Demand Surge Perspective on the Canterbury Earthquake Sequence

A 10-year review

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AIR

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Overview

The Canterbury Earthquake Sequence (CES) in 2010-2011 had all the ingredients for causing loss inflation. The first earthquake occurred at the beginning of the New Zealand spring in September 2010 (when building projects typically start) followed by three more earthquakes ending around the start of winter in June 2011. The situation was compounded by a surge of new construction driven by a housing shortage in the Auckland area. It has been almost 10 years since the CES and the reconstruction work continues.

This paper focuses on demand surge, a term often used interchangeably with loss inflation, but in fact demand surge is just one component of loss inflation. To understand the difference, it is important to define what is meant by loss inflation. After an extreme event, several factors can lead to loss inflation. For insurance this means the increase in the value of claims from losses beyond what would be expected from just the event itself. Some examples are: The claims management process can be overwhelmed by the volume of claims; conditions can extend coverage beyond its original scope; or fraudulent claims can be made by a policyholder or a contractor managing the work.

There is evidence that the CES triggered demand surge, but understanding the source is difficult. The New Zealand Earthquake Commission (EQC) impact on the residential market is substantial. Regulating and underwriting risk at the country level helps create a stable market for earthquake insurance, but it will also distort market responses to a natural catastrophe. The commercial insurance market in New Zealand, however, does not have a similar mechanism, so market forces should respond to reconstruction demand shocks in a similar way to other developed countries that don't have a national insurance program.

We will first look at the economic theory that explains demand surge via changes in market equilibrium, and then consider the available economic data from New Zealand that can be used to measure it. Then we will consider underlying economic data that can help explain if the effect is coming from the residential or commercial market, or both.

What Is Demand Surge?

The economics behind demand surge can best be explained by going back to a simple market equilibrium chart. This example looks only at the labor market to illustrate the point. The chart on the left in Figure 1 shows the supply and demand for a local construction labor market prior to a catastrophic event, with the assumptions that it is the start of the construction season and is at full employment. The supply of construction labor is assumed to be constrained in the short and medium terms as represented by the inflection in the supply curve S1. The demand for construction labor is assumed to be based on construction projects deemed profitable and put into production at the start of

the season. Price (p1) and quantity (q1) identify the equilibrium in this chart, the point where everyone who wants a job in this market has one.

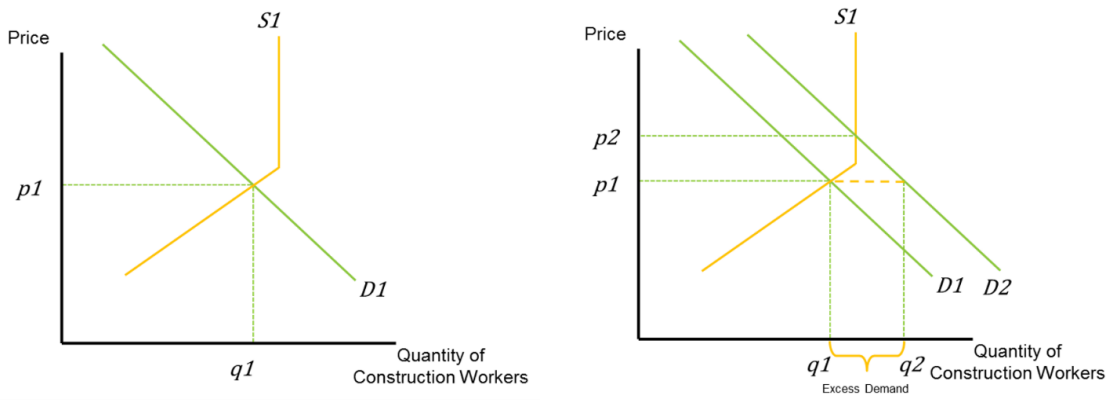

Figure 1. Supply-demand curve in a zero-demand surge market (left); supply-demand curve for a market undergoing demand surge (right)

After a catastrophe strikes the area, the demand curve (D1) shifts to the right (D2) in response to the increased demand for construction labor, as shown on the right in Figure 1 The quantity demanded shifts from q1 to q2; the difference is the excess demand because there is no supply amount that could lead to equilibrium at the same price. The market is at full employment, but there is still some slack at the top end of the supply curve between the old equilibrium and the inflection point. Once these remaining workers enter the market, where the demand curve crosses the vertical portion of the supply-constrained curve, S1 represents the unexpected increase in demand. The labor costs temporarily increase in response to the excess demand at the new equilibrium immediately after the event at (p2).

Evidence of Demand Surge After the CES

The data for this paper is from Statistics New Zealand (Stats NZ) and, unless otherwise specified, includes New Zealand and the following statistical regions: Auckland, Canterbury, and Wellington. The CES took place in the Canterbury region. Stats NZ started collecting labor cost data for the Canterbury region around the time of the CES. Because of this the local labor cost index (LCI) trend in the area affected by the earthquakes can be compared to what was going on in the rest of the country. Figure 2 shows the year-on-year labor cost increases by quarter. The raw data has been detrended by taking a 5 quarter–centered moving average to eliminate the cyclical pattern and highlight the trend. Because of the data series smoothing, year-on-year change for the detrended data starts in 2010 Q4 and includes the most recent changes for 2018 Q3. The horizontal axis shows the percentage change from the same period in

the prior year. The yellow line represents the trend in the LCI for Canterbury and the blue line represents the trend for the rest of the country.

From the beginning of the series, the difference between the yellow line and the blue line represents the LCI index differential caused by the local market disturbance. Starting in 2015 Q1, the annual increase in Canterbury drops below that of the rest of the country. There is no question that there was a modest demand surge bump after the CES, but because of the way the data is aggregated it is difficult to discern how much was in the commercial sector versus the residential sector. It is widely understood that the EQC tries to prevent demand surge in the residential sector by managing the flow of repair work. Because the residential market experienced most of the damage from the CES, we shouldn't observe a distinguishable difference in the Canterbury LCI. But we do see a demand surge response in the data, which implies that there was a significant labor increase in the commercial sector. The rest of this section will show the underlying residential economic data that supports the idea of a non-substantial increase in labor costs in Canterbury. The following section will look at the evidence in the commercial market, which shows a different view.

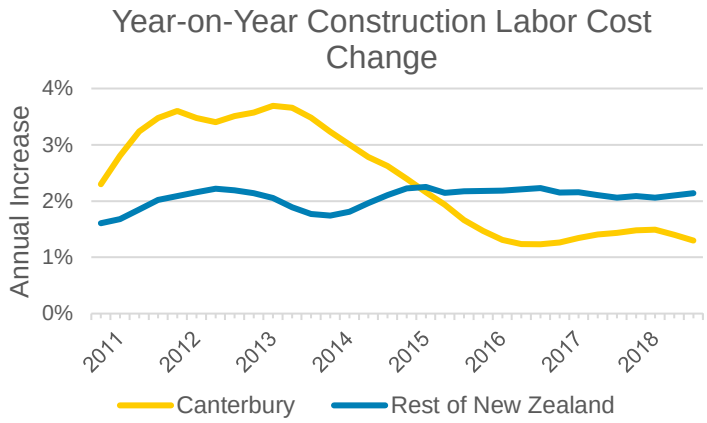

Figure 2. Labor cost index for Canterbury and the rest of New Zealand

Residential Data

Residential Construction Employment

Employment levels over time can also be thought of as a series of market equilibrium points. At each point where the measurement is taken, the supply and demand for employment intersects and the count of employees is the market equilibrium. The point where the price of labor and number of employees make current business activities profitable. For this analysis, Figure 3 shows absolute annual residential construction employment for Auckland, Wellington, and Canterbury from 2000 to 2018. This longer

time series give us an idea of what is going on in the broader economy before and after the CES.

From 2001 to 2008, all three areas show a steady increase in construction employment. With the onset of the global recession of 2008-2009, construction employment drops off dramatically in all three areas. The contraction in construction employment in Wellington extends all the way to 2013, and only rebounds to pre-recession levels 10 years later. Auckland sees a steeper drop, losing about one third of construction employees by 2012 before rebounding and hitting pre-recession levels by 2015. In Canterbury however, employment starts to rebound right after the first event of the CES. The change in employment is modest at first but by 2012 it had jumped almost 50%, with the trend not slowing down until 2015. This corresponds to the LCI inflection point from Figure 2 mentioned earlier, where the New Zealand annual change started exceeding the Canterbury annual change.

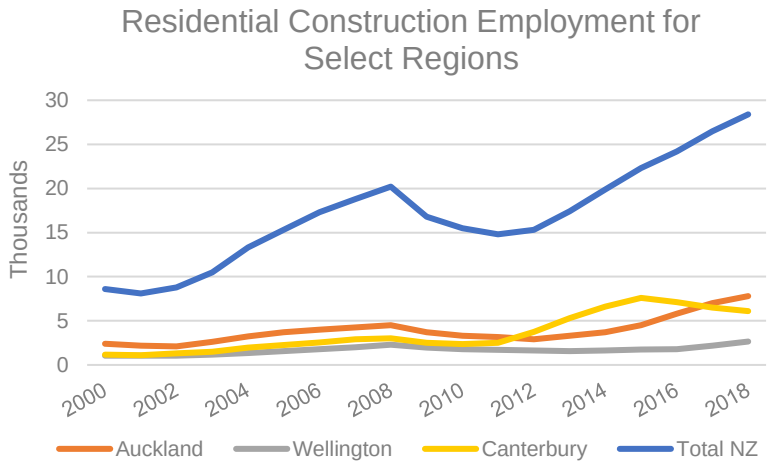

Figure 3. Residential construction employment time series for Auckland, Wellington and Canterbury

Residential Construction Work Volume

Local labor cost increases help explain why employment increases in a region after a natural catastrophe, but why wasn't the increase bigger in Canterbury? Nationally, labor costs were going up about 2% annually, which can be attributed to normal growth. The Canterbury increase was about 2% higher and that only lasted until 2015. To understand why the local market was not overwhelmed, it helps to look at building permits (or "consent" in New Zealand) per worker. New construction projects are always in the pipeline when there is a shortage of housing or commercial space. Based on availability and the respective prices of labor, materials, and other resources, real estate developers will decide to move forward on a project based on whether they can make a profit.

The first step is to get a building consent. So, this measure is a forward-looking indication for the construction market and its capability to meet current needs. Figure 4 shows the building consents per construction worker for New Zealand, Auckland, Wellington, and Canterbury for new construction. To understand why the New Zealand ratios are significant it helps to look at what happened in the U.S. housing market before and after the housing bubble. The right panel in Figure 4 shows evidence from selected markets in the U.S. leading up to the real estate collapse in 2006 and the market response in the years afterward. The most significant impact was in Florida where the ratio of permits to worker started at 3:1 in 2000 going all the way up to 4.3:1 in 2004 before starting a decline that lasted until 2009. Over this same period, construction labor prices in this state increased significantly every year until 2005 at rates that far exceeded the national average before the hurricane season of 2004. Labor costs in Florida trailed the decline and subsequent rebound in permits per worker.

How does this relate to New Zealand? For U.S. markets affected by the real estate bubble but where labor costs followed the national trend, the ratio of permits to worker was closer to 1. This is what we see in New Zealand, and the Wellington and Canterbury regions. This suggests that consents were closely tracking the construction labor market, increasing only at a rate that was consistent with the labor market and not putting a further demand strain that would increase prices even higher. This could be due to new projects being delayed or a slowdown in new construction in Canterbury and Wellington. For Auckland there is a big jump in consents per worker starting in 2012 before the employment started increasing. For the next 3 years the increase in consents exceeded the increase in labor until turning the corner in 2016 suggesting that at that time market forces were putting a damper on demand for new dwellings.

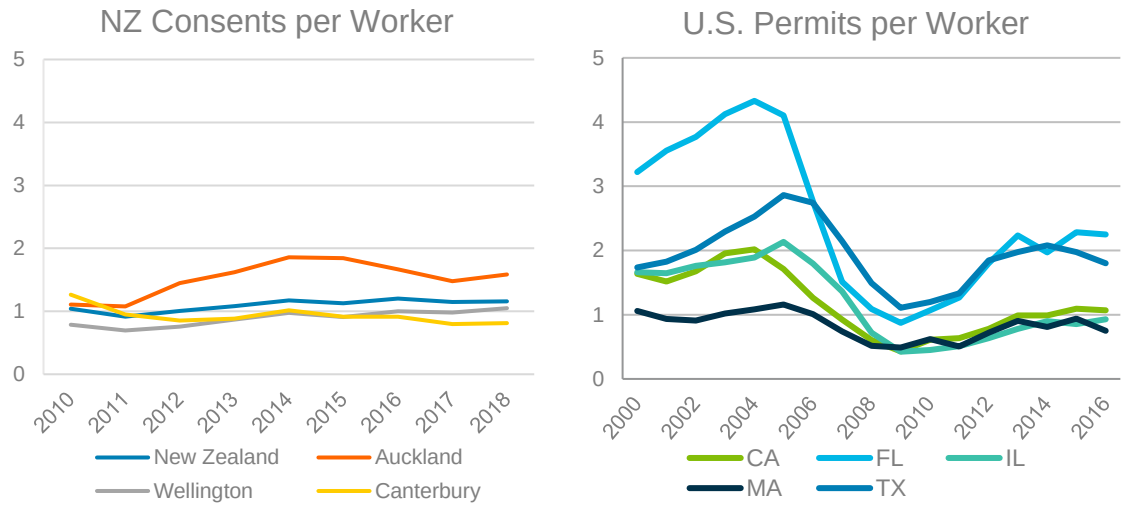

Figure 4. Left: Building consents per worker for New Zealand, Auckland, Wellington, and Canterbury. Right: Building permits per worker for selected U.S. states

Residential construction is arguably homogeneous and makes up most of the building consents issued in a year, so the "building consents per worker" ratio does a good job of explaining the labor market dynamics with respect to residential construction. But this only reveals information about the steady state of the residential construction market for new construction. For the CES, claims greater than NZD 15,000 up to the limit were handled by the Canterbury Home Repair Program. All claims that required structural work also required a consent; to understand the impact from the CES, it is necessary to include the value of the building consents for alterations and create a new metric of residential construction value per work. If there is a significant increase in the value per worker, it may also signal demand surge.

Figure 5 shows the value of new residential construction and alterations per residential construction worker. The raw data is noisy, so the time series for Auckland, Wellington, Canterbury, and New Zealand must be converted to see the trend. The trend lines in the chart have been estimated using fitted quadratic equations. The vertical axis is the value of consented work in thousands. All the areas peak between 2001 and 2002, then the value per employee starts to decrease. In Figure 3, all these areas saw an increase in employed construction workers through 2008, which tells us that the labor market was growing faster than the amount of consented work. From 2008 to 2011 the data tells a more nuanced story. While the labor market continued to decrease over this period, so did the value of consented work, which is consistent with the decrease in value per worker over this period. One remarkable point is that the value per worker continued to drop in Canterbury through 2014, which suggests that a differential in labor cost in residential construction work might not have been needed to draw post-CES workers to the area. Auckland tells a slightly different story—the construction market did not turn around until 2012 and doubled by 2016, at which time employment growth started to catch up to planned work and the value per worker began to decline.

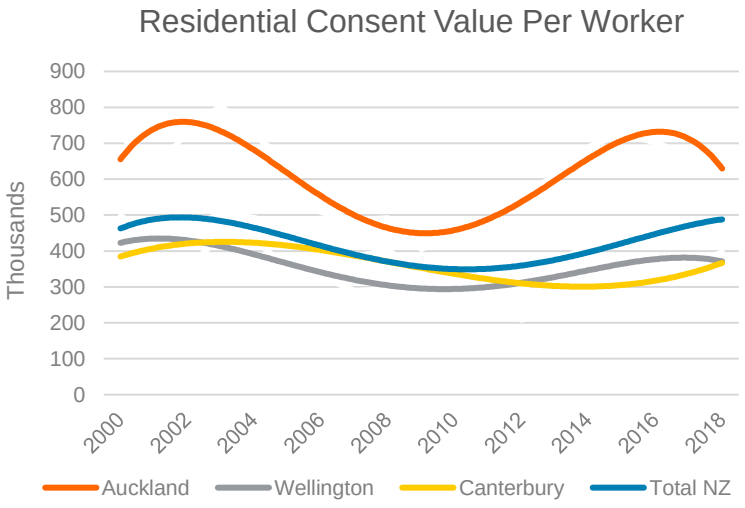

Figure 5. Residential consent value per residential construction employee

Commercial Data

Commercial Construction Employment

So far, this analysis has focused on the residential market, which accounted for most of the CES-related losses. While there is an indication of demand surge right after the CES in the Canterbury region, there is no evidence from the underlying residential economic data to suggest it came from that side. This section will look at the data on the non-residential side, which could explain the increase in labor costs.

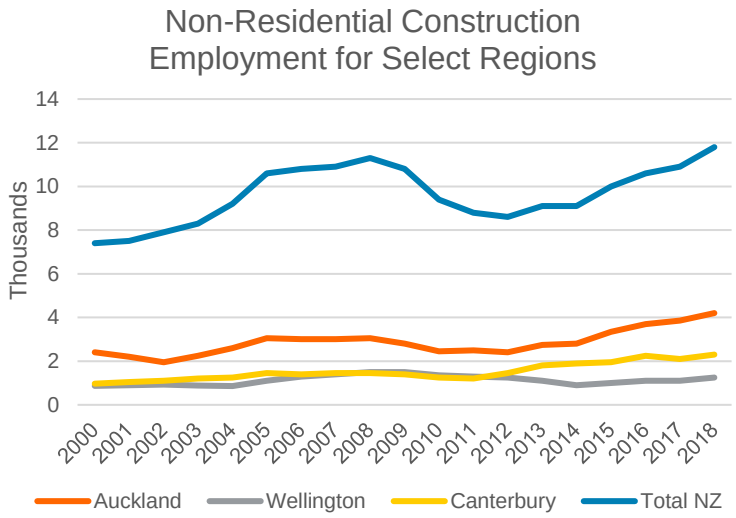

Figure 6. Construction Employment time series for Auckland, Wellington and Canterbury

Figure 6 shows absolute annual non-residential construction employment for Auckland, Wellington, and Canterbury from 2000 to 2018. This employment time series has a shape that is similar to the residential construction employment time series. From 2000 to 2008, non-residential construction employment shows a sharp increase followed by a steady upward trend, with employment in Auckland accounting for one third of the increase in country-wide employment. Following the recession, employment dropped off gradually compared to the residential employment time series. Notably, the employment level did not return to its 2008 peak until 2018. Further data would be needed to determine how much of the decline was due to foreign workers leaving the country versus domestic workers being unemployed. The Auckland area saw the softening of labor demand between 2008 and 2010 with the market shrinking by about 20%, but five years later in 2015 the demand for non-residential construction employment had already passed the peak of 2008. One unanswered question is: How much did this Auckland non-CES related demand for labor affect Canterbury? The Canterbury region saw a similar 20% decrease in construction employment, which bottomed out in 2011 before rebounding 50% by 2013. The country-level statistics suggest that non-residential

construction labor could have been coming from other regions. In this chart the decrease in labor in nearby Wellington could have easily accounted for about 30% to 50% of the increase.

Commercial Construction Work Volume

In the commercial market, far fewer building consents are issued every year and each one is for very different types of structures, so building consents per worker become meaningless. As with the residential analysis, an alternative measure of construction demand using the value of construction per worker must be created.

Figure 7 shows the value of non-residential construction, including new construction and alterations per non-residential construction worker. Like the residential data, it is noisy so the times series for Auckland, Wellington, Canterbury, and New Zealand have been converted to trend lines. The vertical axis is the value of consented work in thousands. Here, the most significant thing to notice is that although non-residential employment dropped after the recession, the value of consented work per work continued to increase. The blue line represents the national trend and shows an increasing monotonic level of work over the entire period. The other series show flattening after 2008 in the Auckland market and a slight decrease in Wellington before increasing slightly. The Wellington increase could in part be caused by the decrease in non-residential employment. The yellow line representing the trend in Canterbury is the most surprising. The value-per-worker trend was flat from 2001 to 2006 before increasing to a 2017 peak. Combined with stagnant non-residential employment until 2012, this suggests that the unit cost of non-residential construction labor would have had to increase to draw new workers to the area even before the CES (although a longer time-series would be needed to confirm this). This is the most significant finding to suggest that non-residential construction demands were the source of LCI increases in the Canterbury region.

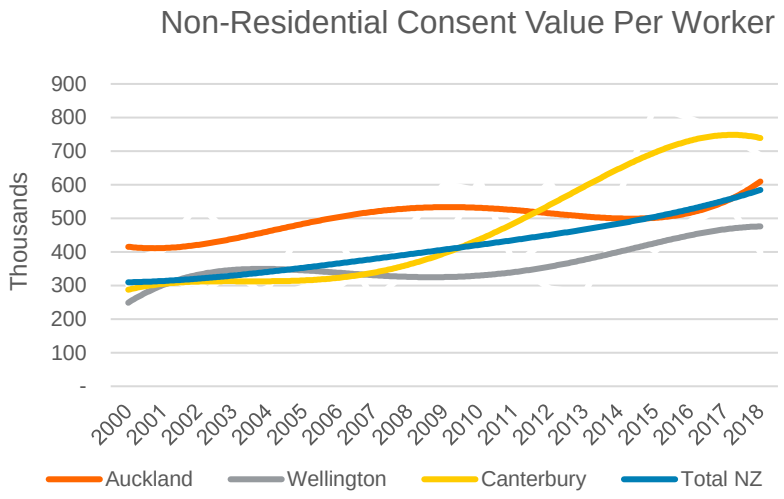

Figure 7. Non-residential consent value per residential construction employee

Estimating the Non-Residential Labor Cost

The data suggests that if we were able to take the LCI for the Canterbury region and separate it into residential and non-residential indexes, those indexes would most likely diverge greatly from the index in the official data from Stats NZ. By making a few assumptions, however, we can get some insight into the magnitude of this difference. In Figure 8, the top panel shows the effect of taking the LCI time series and creating a cumulative labor cost index increase from Q4 2010 to Q1 2015 for Canterbury and the rest of New Zealand. As in the section "Evidence of Demand Surge after the CES," the raw data has been detrended by taking a 5 quarter–centered moving average to eliminate the cyclical pattern and highlight the trend. Figure 8 makes no assumption about when a claim is settled and what value of demand surge to apply; it only illustrates the medium-term trend that will be used for the calculations. To break this into residential and non-residential indexes, we made assumptions about what the residential index would look like then estimated the non-residential index that would be needed to create the actual Canterbury statistic from Stats NZ. It's important to note that by Q1 2019, the raw index for Canterbury had started to converge with the long-term trend.

Our first assumption is that the LCI for the rest of New Zealand is an approximation for the residential LCI in Canterbury. This is indicated in the bottom panel of Figure 8 where the LCI for the "Rest of New Zealand" (blue line) has been renamed "Residential." There are a few reasons why this is a reasonable assumption. We have already established that the underlying economic data for residential construction do not support an increase in labor costs beyond normal inflation. In addition, the increase in the New Zealand consumer price index (CPI) for the same time follows a similar pattern and magnitude. Using this residential proxy and the existing Canterbury LCI, we should be able to calculate what the non-residential LCI would have to look like. This is because the Canterbury LCI should be a weighted combination of the residential and non-residential LCIs.

The second assumption involves weighting of the data; we created weights using the count of residential and non-residential construction employees from Stats NZ over time. The result is the dashed gray line in the right-hand panel of Figure 8, which represents what the non-residential LCI could look like in Canterbury. One of the significant drivers of the commercial LCI is the increasing proportion of residential construction workers over time. This leads to a sharp increase in the non-residential LCI at the end of the series. While this theory is reasonable, it helps to compare the non-residential LCI to other industry data.

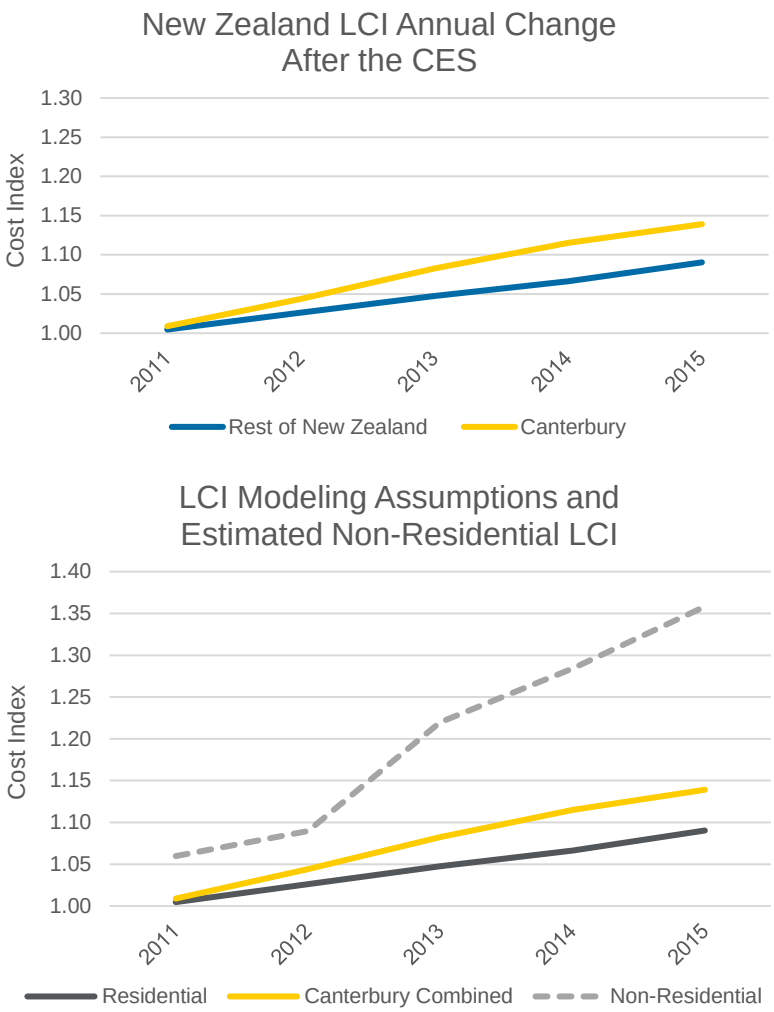

Figure 8. New Zealand Labor Cost Index Change after the CES

One widely available metric is the tender price time series data provided by Rider, Levett, Bucknall Digest 2019 (RLB) for major cities in New Zealand, including Christchurch. The tender price time series is for non-residential construction and represents the change in the costs of labor, materials, and doing business over time. While Christchurch is not exactly the same as the Canterbury region, it dominates the Canterbury region to the extent that this city is mostly likely driving the cost trends in the region and can be used to calculate a tender price index (TPI). Theoretically it is a weighted average of the LCI and the materials cost index (MCI), and some additional costs. Figure 9 compares the estimated non-residential LCI, the national MCI for New Zealand, and the TPI from RLB. As expected the TPI relationship falls between the LCI and the MCI time series. It also appears that the non-residential LCI may be a dominating factor in the trend of the TPI.

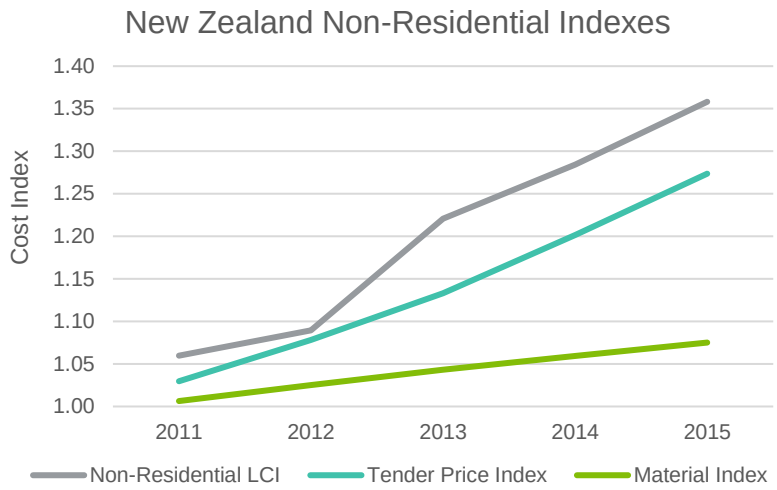

Figure 9. Comparing the LCI and MCI with the RLB Tender Price Index

Summary

The data from Canterbury and the rest of New Zealand shows substantial evidence of demand surge following the 2010-2011 Canterbury Earthquake Sequence. Notwithstanding, there are some complicating factors. Normally after a catastrophic event, a shortage of construction labor drives the short- and medium-term labor costs above the long-term trend, assuming the market is in a long-term equilibrium. In the case of CES, the country had just been impacted by the global recession. Employment levels had contracted drastically, so there was capacity to cope with the damage from a severe natural catastrophe. By the time of the CES, the residential construction labor market had bottomed out, and plentiful labor was available to go back to work. Furthermore, about two thirds of the losses were residential, which means they would have been handled by the New Zealand Earthquake Commission. One of the main goals of the EQC is to keep repair costs under control, and the data suggests that this goal was largely met for this type of claim. The construction labor cost index shows a modest increase in the Canterbury region as compared to the rest of the country. What it doesn't show is how residential labor costs may have responded differently from non-residential labor costs.

On the non-residential side, the long-term trend was a steadily increasing demand for construction work. Country-wide, the amount of non-residential construction projects was increasing long before the CES and continued through the rebuilding period. Value-wise, the most construction was going on in the Auckland region, but the highest value per worker was in Canterbury. Absent additional data to explain otherwise, it is reasonable to assume that this increased rate of construction came with higher relative wages. Without more detailed data, this will be difficult to confirm.

The New Zealand residential insurance market is unique in that it provides for automatic earthquake cover for every residential fire policy. For other regions that take a similar approach, it makes sense to consider the impact of demand surge by line of business. Creating labor cost indexes by even general lines of business would better support an understanding of the labor market dynamics before the next catastrophe strikes.

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