing	Fast declining	-	-	-	-
Electrical and electronic goods retailing	Fast declining	-	-	-	-
Hardware, building and garden supplies retailing	Slow declining	Positive	-	-	-
Recreational goods retailing	Fast declining	Negative	-	-	-
Clothing, footware and personal accessory retailing	Unclear	Positive	-	Positive	-
Department stores	Unclear	-	-	-	-
Pharmaceutical and other store-based retailing	Unclear	-	-	Positive	-
Accommodation and food services					
Accommodation	Fast declining	-	-	-	-
Food and beverage services	Fast growing	-	-	-	Negative

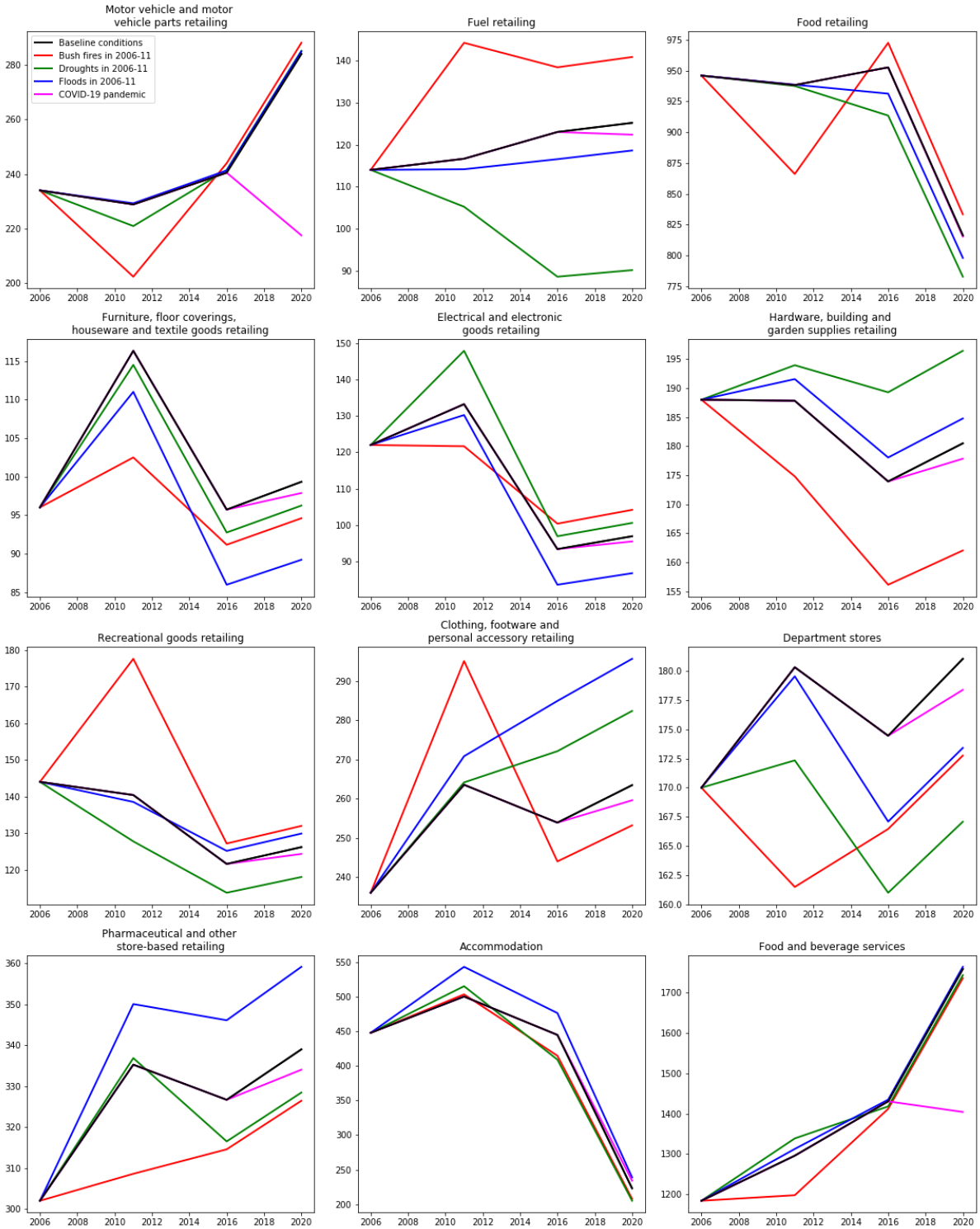

Figure 19: *Counterfactual analysis of growth in number of jobs across different main-street retail and service industries for a regional town with a total employed workforce of 20,000 individuals in 2006*

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