Adjustment in Local Labour and Housing Markets

Arthur Grimes, David C Maré, Melanie Morten

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Author contact details

Arthur Grimes
Motu Economic and Public Policy Research
PO Box 24390
Wellington
Arthur.grimes@motu.org.nz

Dave Maré
Motu Economic and Public Policy Research
PO Box 24390
Wellington
Dave.Mare@motu.org.nz

Melanie Morten
Motu Economic and Public Policy Research
PO Box 24390
Wellington

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Motu Economic and Public Policy Research
PO Box 24390
Wellington
New Zealand

Email info@motu.org.nz
Telephone +64-4-939-4250
Website www.motu.org.nz

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Abstract

This paper analyses local labour and hosuing market adjustment in New Zealand from 1989 to 2006. We use a VAR approach to examine the adjustment of employment, employment rate, participation rate, wages, and house prices in response to employment shocks. Migration is a major adjustment response at both a national and regional level. Nationally, a 1% positive employment shock leads to a long-run level of employment 1.3% higher, with half of the extra jobs filled by migrants. A 1% region-specific employment shock raises the long-run regional share of employment by 0.5 percentage points, due entirely to in-migration. House price responses differ at different spatial scales. Nationally, house prices are very responsive to employment shocks: a 1% employment shock raising long run house prices by 6% , as may be expected with an upward sloping housing supply curve. Paradoxically, this relationship does not hold at the regional level.

JEL classification

R23 – Regional Migration; Regional Labour Markets; Population
J61 – Geographic Labour Mobility; Immigrant Workers
C33 – Models with Panel Data

Keywords

Regional Labour Market Adjustment; Internal Migration; House Prices; Vector Autoregression

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1 Introduction

This paper examines regional adjustment in New Zealand over the period 1989 to 2006. The fortunes of New Zealand's regions have differed greatly over this time: areas such as Auckland and Canterbury have had employment growth above the national average, whereas areas such as Waikato and Southland have had growth below the national average. We investigate the dynamics of how regions adjust to local employment shocks by estimating a panel vector autoregression (VAR) model.

In line with other research, we find that migration is a major adjustment response to employment shocks at both a national and regional level. However, the pattern of adjustment varies at different spatial scales. Nationally, a 1% positive employment shock leads to a long-run level of employment 1.3% higher, with approximately half of these extra jobs filled by migrants. In contrast, a 1% region-specific shock causes the long-run regional share of employment to be 0.5% higher, with the adjustment to the employment shock entirely explained by migration into the region. We uncover a paradox in the relationship between employment and house prices at different spatial scales. Nationally, house prices are very responsive to employment shocks: a 1% employment shock causes house prices to be 6% higher in the long run, as may be expected with an upward sloping housing supply curve. However, this relationship does not hold at the regional level.

We uncover a paradox between employment and house prices. Nationally, house prices are very responsive to employment shocks: a 1% employment shock causes house prices to be 6% higher in the long run, as may be expected with an upward sloping housing supply curve. However, there is very little adjustment to house prices at the regional level, despite substantial in-migration to the region in response to the employment shock.

The structure of this paper is as follows. Section Two briefly reviews the literature on regional adjustment. Section Three discusses the data sources used in the estimation of the VAR model, and discusses national adjustment. Section Four lays outs the methodology employed to specify the structure of the model. We examine the regional adjustment process in Section Five by analysing the impulse response functions of the VAR. We consider the possibility of cointegration between employment and house prices in Section Six, and then briefly conclude.

2 Related Studies

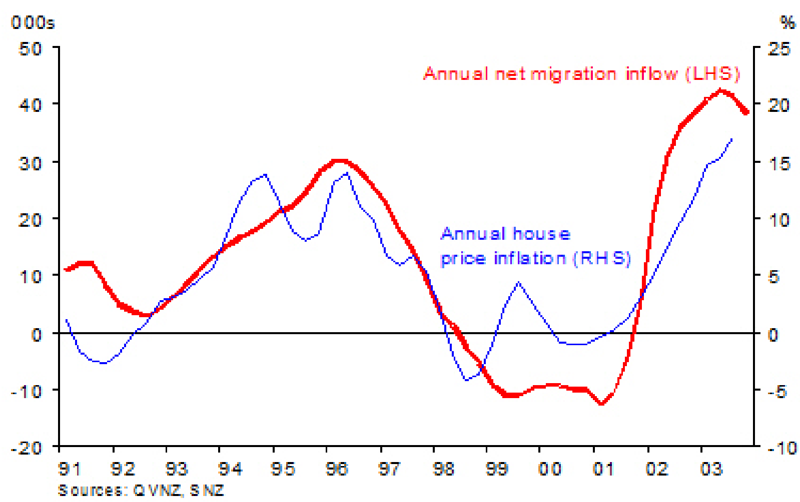
There are several possible channels of response to a positive employment shock: the unemployment rate may decrease, the participation rate may increase as individuals choose to enter the labour force, the wage rate may rise to clear the labour market, or individuals may move into the region. This paper considers an additional key variable in the adjustment process: house prices. If housing has an upward sloping supply curve, changes in demand for housing (such as would arise from an inflow of migrants in response to favourable employment conditions) will have an impact on house prices, affecting the cost of living in a region. This effect may influence decisions about migration into and out of a region.

The relationship between house prices and net migration is a topical issue in New Zealand. House price inflation is a significant current concern for macroeconomic policy and migration flows are often seen as a driver of this key component of inflation. Although we briefly overview the national patterns, this paper primarily examines regional labour market adjustment in New Zealand. We employ a methodology adopted by Blanchard and Katz in their seminal paper, 'Regional Evolutions'(1992). Blanchard and Katz analyse regional adjustment at the US state-level by constructing regionally differenced variables, defined as the nominal regional value relative to the nominal national mean. Using US data between 1950 and 1990, they find that the dominant adjustment mechanism to an employment shock is labour mobility – in the first year after a negative employment shock of 100 workers unemployment increases by 30 workers, participation declines by 5 workers, and there is net migration out of the region of 65 workers. Five to seven years after the shock, the employment response is consists entirely of migration out of the region (Blanchard and Katz (1992)).

Figure 1 shows a graph of house price growth and net national migration flows over the period 1991-2004 (Source: RBNZ (2004) :14). We find a similar relationship in our analysis in the following section, although we find that migration and house prices move together at least partly because they both respond to employment demand shocks: a positive employment shock at the national level results in increased migration, and in increased house prices.

Although we briefly overview the national patterns, this paper primarily examines regional labour market adjustment in New Zealand. We employ a methodology adopted by Blanchard and Katz in their seminal paper, 'Regional Evolutions'(1992). Blanchard and Katz analyse regional adjustment at the US state-level by constructing regionally differenced variables, defined as the nominal regional value relative to the nominal national mean[1]. Using US data between 1950 and 1990, they find that the dominant adjustment mechanism to an employment shock is labour mobility – in the first year after a negative employment shock of 100 workers unemployment increases by 30 workers, participation declines by 5 workers, and there is net migration out of the region of 65 workers. Five to seven years after the shock, the employment response is consists entirely of migration out of the region (Blanchard and Katz (1992)).

Figure 1: Graph of Migration and House Price Growth



[1] Note that this means that the regionally differenced variables are real.

A similar methodology has been applied to regional studies in many countries. Decressin and Fatas (1995) studied regional labour market dynamics in Europe, finding the main adjustment response in the first three years of a labour demand shock was through changes to the participation rate. Mauro and Spilimbergo (1998) study regional labour adjustment for Spain, differentiating between high skilled and low skilled workers. They find that the response differs between these two groups: highly skilled workers migrate, while low skilled workers leave the labour force or become unemployed. Debelle and Vickery (1999) look at adjustment between labour markets in Australia. Using Australian states as their level of analysis, they find that a 1% change to employment causes a 0.31% change in the working age population of the region. Debelle and Vickery estimate a model that includes house price adjustment, and find that while house prices drop in response to a negative employment shock, including house prices does not affect the adjustment path of the other variables.

The New Zealand case was examined by Choy et al (2002) who found a strong migration response to a region-specific employment shock. A temporary negative employment shock of 100 people causes approximately 71 people to migrate out of the region in the initial period of the shock. The long-run impact of the shock depends on whether employment is modelled as a stationary variable or difference-stationary variable. However, in both cases migration is the sole response to the employment shock six years after the shock[2].

A key difference between these regional studies is the average size of the regions analysed. For the US studies, the average regional population is 5.3 million people, and the average size of a region in European studies is 6.8 million. Australia states have a mean population of approximately 2.3 million people. However, the average NZ region is much smaller, around 320,000 people (Choy et al (2002)). Given the regional size differences, people may be more likely to leave a region in New Zealand in search of work rather than to be able to find other employment opportunities within a region. Choy et al. find that the NZ migration response, although much bigger than that of the US or Australia, is close to that found for Sweden in a study by Fredriksson (1999) that examines adjustment within regions of approximately the same size.

We build on previous New Zealand work examining labour market adjustment (Choy et al (2002)). Firstly, we include house prices in the model, and consider how house prices interact with labour market adjustment. There is overseas evidence that relative house prices have a direct effect on migration (Meen (2001)). In the New Zealand context, Grimes and Aitken find a strong correlation between regional population and house prices (Grimes and Aitken (2004)). Secondly, we use a more functional unit of regional aggregation than administratively-defined regional councils. Thirdly, we extend the time period analysed, covering the period 1989 to 2006.

3 Data

Data on employment, working age population, and labour force[3,4] for each of our fifteen regions[5] were obtained from the *Household Labour Force Survey*, on a quarterly basis from 1986q1 to 2006q2. We restrict the age range of individuals included to 20-64 years. Wage data[6] were sourced from *the Quarterly Employment Survey* for our fifteen regions, covering the period 1989q1 to 2006q1. Prior to 1999, the survey included only firms with at least 2.5 full time employees

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[2] If employment share is modelled as a difference-stationary variable, the migration response six years after the shock is 42 people. If employment share is modelled as a stationary variable, migration response six years after the shock is 3 people.

[3] Employment is defined by the HLFS as respondents who had: worked for one hour or more or worked without pay for an hour or more in a business owned or operated by a relative. The working age population is defined as the total usually resident, non-institutionalised, civilian population of New Zealand. The labour force is defined as members of the working age population who are classified as either employed or unemployed. Unemployed is defined as persons in the working age population without a paid job who were actively looking for work

[4] The HLFS is a sample survey. Individuals have weights applied to them to provide figures representative of the whole population. The benchmark population of a region is based on the most recent census count, which is updated to reflect quarterly changes by accounting for natural increases and internal migration (using symptomatic population series such as residential building consents and electoral enrolments). HLFS respondents have weights applied so that population estimates match the national population by age and sex.

[5] There are several caveats associated with the HLFS data. Firstly, the regions we request differ than those the official HLFS statistics are released at. There are no intra-regional weights applied to local regions, hence demographic changes in one part of a region show up as changes to the population. The second issue is that there were changes to the frequency of rotation groups in the HLFS: in 1998q3 the rotation increased to 2/8 from 1/8. This may have caused sudden changes to population in certain regions until the primary sampling units were adjusted.

(FTE). This was adjusted in 1999q3 to include small business. To improve comparability between the two periods we restrict the wage date to include wages only from firms with at least 2.5 FTE. In addition, we follow Choy et al (2002) and impose a restriction that the change in wage rate for each region between 1999q3 and 1999q4 is equal to zero.

House price data are sourced from Quotable Value New Zealand. The data series are released at territorial authority (TA) level on a quarterly basis[7]. The house price per region is calculated by weighting median sales prices for each component TA by 2006 population weights, in order to remove seasonal and/or cyclical house sale trends.

The regions used in this paper are groupings of territorial authorities (TAs), approximately replicating groupings of labour market areas (LMAs)[8]. Because LMAs are defined by actual labour market behaviour of individuals, they are a more functional regional unit compared with other areas, such as administratively defined regional councils. We use quarterly house price data that is released at TA level. There is not a perfect match between LMAs and TAs (Grimes et al (2006)). Based on a match quality analysis in Grimes et al (2006), the best match to minimise the error between LMAs and TAs is to group TAs into fifteen areas. The primary difference between these regions and regional councils is that the larger areas, Auckland and Wellington, are separated into sub-areas that differentiate between distinct labour markets in these areas. Appendix 1 contains the TA composition of the fifteen regions we use for this paper.

To analyse region-specific changes we transform the raw data from region i at time t into log-differenced variables from the national mean at time t, following Blanchard and Katz (1992); that is:

[6] Average Ordinary Time Hourly Earnings is ordinary time earnings divided by ordinary time paid hours. Paid travelling time and hours represented by holiday pay and sick pay are included.

[7] We drop the observations with the highest 1% and lowest 1% of median sales price to median government valuation ratio from our analysis. The median sales price should be close to the mean government valuation.

[8] Labour Market Areas (LMAs) are areas defined by an algorithm such that most people who live in the area also work in the area. Migration out of a LMA is usually associated with a change of job (Mare and Timmins (2003)).

$$wage_{i,t} = \ln(\frac{average\ ord\ hourly\ earnings_{i,t}}{average\ ord\ hourly\ earnings_{nat,t}})$$

$$emp_{i,t} = \ln(\frac{employment_{i,t}}{employment_{nat,t}})$$

$$er_{i,t} = \ln(\frac{employment\ rate_{i,t}}{employment\ rate_{nat,t}}),$$

where $employment\ rate_{i,t} = \dfrac{emp_{i,t}}{labour\ \ force_{i,t}}$.

$$pr_{i,t} = \ln(\frac{participation\ rate_{i,t}}{participation\ rate_{nat,t}}),$$

where $participation\ rate_{i,t} = \dfrac{labour\ \ force_{i,t}}{working\ age\ population_{i,t}}$

$$hp_{i,t} = \ln(\frac{mean\ house\ price_{i,t}}{mean\ house\ price_{nat,t}}).$$

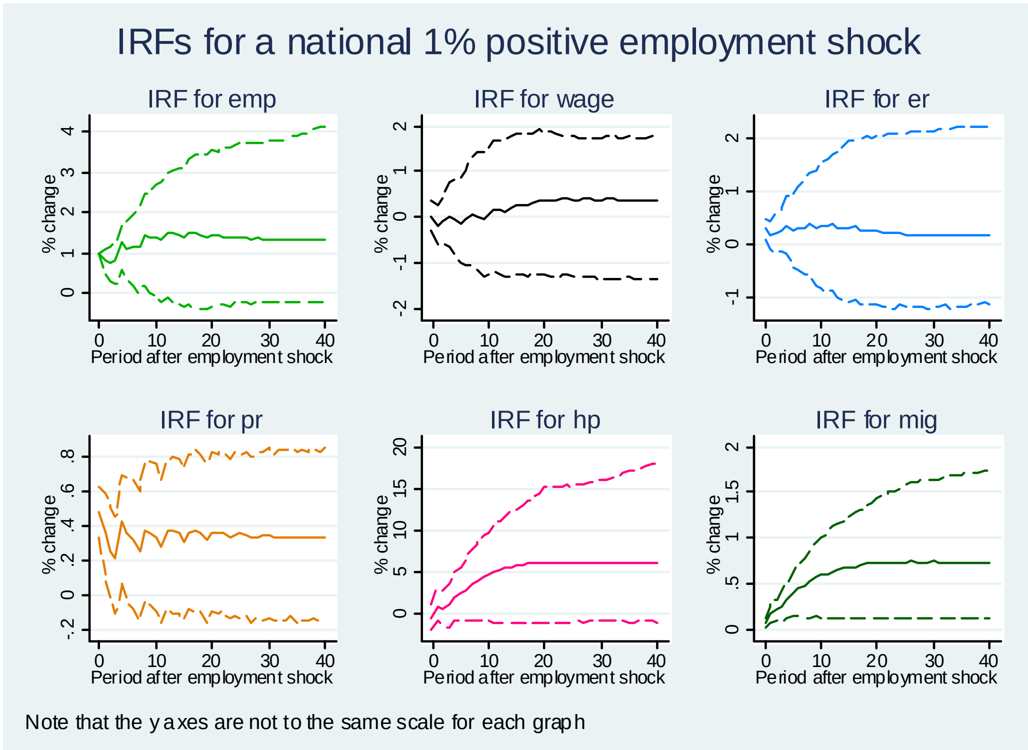
3.1 National Adjustment

Before examining the region-specific adjustment process, we examine the interaction between national-level variables. We estimate a vector autoregression model for the five variables, all in natural logarithms: employment, employment rate, participation rate[9], wages, and house prices. This model is developed in more depth in Section 4. We assume that employment has a contemporaneous effect on all variables, and house price has a contemporaneous effect on employment rate, participation rate, and wages. Unit root tests suggest that all the national level variables are 1(1), so all variables are entered in first-differenced form.

We introduce a positive employment shock into the system and examine the impulse response functions (IRFs), converted to levels, of each of the variables in the system. The migration IRF is derived from the other aggregates[10]. The IRFs are shown in Figure 2.

[9] Employment rate is defined an the number of employed divided by the labour force. Participation rate is defined as the size of the labour force divided by the size of the working age population.
[10] For full details, see Section Five.

Figure 2: Impulse response function: national 1% employment shock



In the long run, a 1% positive employment shock causes national employment to be 1.3% higher than in the absence of the shock. Wages adjust slightly, but slowly: ten periods after the shock wages are 0.06% higher, and settle to be 0.38% higher in the long run. There are initial increases in the participation rate and employment rates: the employment rate increases by 0.29 percentage points in the period of the shock; the participation rate increases by 0.48 percentage points. In the long run, the employment rate is 0.17 percentage points higher, and the participation rate 0.34 percentage points higher than they would have been in the absence of the shock. Migration, defined as the change in working age population due to the shock, increases steadily, and in the long run working age population has increased by 0.73%. There is a substantial house price adjustment: house prices do not move much in the first four periods of the shock, consistent with the gradual response of international migration, but then increase to be almost 6% higher in the long-run.

Table 1 converts the IRF responses in Figure 2 into implied 'person counts', in which the initial employment shock raises employment in New

Zealand by 100 jobs. The table shows that in the long run there are 140 new jobs created as a result of the initial shock, with over half of these jobs filled by migrants. 22 people are employed who would have otherwise been unemployed, and 45 people have chosen to enter the labour force. The second part of the table shows the total migration response. In the initial period of the shock working age population increases by 8 people, and of these 8, 6 are expected to be employed, and 2 are not expected to participate in the labour force. These people could be non-working partners or family members who are migrating with someone who has a job. The migration response increases over the periods following the shock. Six years after the shock there are 100 extra migrants in New Zealand: 73 of these are employed (this is equivalent to the migration figure of the upper panel), 22 are not in the labour force, and 5 are unemployed.

Table 1: Population response: national employment shock

National shock to employment	Initial quarter	1 quarter after	1 year after	4 years after	6 years after
A. Net impact of change in employment due to:					
Working age population	6	16	32	68	73
Employment rate	32	17	39	35	22
Participation rate	62	47	56	47	45
Employment response to shock	***100***	***81***	***127***	***150***	***140***
B. Migration's impact on:					
Employment	6	16	32	68	73
Unemployment	0	1	2	4	5
Non-labour force participants	2	5	10	21	22
Migration response to shock	***8***	***22***	***45***	***93***	***100***

At the national level, the initial employment shock has a long-run multiplier effect; the initial 1% shock results in 1.4% more jobs in the long run. Three types of people fill these new jobs: migrants, individuals who would have otherwise been unemployed, and individuals who would have otherwise not been participating in the labour force. There is a strong house price response to the employment shock. This is as expected: given an upward sloping supply curve for housing, an increase in (domestic and migrant) housing demand should increase house prices.

The remainder of the paper focuses on patterns of adjustment to employment shocks at a smaller spatial scale, revealing patterns of regional adjustment that contrast with what is observed nationally.

3.2 Regional Adjustment

Regions in New Zealand have fared very differently over the time period analysed; some regions have flourished while others have struggled. Table 2 shows the mean growth rate[11] and the extremes over the fifteen regions. Employment rate growth and participation rate growth are measured in percentage point changes. This table shows the range in the regional fortunes over the period: Canterbury has had the strongest employment growth, as well as the strongest labour force and working age population growth. The wage rate grew most in Wellington West, and least in the Bay of Plenty. Gisborne/Hawke's Bay region had the largest growth in participation rate, of 9.5 percentage points.

Table 2: Growth in variables over the period 1989-2006

	Mean	Minimum	Maximum
Employment	33.6%	2.4% Waikato	64.3% Canterbury
Employment rate	3.9%	1.4% North Auckland	7.1% Taranaki
Participation rate	5.6%	-1.0% Auckland City	9.5% Gisborne/ Hawkes' Bay
Wage	51.1%	41.0% Bay of Plenty	61.8% Wellington West
House price	193.8%	109.6% Manawatu	265.6% Otago
Labour force	28.4%	-1.6% Waikato	57.8% Canterbury
Working age population	19.5%	-8.6% Waikato	41.6% Canterbury

Changes are percentage change between mean of first 8 quarters and last 8 quarters of full data sample
er and pr are percentage point difference, calculated by subtraction

Table 3 shows the pairwise correlations between the growth rates. Note that this table only shows the static change between the two end-periods of the sample. We will develop a richer model of the dynamics by modelling the VAR system in the following section. Two stories seem to emerge from this table. The first story is essentially one of movement of people: regions with high employment growth also had high growth in labour force (correlation=0.99) and high growth in working age population (correlation=0.91). Note that there is only a very small correlation between house prices and employment (correlation=0.02). A second story is evident from the correlation between employment rate and house price (correlation=0.53). If house prices are high, people may be deterred from moving into a region even if there are jobs available. As a result, the participation rate and employment rate may rise as individuals who already live in the region become employed. The VAR modelling in Section 4 looks at the dynamic relationship over time of these variables.

Table 3: Pairwise correlation of growth rates

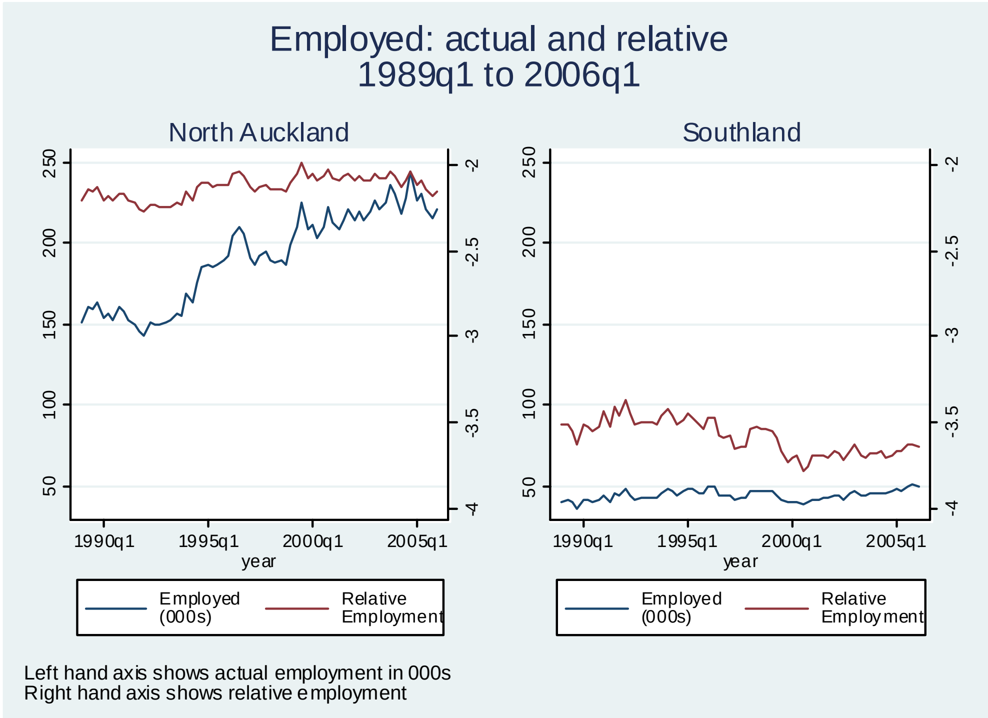
	Employment	Employment rate	Participation rate	Wage	House price	Labour force	Working age population
Employment	1						
Employment rate	-0.1005	1					
Participation rate	-0.0642	0.6221	1				
Wage	0.2425	-0.4278	-0.5699	1			
House price	0.0223	0.5311	0.2825	-0.0177	1		
Labour force	0.9915	-0.2286	-0.1449	0.2918	-0.0471	1	
Working age population	0.9102	-0.4125	-0.4596	0.4443	-0.1353	0.9449	1

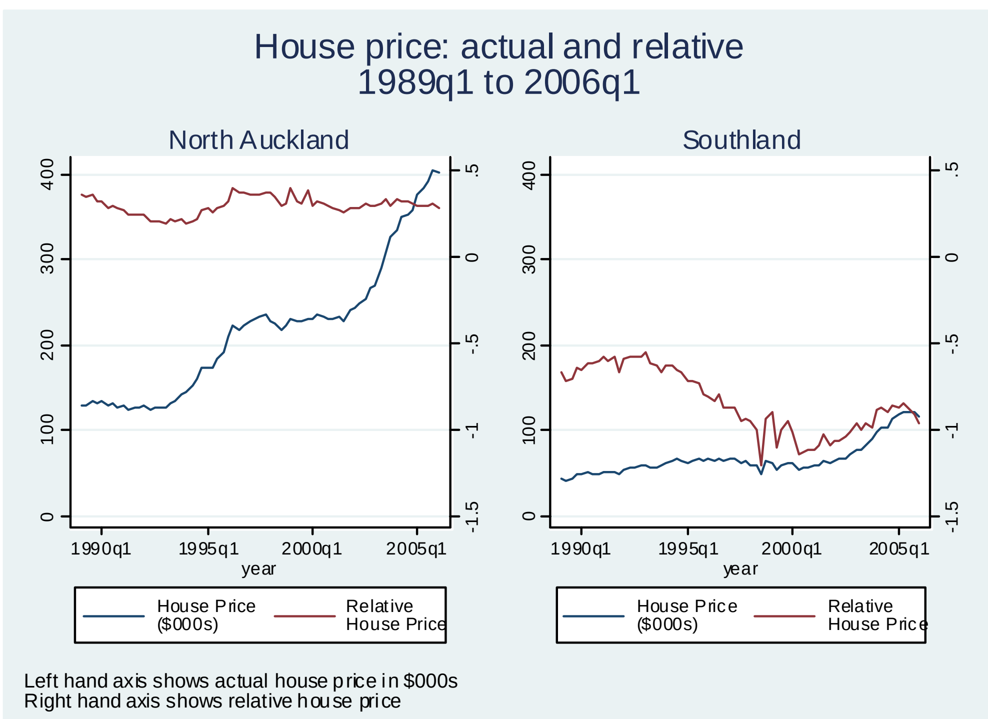
See notes on previous table
n=15 for each cell

Figure 3 shows North Auckland[12] and Southland over the time period analysed. The left hand axis shows the actual value of the variable, and the right hand scale shows the relative measure of the variable. North Auckland is a region that has prospered: employment growth was 44% over the period, above the national average of 34%. As a result, North Auckland's relative employment share has increase over the period. Southland has not been as fortunate: Southland had an average rate of employment growth half that of North Auckland, at 20%, and less than the national mean.

[11] The percentage change is calculated by the percentage change between the mean of the first eight quarters and the last eight quarters in the sample for each region in order to reduce the influence of quarter-to-quarter volatility.
[12] North Auckland consists of Rodney, North Shore, and Waitakere Districts.

Figure 3: Regional heterogeneity: North Auckland and Southland



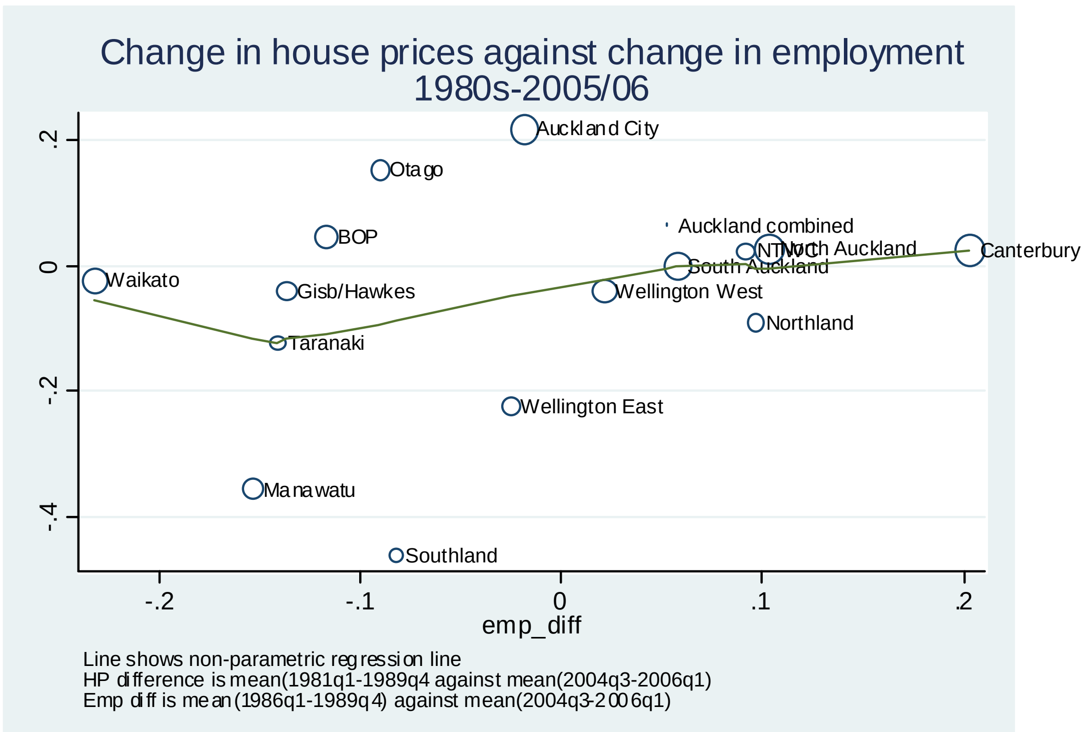


A similar pattern holds for house prices. North Auckland's house prices have increased over the period, leading to a slight overall increase in North

Auckland's relative house price. Southland's house prices have grown 145% over the period, below the mean national growth rate of 194%, contributing to a decreasing relative house price compared to the rest of the country.

An innovation of this paper is to include house prices in the model for labour market adjustment. *A priori*, an upward sloping supply curve for housing predicts that changes to housing demand, such as may result from increases in employment, will lead to increases in house prices. Figure 4 graphs the relationship between the change in house price and change in employment using regionally defined variables[13]. The circles in the graph are weighted by 2006 population counts and a non-parametric regression line is fitted.

Figure 4: Change in house prices against change in employment



[13] The graph looks at the change in house prices using the mean house price over the period 1981q1-1989q4 as the initial value. The relationship between house price growth and employment growth varies slightly by the initial period used – a graph of house price change from 1989 to 2006 has a smaller slope; a graph examining change from 1995-2006 a slightly steeper slope.

4 Methodology

This section details the specification of the model used to analyse regional adjustment. We first consider the univariate properties of the data series by performing unit root tests. We then examine the contemporaneous correlation between the variables to specify the lag structure of the VAR model. Once we have identified the model, we estimate it and then analyse the impulse response functions arising from a region-specific positive employment shock.

4.1 Univariate processes

Unit root tests are performed on the five log differenced data series entering the VAR. We include specifications both with and without a time trend, and consider the order of integration of the series at both the individual region level and the panel level.

Table 4 summarises the results from ADF and PP individual unit root tests, run at a regional level. The table gives the number of regions for which the null can be rejected at a 10% and a 1% level, out of a total of 15 regions. The full unit root results are provided in Appendix 2. House price appears to be non-stationary; employment rate, participation rate, and wage appear stationary; employment is unclear, but we treat it as nonstationary. The results of two panel unit root tests are reported in Appendix 3; the interpretation of these tests depends crucially on the assumption regarding a deterministic trend in the data.

Due to the conflicting results between the panel unit root tests and the individual unit root tests, we rely primarily on the individual region ADF tests. Based on these tests, we characterise regionally log-differenced employment and house prices as I(1) variables, and enter them in the VAR in first differences. The regionally log-differenced employment rate, participation rate and wage variables are characterised as I(0) and are entered in levels.

Table 4: Summary of individual unit root tests

Number of rejections out of 15 regions using 10% level of significance

	ADF		PP	
	Null: Unit root		Null: Unit root	
	Trend	No trend	Trend	No trend
emp	9	10	4	12
d_emp	15	15	15	15
er	15	15	14	15
d_er	15	15	15	15
hp	2	6	2	3
d_hp	15	15	15	15
pr	15	14	10	15
d_pr	15	15	15	15
wage	14	14	8	15
d_wage	15	15	15	15

Number of rejections out of 15 regions using 1% level of significance

	ADF		PP	
	Null: Unit root		Null: Unit root	
	Trend	No trend	Trend	No trend
emp	3	3	3	6
d_emp	15	15	15	15
er	12	13	11	13
d_er	15	15	15	15
hp	0	0	0	3
d_hp	15	15	15	15
pr	12	8	5	14
d_pr	15	15	15	15
wage	11	7	5	13
d_wage	15	15	15	15

4.2 Model specification

Blanchard and Katz (1992) argue that labour market shocks are the result of shocks to labour demand. This assumption leads to a structural VAR where employment affects current participation rate and employment rate, but employment rate and participation rate do not have a contemporaneous impact on employment. This is the same structure adapted by Choy et al (2002) and other papers using this methodology[14].

[14] An alternative panel VAR approach, used by Love and Zicchino (2002) is to take the forward mean differencing (Helmert differencing) of the variables to remove the region-specific fixed effects. After consideration we opted not to use this approach as it removes the effects of a permanent shock and therefore only examines short-run dynamics.

We examine whether this assumption holds for our data by analysing the error-covariance matrix from an unrestricted VAR. We estimate the reduced form VAR for our system of five variables where each variable is a function of the past four lags of itself and the other four variables: $\Gamma(L)y_t = u + \varepsilon_t$. $\Gamma(L)$ is the lag operator of degree 4, y_t is a (5 x 1) vector of regressors, u is a constant and ε_t is a vector of non-autocorrelated disturbances with zero mean. Estimation is by seemingly unrelated regression (SUR).

Appendix 4 reports the Cholesky decomposition of the error covariance matrix for this system. The Cholesky decomposition analyses the contemporaneous correlations between the error terms from each equation in the system. The first entry in each matrix has been normalised to 0.01. Table 1 and Table 2 examine the correlation between employment and house prices residuals, switching the ordering of the first variable. There is very little contemporaneous correlation between employment and house prices. This suggests that a shock to employment is orthogonal to house prices in the initial period. Table 1, Table 3, and Table 4 shed light on the dynamics between employment, employment rate, and participation rate, the three labour market variables in the system. If employment is ordered first in the system, there is very little correlation with employment rate or with participation rate. However, if either employment rate or participation rate are ordered first, there is a strong correlation with employment. This suggests that labour market shocks are best characterised as shocks to employment.

We assume that employment affects the employment rate, participation rate, wage rate, and house price contemporaneously. House prices are an asset price and should jump in response to shocks. We therefore assume that house price has a contemporaneous effect on variables other than employment. The system in full is[15]:

[15] Note that a constant term in a difference equation implies a trend in the level variable.

$$\Delta emp_{it} = \alpha_{i1} + \sum_{j=1}^{4}\alpha_j \Delta emp_{i,t-j} + \sum_{j=1}^{4}\beta_j er_{i,t-j} + \sum_{j=1}^{4}\gamma_j pr_{i,t-j} + \sum_{j=1}^{4}\gamma_j wage_{i,t-j} + \sum_{j=1}^{4}\gamma_j \Delta hp_{i,t-j} + \varepsilon_{it1}$$
$$\Delta hp_{it} = \alpha_{i2} + \sum_{j=0}^{4}\alpha_j \Delta emp_{i,t-j} + \sum_{j=1}^{4}\beta_j er_{i,t-j} + \sum_{j=1}^{4}\gamma_j pr_{i,t-j} + \sum_{j=1}^{4}\gamma_j wage_{i,t-j} + \sum_{j=1}^{4}\gamma_j \Delta hp_{i,t-j} + \varepsilon_{it2} \quad (1)$$
$$wage_{it} = \alpha_{i3} + \sum_{j=0}^{4}\alpha_j \Delta emp_{i,t-j} + \sum_{j=1}^{4}\beta_j er_{i,t-j} + \sum_{j=1}^{4}\gamma_j pr_{i,t-j} + \sum_{j=1}^{4}\gamma_j wage_{i,t-j} + \sum_{j=0}^{4}\gamma_j \Delta hp_{i,t-j} + \varepsilon_{it3}$$
$$er_{it} = \alpha_{i4} + \sum_{j=0}^{4}\alpha_j \Delta emp_{i,t-j} + \sum_{j=1}^{4}\beta_j er_{i,t-j} + \sum_{j=1}^{4}\gamma_j pr_{i,t-j} + \sum_{j=1}^{4}\gamma_j wage_{i,t-j} + \sum_{j=0}^{4}\gamma_j \Delta hp_{i,t-j} + \varepsilon_{it4}$$
$$pr_{it} = \alpha_{i5} + \sum_{j=0}^{4}\alpha_j \Delta emp_{i,t-j} + \sum_{j=1}^{4}\beta_j er_{i,t-j} + \sum_{j=1}^{4}\gamma_j pr_{i,t-j} + \sum_{j=1}^{4}\gamma_j wage_{i,t-j} + \sum_{j=0}^{4}\gamma_j \Delta hp_{i,t-j} + \varepsilon_{it5}$$

where i denotes region, and t denotes time.

The panel structure of the data is reflected in the inclusion of region-specific intercepts in each equation. Slope coefficients are constrained to be constant across regions.

5 Results

The panel VAR is estimated by seemingly unrelated regression (SUR). We report the impulse response functions of the VAR below. IRF confidence intervals are found by bootstrapping the regression residuals, following Benkwitz et al (2001)[16]. The VAR coefficients are contained in Appendix 5.

We present the IRFs for employment, employment rate, participation rate, wages, and migration, displayed in levels. As the rate variables enter the VAR in logarithmic form it is necessary to convert the rate variable IRFs into percentage change form using the following transformations. For participation rate, $d(\frac{L}{WP}) = \frac{L}{WP} d(\ln \frac{L}{WP})$, where $\frac{L}{WP}$ is the average participation rate (labour force over working age population) across the panel. For employment rate, the transformation is $d(\frac{E}{L}) = \frac{E}{L} d(\ln \frac{E}{L})$, where $\frac{E}{L}$ is the mean panel employment

[16] From the initial estimation of the model we create a set of re-centred residuals for each region. We draw a bootstrapped sample of residuals with replacement from this set, by region. We then recursively regenerate the data series period-by-period using the initial VAR coefficient estimates, treating the first four (number of lags in the model) observations as exogenous. We then re-estimate the VAR to gain new estimation parameters, and use these parameters to compute the IRFs. This process is repeated 1000 times to find a 95% bootstrap confidence interval for the IRFs.

rate (employment over labour force)[17]. The migration IRF is derived as a transformation of the IRFs for the other labour market variables, using $d\ln(WP) = d\ln(E) - d\ln(ER) - d\ln(PR)$ [18]. No additional transformations are necessary (once the IRF has been converted into levels, if the variable is estimated in differences) for house prices, employment, and wages.

5.1 5 variable VAR: Shock to employment

Figure 5 shows the IRFs for the average region from a shock to employment. This region-specific shock could be a new factory or new business opening in one region, or a change in demand for locally produced goods. The IRF coefficients are summarized in Table 6. A 1% positive shock to employment causes a contemporaneous positive response of 0.05% to the employment rate, a 0.14% positive response to the participation rate, and a 0.75% positive response to working age population due to migration. The contemporaneous impact on wage and house price is negligible. Employment has a unit root, so temporary shocks can cause permanent effects. In this case, a 1% employment shock slowly subsides, but causes long-run employment to be 0.48% higher than it would have been without the shock. The migration response is strongest the period of the shock, and then also recedes. In the long run, working age population is 0.48% higher than in the absence of the shock, matching the growth rate of employment. There is a very small impact on house prices: an employment shock has the largest effect on house prices five periods after the initial shock, where house prices are 0.03% higher than what they would have been without the employment shock. In the long run, a 1% employment shock causes house prices to be 0.02% higher.

[17] $\frac{L}{WP}$ is 0.78 and $\frac{E}{L}$ is 0.94, found by averaging across panel and time.

[18] That is, for the impulse response functions: $mig\_irf = emp\_irf - er\_irf - pr\_irf$

Figure 5: IRF from a positive 1% employment shock

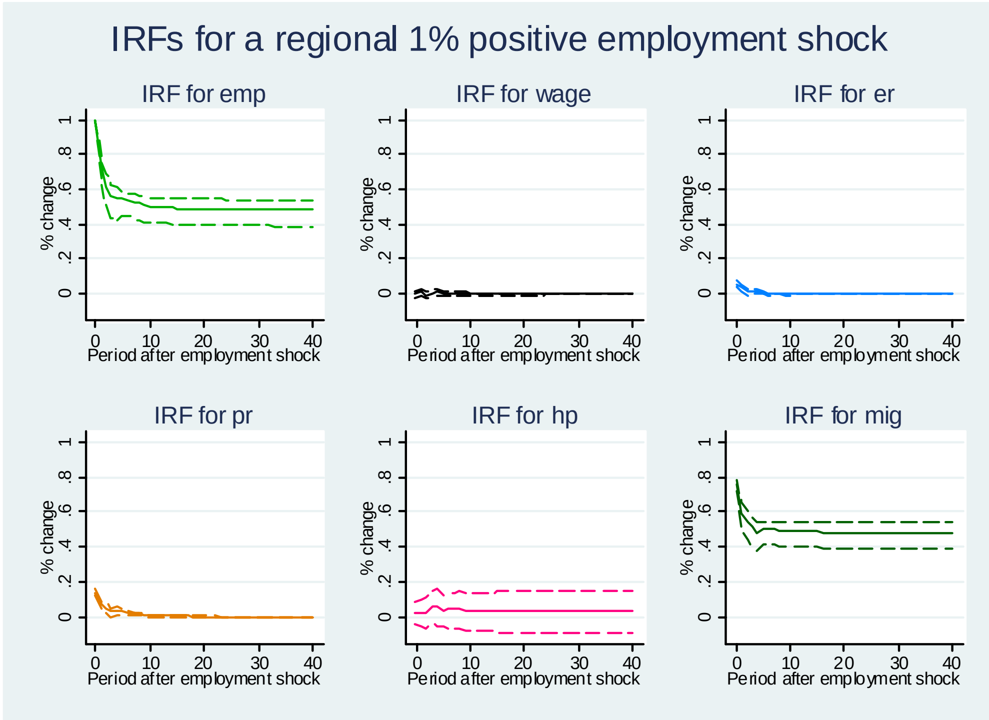


Table 5: Summary of IRF coefficients

Periods after shock	0	1	2	5	10	15	20	30	40
emp	1.000	0.724	0.619	0.550	0.506	0.491	0.485	0.482	0.481
wage	-0.002	0.012	-0.004	0.009	0.002	0.001	0.000	0.000	0.000
er	0.057	0.041	0.013	0.009	0.000	0.000	0.000	0.000	0.000
pr	0.142	0.067	0.049	0.032	0.012	0.005	0.002	0.000	0.000
hp	0.021	0.025	0.024	0.039	0.037	0.032	0.030	0.029	0.029
migration	0.758	0.594	0.542	0.500	0.491	0.485	0.483	0.482	0.481

Table 6 presents the implied population impact of the shocks, to convey the magnitudes of the impulse responses. We recast the IRF coefficients to show the response to an employment shock that creates 100 new jobs in a region. In the initial period, the 100 new jobs are filled by 75 migrants into the region, 6 individuals who would have otherwise been unemployed, and 18 individuals who enter the labour force. The total working age population of the region grows by 104 people, but not all of these people become employed: 23 are expected to not be in the labour force (for example, non-working partners), and 5 are expected to be unemployed when they arrive.

As the region adjusts over time, the employment rate and participation rate return to their pre-shock levels – a consequence of their stationarity. Some positive benefits of the shock remain: six years after the shock there are 48 more jobs than without the shock. The long-run adjustment process is accounted for entirely by migration into the region. There is some migration out of the region after the initial inflow, causing the net change to the working age population to be 66 people, 48 of whom are working, 3 unemployed, and 15 not in the labour force.

Table 6: Implied human impact of the IRF: regional employment shock

Regional shock to employment	Initial quarter	1 quarter after	1 year after	4 years after	6 years after
A. Net impact of change in employment due to:					
Working age population	75	59	48	48	48
Employment rate	6	4	2	0	0
Participation rate	18	9	5	1	0
Employment response to shock	***100***	***72***	***55***	***49***	***48***
B. Migration's impact on:					
Employment	75	59	48	48	48
Unemployment	5	4	3	3	3
Non-labour force participants	23	18	15	15	15
Migration response to shock	***104***	***81***	***66***	***66***	***66***

This is a story of adjustment due to the movement of people: a new store open or expands in a region, and people move into the region to work. In the initial periods of the shock the labour market behaviours of individuals living in the region change temporarily: people who were not in the labour force may decide to work. People who were unemployed find jobs. As the region adjusts, the beneficial impact of the employment shock recedes, but not completely. In the long-run, approximately half of the extra jobs remain. As participation rates and unemployment rates return to their long-run values, the extra jobs are filled by migrants who move into the region. The working age population also adjusts during this time: initially, many people move to the region, but as the positive employment effect subsides people move out of the region again. The region is left with a net gain in working age population, but not all of these new migrants are employed: some are not in the labour force, and some are unemployed.

As a robustness check on the sensitivity of the results to the specification, we have estimated the VAR with working age population explicitly included in the system. The results are unchanged.

The lack of a regional house price response provides an interesting paradox. The adjustment process to a region-specific employment shock involves migration into the region, which could be expected to cause an increase in demand for housing, yet we do not see house prices rise materially in response to this increase in demand. A 1% region-specific employment shock causes house prices to rise by only 0.02% in the long run. This is in contrast to the relationship observed at the national level, where a 1% employment shock causes house prices to rise by almost 6%.

There are four possible explanations for this result. We deal with the first three here and a fourth in the next section. The first is that the housing market is to some extent a national market. If national trends determine local house prices, we would not expect to see a house price response to a region-specific shock. This may be a partial explanation for our results. As the region-specific house price series displayed a unit root, regional house prices need not fully revert to the national mean. However, there may be partial reversion to national prices. An example of such national pricing is evident in regions that are attractive to investors, such as South Waikato, which has high prospective rental yields and higher rates of foreign ownership than other regions (RBNZ (2007)). The second possibility is that housing market effects may be more localized than the regions we use. For example, an employment shock such as a new factory in one specific part of a region may affect house prices only in the immediate vicinity, and not throughout the region as a whole. If this were the case, then our regions may be too large to adequately capture the localized housing market effects. The third explanation is that the relative sampling error in our data is high. Our data are survey data and normal volatility due to sampling error is accentuated by changes in sampling processes during the sample period.

6 A VECM model?

A fourth explanation for the lack of estimated effects of an employment shock on house prices within our regional VAR is that the dynamics of the two series are not closely related at short time horizons, but a long run relationship between the two may still exist. If this were the case, and if employment and house prices were regionally cointegrated then a vector error correction model

(VECM) would be a more appropriate modelling approach. Prior to estimating a VECM, we first test for cointegration between employment and house prices.

Both employment and house price display a unit root. We test for cointegration between these series using a number of cointegration techniques. These are summarised here; details are available on request from the authors. The Kao Panel cointegration test finds evidence of cointegration between the two series. Examining the individual regions, we find evidence of cointegration in four regions out of the fifteen: Northland, Wellington East, Wellington West, and Southland. Performing a principal components decomposition as in Holmes and Grimes (2005) does not find cointegration between employment and house prices, but suggests that there may be a common deterministic time trend between employment and house price.

We are not able to conclude unambiguously that there is a cointegrating relationship between employment and house price from these tests; on balance, the tests seem to reject such a relationship. Nevertheless, we have estimated a vector error correction model by including the cointegrating vector between employment and house price in the model, where the cointegrating vector is obtained by regressing house price on employment and a constant. We then run IRFs for an employment shock as before. The results from adopting this approach do not differ materially from the VAR results presented above. We therefore do not discuss these results explicitly here. However, we conclude that the lack of response of house prices to regional employment shocks indicated by our VAR model is not due to the model overlooking a longer run relationship between the two variables.

7 Conclusion

This paper has analysed adjustment to employment shocks in New Zealand at both a national and a regional level. This adjustment story is motivated by the differences in regional fortunes experienced by New Zealand regions. While national employment over the period 1989 to 2006 grew by 34%, the rate of employment growth in North Auckland of 44% was over twice the rate of growth of Southland of 20%.

We model the adjustment process between employment, employment rate, participation rate, wages, and house prices using a panel VAR model. We find that regional shocks are persistent: a region that has a positive employment shock will continue to feel the positive effects of this shock in the future. While we have focussed on positive shocks in this paper, the converse also holds: a region that suffers a negative shock experiences a permanent negative effect from this shock.

Migration is a major adjustment response to employment shocks. Nationally, a 1% positive employment shock leads to a long-run level of employment 1.3% higher than in the absence of the shock, with approximately half of these extra jobs filled by migrants. At the regional level, a 1% region-specific shock causes the long-run regional share of employment to be 0.5% higher, with the adjustment to the employment shock entirely explained by migration into the region in the long-run.

An innovation in this paper was including house prices in the adjustment response. A priori, we expect that an upward sloping supply curve will cause house prices to rise in the face of increased employment. We find evidence of this at the national level: a 1% increase in employment causes house prices to rise by 6%. However, we do not find evidence of house price adjustment in response to region-specific employment shocks. We offer three explanations for this paradox: housing prices may be partially determined by a national housing market, housing market adjustment may occur in more localised areas than the ones that we use, or the volatility present in our data series may mean sampling error is clouding our results. A fourth explanation, that house prices and employment are cointegrated, does not appear to hold, and even if they were cointegrated, our results are robust to incorporating this effect.

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Appendices

Appendix 1: Composition of Motu areas from TAs

Appendix 2: Individual Unit root tests

Appendix 3: Panel Unit root tests

Appendix 4: Cholesky decomposition matrices

Appendix 5: 5 variable VAR coefficients

Appendix 1: TA components of Motu areas

Territorial Authority	Territorial Authority name	Motu Area	Motu Area name
1	Far North District	1	Northland
2	Whangarei District	1	Northland
3	Kaipara District	1	Northland
4	Rodney District	2	North Auckland
5	North Shore City	2	North Auckland
6	Waitakere City	2	North Auckland
7	Auckland City	3	Auckland City
8	Manukau City	4	South Auckland
9	Papakura District	4	South Auckland
10	Franklin District	4	South Auckland
11	Thames-Coromandel District	5	Waikato
12	Hauraki District	5	Waikato
13	Waikato District	5	Waikato
15	Matamata-Piako District	5	Waikato
16	Hamilton City	5	Waikato
17	Waipa District	5	Waikato
18	Otorohanga District	5	Waikato
19	South Waikato District	5	Waikato
20	Waitomo District	5	Waikato
21	Taupo District	5	Waikato
22	Western Bay of Plenty Distri	6	BOP
23	Tauranga District	6	BOP
24	Rotorua District	6	BOP
25	Whakatane District	6	BOP
26	Kawerau District	6	BOP
27	Opotiki District	6	BOP
28	Gisborne District	7	Gisb/Hawkes
29	Wairoa District	7	Gisb/Hawkes
30	Hastings District	7	Gisb/Hawkes
31	Napier City	7	Gisb/Hawkes
32	Central Hawke's Bay District	7	Gisb/Hawkes
33	New Plymouth District	8	Taranaki
34	Stratford District	8	Taranaki
35	South Taranaki District	8	Taranaki
36	Ruapehu District	9	Manawatu
37	Wanganui District	9	Manawatu
38	Rangitikei District	9	Manawatu
39	Manawatu District	9	Manawatu
40	Palmerston North City	9	Manawatu
41	Tararua District	9	Manawatu
42	Horowhenua District	9	Manawatu
43	Kapiti Coast District	10	Wellington West
44	Porirua City	10	Wellington West
45	Upper Hutt City	11	Wellington East
46	Lower Hutt City	11	Wellington East

Territorial Authority	Territorial Authority name	Motu Area	Motu Area name
47	Wellington City	10	Wellington West
48	Masterton District	11	Wellington East
49	Carterton District	11	Wellington East
50	South Wairarapa District	11	Wellington East
51	Tasman District	12	NTWC
52	Nelson City	12	NTWC
53	Marlborough District	12	NTWC
54	Kaikoura District	13	Canterbury
55	Buller District	12	NTWC
56	Grey District	12	NTWC
57	Westland District	12	NTWC
58	Hurunui District	13	Canterbury
59	Waimakariri District	13	Canterbury
60	Christchurch City	13	Canterbury
61	Banks Peninsula District	13	Canterbury
62	Selwyn District	13	Canterbury
63	Ashburton District	13	Canterbury
64	Timaru District	13	Canterbury
65	Mackenzie District	13	Canterbury
66	Waimate District	13	Canterbury
68	Waitaki District	14	Otago
69	Central Otago District	14	Otago
70	Queenstown-Lakes District	14	Otago
71	Dunedin City	14	Otago
72	Clutha District	14	Otago
73	Southland District	15	Southland
74	Gore District	15	Southland
75	Invercargill City	15	Southland

Appendix 2: Individual Unit root tests

			ADF		PP	
			Null: Unit root		Null: Unit root	
Region	Region name	Variable	Trend	No trend	Trend	No trend
1	Northland	emp	-5.6135***	-5.1133***	-5.155***	-5.6801***
2	North Auckland	emp	-3.1298	-2.8184*	-2.6598	-3.0221**
3	Auckland City	emp	-2.3233	-2.3363	-2.4961	-2.5411
4	South Auckland	emp	-3.8555**	-3.02**	-2.8131	-3.713***
5	Waikato	emp	-3.6359**	-0.8295	-0.8423	-3.6643***
6	BOP	emp	-3.3323*	-3.2411**	-3.2471*	-3.3293**
7	Gisb/Hawkes	emp	-3.9618**	-2.8388*	-2.7101	-4.0206***
8	Taranaki	emp	-5.4018***	-4.3967***	-4.3503***	-5.4644***
9	Manawatu	emp	-2.5293	-1.9992	-1.8464	-2.4264
10	Wellington West	emp	-3.4565*	-3.2503**	-3.0643	-3.3414**
11	Wellington East	emp	-5.9913***	-5.3175***	-5.4117***	-6.1114***
12	NTWC	emp	-3.161	-2.8138*	-2.7978	-3.2233**
13	Canterbury	emp	-2.8307	-0.5551	-0.241	-2.7075*
14	Otago	emp	-2.7786	-2.1045	-1.7148	-2.5156
15	Southland	emp	-3.4696**	-2.8177*	-2.5724	-3.3126**
1	Northland	d_emp	-12.6788***	-12.7526***	-13.7922***	-13.7097***
2	North Auckland	d_emp	-11.1563***	-11.0973***	-11.4536***	-11.597***
3	Auckland City	d_emp	-10.2748***	-10.2706***	-10.2168***	-10.2313***
4	South Auckland	d_emp	-10.3604***	-10.4172***	-11.0262***	-10.9687***
5	Waikato	d_emp	-8.9144***	-8.8537***	-8.8909***	-8.9565***
6	BOP	d_emp	-9.621***	-9.6718***	-9.8577***	-9.8087***
7	Gisb/Hawkes	d_emp	-10.7791***	-10.8273***	-11.0569***	-11.0053***
8	Taranaki	d_emp	-11.335***	-11.4104***	-12.1706***	-12.0877***
9	Manawatu	d_emp	-10.1865***	-10.246***	-10.3572***	-10.2998***
10	Wellington West	d_emp	-11.277***	-11.3107***	-11.8916***	-11.9009***
11	Wellington East	d_emp	-14.1131***	-14.207***	-15.1009***	-14.9926***
12	NTWC	d_emp	-9.6976***	-9.7418***	-9.8166***	-9.7718***
13	Canterbury	d_emp	-9.8114***	-9.6662***	-9.8161***	-10.043***
14	Otago	d_emp	-12.9764***	-13.039***	-13.2517***	-13.2182***
15	Southland	d_emp	-10.1768***	-10.2452***	-11.1409***	-11.0739***
1	Northland	er	-5.1602***	-5.1853***	-5.1595***	-5.1332***
2	North Auckland	er	-4.6405***	-3.976***	-3.7503**	-4.4327***
3	Auckland City	er	-4.7819***	-4.8088***	-4.8016***	-4.7666***
4	South Auckland	er	-3.4237*	-3.44**	-3.241*	-3.2188**
5	Waikato	er	-7.2723***	-7.0994***	-7.1829***	-7.3438***
6	BOP	er	-5.663***	-5.699***	-5.6599***	-5.6325***
7	Gisb/Hawkes	er	-7.3988***	-7.0615***	-7.1283***	-7.4372***
8	Taranaki	er	-5.2347***	-4.8645***	-4.8116***	-5.1818***
9	Manawatu	er	-6.1263***	-6.1728***	-6.2643***	-6.2224***
10	Wellington West	er	-4.5726***	-3.9327***	-3.7793**	-4.5336***
11	Wellington East	er	-4.4844***	-4.1132***	-4.1077***	-4.4892***
12	NTWC	er	-5.5757***	-5.2073***	-5.2263***	-5.605***
13	Canterbury	er	-4.9719***	-4.9008***	-4.9347***	-5.0237***
14	Otago	er	-3.4705**	-3.439**	-3.0409	-3.0913**
15	Southland	er	-5.979***	-5.4631***	-5.4053***	-5.969***

			ADF		PP	
			Null: Unit root		Null: Unit root	
Region	Region name	Variable	Trend	No trend	Trend	No trend
1	Northland	d_er	-11.5871***	-11.6542***	-13.2658***	-13.1896***
2	North Auckland	d_er	-10.4421***	-10.4879***	-11.8707***	-11.8528***
3	Auckland City	d_er	-14.0658***	-14.1107***	-15.8454***	-15.9057***
4	South Auckland	d_er	-10.4336***	-10.4977***	-11.5349***	-11.4648***
5	Waikato	d_er	-14.2819***	-14.3697***	-18.6619***	-18.522***
6	BOP	d_er	-12.032***	-12.0878***	-14.5741***	-14.5938***
7	Gisb/Hawkes	d_er	-14.1522***	-14.2454***	-17.7309***	-17.5815***
8	Taranaki	d_er	-11.2283***	-11.2903***	-12.2244***	-12.1452***
9	Manawatu	d_er	-13.9689***	-14.0308***	-15.9658***	-15.9272***
10	Wellington West	d_er	-13.0087***	-13.0742***	-14.1131***	-14.0441***
11	Wellington East	d_er	-10.6485***	-10.6821***	-11.1621***	-11.1292***
12	NTWC	d_er	-12.4624***	-12.5429***	-14.2974***	-14.192***
13	Canterbury	d_er	-15.9193***	-16.0214***	-18.3323***	-18.2071***
14	Otago	d_er	-14.0894***	-14.1631***	-16.7787***	-16.7624***
15	Southland	d_er	-11.9138***	-11.9883***	-15.355***	-15.2814***
1	Northland	hp	-3.4105*	-3.4082**	-3.2948*	-3.2939**
2	North Auckland	hp	-2.7874	-2.5977*	-2.4259	-2.6175*
3	Auckland City	hp	-2.2691	-1.6535	-1.525	-2.2275
4	South Auckland	hp	-3.4826**	-3.4978**	-3.3182*	-3.3093**
5	Waikato	hp	-2.5945	-2.7208*	-2.5785	-2.4366
6	BOP	hp	-2.7239	-2.0489	-1.8265	-2.5231
7	Gisb/Hawkes	hp	-2.678	-2.6301*	-2.3868	-2.443
8	Taranaki	hp	-0.7587	-1.1667	-0.9724	-0.3646
9	Manawatu	hp	-1.4444	-1.124	-1.0387	-1.3084
10	Wellington West	hp	-1.626	-1.7784	-1.6649	-1.465
11	Wellington East	hp	-1.8897	-2.1454	-2.0183	-1.3099
12	NTWC	hp	-2.6707	-2.6985*	-2.5647	-2.5347
13	Canterbury	hp	-2.1227	-1.8477	-1.768	-2.0601
14	Otago	hp	-1.6506	-1.6573	-1.4588	-1.4492
15	Southland	hp	-2.3439	-1.5536	-1.1828	-1.9484
1	Northland	d_hp	-11.6162***	-11.6668***	-12.1856***	-12.1626***
2	North Auckland	d_hp	-11.1474***	-11.2068***	-11.3731***	-11.3256***
3	Auckland City	d_hp	-10.2363***	-10.284***	-10.2507***	-10.2153***
4	South Auckland	d_hp	-13.0281***	-13.1278***	-13.6106***	-13.5026***
5	Waikato	d_hp	-10.9927***	-10.9334***	-11.151***	-11.245***
6	BOP	d_hp	-11.3277***	-11.374***	-11.7053***	-11.6848***
7	Gisb/Hawkes	d_hp	-11.5883***	-11.6781***	-12.1804***	-12.079***
8	Taranaki	d_hp	-10.753***	-10.5632***	-10.4504***	-10.6922***
9	Manawatu	d_hp	-10.3107***	-10.2741***	-10.223***	-10.2924***
10	Wellington West	d_hp	-9.4136***	-9.3636***	-9.4774***	-9.568***
11	Wellington East	d_hp	-11.3876***	-11.2024***	-12.3197***	-13.1436***
12	NTWC	d_hp	-10.2***	-10.2863***	-10.5195***	-10.422***
13	Canterbury	d_hp	-10.6034***	-10.6848***	-10.4886***	-10.4138***
14	Otago	d_hp	-10.2961***	-10.3666***	-10.4337***	-10.3683***
15	Southland	d_hp	-10.5083***	-10.5898***	-11.673***	-11.5681***

			ADF		PP	
			Null: Unit root		Null: Unit root	
Region	Region name	Variable	Trend	No trend	Trend	No trend
1	Northland	pr	-4.1508***	-4.1486***	-4.0806**	-4.0821***
2	North Auckland	pr	-4.6362***	-2.8724*	-2.5659	-4.553***
3	Auckland City	pr	-5.2424***	-2.7976*	-2.3682	-5.1831***
4	South Auckland	pr	-3.7599**	-3.0629**	-3.0827	-3.8965***
5	Waikato	pr	-3.6267**	-3.5131**	-3.3914*	-3.5442***
6	BOP	pr	-4.5998***	-3.8071***	-3.6211**	-4.5519***
7	Gisb/Hawkes	pr	-4.8729***	-3.8438***	-3.6841**	-4.7667***
8	Taranaki	pr	-5.3679***	-4.3291***	-4.2949***	-5.4955***
9	Manawatu	pr	-4.6476***	-4.5863***	-4.5004***	-4.6037***
10	Wellington West	pr	-4.3903***	-3.4801**	-3.2677*	-4.3669***
11	Wellington East	pr	-5.6452***	-5.1986***	-5.2642***	-5.7667***
12	NTWC	pr	-3.4192*	-2.9899**	-2.7397	-3.2467**
13	Canterbury	pr	-5.0773***	-2.2478	-1.9948	-5.0613***
14	Otago	pr	-5.761***	-5.1761***	-5.0793***	-5.6477***
15	Southland	pr	-6.4229***	-5.408***	-5.1363***	-6.2552***
1	Northland	d_pr	-13.5066***	-13.5903***	-14.9159***	-14.8238***
2	North Auckland	d_pr	-12.4123***	-12.4394***	-13.543***	-13.5562***
3	Auckland City	d_pr	-12.2494***	-12.3288***	-14.0533***	-13.9486***
4	South Auckland	d_pr	-9.5442***	-9.6046***	-9.6682***	-9.6053***
5	Waikato	d_pr	-11.9495***	-12.0233***	-12.4078***	-12.3329***
6	BOP	d_pr	-12.5741***	-12.642***	-14.3103***	-14.2476***
7	Gisb/Hawkes	d_pr	-11.5716***	-11.543***	-12.9551***	-13.1205***
8	Taranaki	d_pr	-13.9657***	-14.0496***	-14.5876***	-14.4988***
9	Manawatu	d_pr	-12.918***	-12.9825***	-15.2726***	-15.2944***
10	Wellington West	d_pr	-12.8621***	-12.9255***	-13.6041***	-13.5348***
11	Wellington East	d_pr	-13.6803***	-13.7477***	-14.3182***	-14.2359***
12	NTWC	d_pr	-11.1079***	-11.1038***	-11.4779***	-11.5195***
13	Canterbury	d_pr	-10.2959***	-10.3557***	-10.6875***	-10.6176***
14	Otago	d_pr	-11.5838***	-11.6446***	-14.213***	-14.1853***
15	Southland	d_pr	-12.4372***	-12.4653***	-15.58***	-15.7174***
1	Northland	wage	-5.0602***	-4.3994***	-4.3459***	-5.0893***
2	North Auckland	wage	-4.7165***	-2.7433*	-2.5263	-4.6687***
3	Auckland City	wage	-4.9939***	-3.2834**	-3.512**	-4.8264***
4	South Auckland	wage	-5.5478***	-2.9196**	-2.4717	-5.4861***
5	Waikato	wage	-3.7728**	-2.9411**	-2.5701	-3.6656***
6	BOP	wage	-4.6059***	-1.3628	-1.0308	-4.436***
7	Gisb/Hawkes	wage	-4.6154***	-4.6029***	-4.7342***	-4.7118***
8	Taranaki	wage	-4.1508***	-3.9484***	-3.9412**	-4.1476***
9	Manawatu	wage	-3.3386*	-2.6232*	-2.3263	-3.2085**
10	Wellington West	wage	-3.685**	-2.8927*	-2.8296	-3.629***
11	Wellington East	wage	-2.985	-2.7965*	-2.6098	-2.8187*
12	NTWC	wage	-5.8264***	-5.8768***	-5.903***	-5.8598***
13	Canterbury	wage	-4.845***	-4.9715***	-4.8615***	-4.7143***
14	Otago	wage	-4.7055***	-4.2538***	-4.1056***	-4.5691***
15	Southland	wage	-7.3976***	-5.1901***	-4.9459***	-8.0293***

			ADF		PP	
			Null: Unit root		Null: Unit root	
Region	Region name	Variable	Trend	No trend	Trend	No trend
1	Northland	d_wage	-12.0081***	-12.1437***	-13.798***	-13.6057***
2	North Auckland	d_wage	-10.9926***	-11.0477***	-11.5287***	-11.4943***
3	Auckland City	d_wage	-10.1769***	-10.0963***	-12.6404***	-13.4097***
4	South Auckland	d_wage	-11.4134***	-11.4956***	-13.0452***	-12.9379***
5	Waikato	d_wage	-12.6057***	-12.679***	-14.3438***	-14.3665***
6	BOP	d_wage	-9.8654***	-9.947***	-11.484***	-11.3688***
7	Gisb/Hawkes	d_wage	-10.3694***	-10.3725***	-11.2411***	-11.2997***
8	Taranaki	d_wage	-8.554***	-8.6187***	-8.925***	-8.8477***
9	Manawatu	d_wage	-11.3713***	-11.367***	-11.9733***	-12.1672***
10	Wellington West	d_wage	-8.139***	-8.069***	-8.1188***	-8.2117***
11	Wellington East	d_wage	-10.659***	-10.6579***	-11.3424***	-11.4532***
12	NTWC	d_wage	-12.2831***	-12.3797***	-14.2989***	-14.1726***
13	Canterbury	d_wage	-9.8949***	-9.9035***	-11.1509***	-11.1828***
14	Otago	d_wage	-9.0913***	-9.0852***	-11.0307***	-11.1462***
15	Southland	d_wage	-8.9108***	-8.9386***	-13.4231***	-13.4247***

Highlighted cells indicate that the series is stationary (ie the null is rejected with at least 10% level of significance)

Appendix 3: Panel unit root tests

	Im-Pesaran-Shin		**Hadri**	
	Null: Unit root		Null: Stationarity	
	constant & trend	constant	Trend	No trend
emp	-1.9452	-2.5692***	79.0704***	46.4304***
d_emp	-4.8706***	-4.9335***	-2.5899	-3.4688
er	-2.4202	-2.6034***	18.2836***	30.9472***
d_er	-5.0642***	-5.06***	-3.7756	-4.8915
hp	-1.935	-1.918**	55.2716***	61.3276***
d_hp	-2.8681***	-2.9454***	-1.7918	-0.0992
pr	-2.0502	-2.8897***	63.3726***	33.66***
d_pr	-4.7556***	-4.7591***	-3.5918	-4.6722
wage	-1.8088	-2.5064***	67.612***	24.5026***
d_wage	-4.3629***	-4.4099***	-2.8879	-4.0469

* indicates significance at 10% level, ** indicates significance at 5% level, *** indicates significance at 1% level

Highlighted series suggest the series is stationary, at the 10% level

Appendix 4: Cholesky decomposition of residuals

Table 1: Ordering: emp, hp, wage, er, pr

	r_emp	r_hp	r_wage	r_er	r_pr
r_emp	0.01	0	0	0	0
r_hp	8.451E-05	0.0097859	0	0	0
r_wage	-3.011E-05	0.0001484	0.0026638	0	0
r_er	0.0006059	6.521E-05	8.235E-05	0.0023679	0
r_pr	0.0018224	-0.0000443	0.0001701	-0.0006237	0.0034603

Table 2: Ordering: hp, emp, wage, er, pr

	r_hp	r_emp	r_wage	r_er	r_pr
r_hp	0.01	0	0	0	0
r_emp	8.824E-05	0.010218	0	0	0
r_wage	0.0001514	-3.207E-05	0.002722	0	0
r_er	7.198E-05	0.0006185	8.415E-05	0.0024196	0
r_pr	-2.919E-05	0.0018625	0.0001739	-0.0006373	0.0035358

Table 3: Ordering: er, pr, emp, wage, hp

	r_er	r_pr	r_emp	r_wage	r_hp
r_er	0.01	0	0	0	0
r_pr	-0.0006043	0.0161926	0	0	0
r_emp	0.0101229	0.0191825	0.0346471	0	0
r_wage	0.0003522	0.0004174	-0.0004792	0.0108819	0
r_hp	0.0011518	-0.0002455	0.0002069	0.0022077	0.0399237

Table 4: Ordering: pr, emp, er, wage, hp

	r_pr	r_emp	r_er	r_wage	r_hp
r_pr	0.01	0	0	0	0
r_emp	0.011597	0.0224025	0	0	0
r_er	-0.0002301	0.0018401	0.0058862	0	0
r_wage	0.0002493	-0.0002146	0.0003047	0.0067156	0
r_hp	-0.0001779	0.0003321	0.0006345	0.0013625	0.0246384

The tables list the residuals from each of the five VAR equations, where er is employment rate, pr is participation rate, emp is employment, wage is wage, hp is house price. All variables are regionally log differenced. Employment and house prices are differenced.

Note: This was calculated by converting the panel structure where each error vector (from each equation in the VAR) is (15x1). n is the number of panels (i.e. n=15)

$$u'u = \frac{1}{n}\begin{bmatrix} u_1'u_1 & \dots & u_1'u_5 \\ \dots & \dots & \dots \\ u_5'u_1 & \dots & u_5'u_5 \end{bmatrix}$$

Appendix 5: VAR coefficients

Seemingly unrelated regression

Equation	Obs	Parms	RMSE	R-sq	chi2	P
empeqn	960	35	0.0402	0.1096	118.19	0
ereqn	960	37	0.0095	0.6672	1924.28	0
hpeqn	960	36	0.0393	0.163	187.01	0
preqn	960	37	0.0141	0.8147	4221.86	0
wageeqn	960	37	0.0107	0.9832	56110.82	0

	Coef.	Std. Err.	z	P>z	[95% Conf Interval]	
empeqn						
emp						
L1.	-0.2387	0.0378	-6.32	0	-0.3127	-0.1646
L2.	-0.1517	0.0390	-3.89	0	-0.2282	-0.0752
L3.	-0.0989	0.0398	-2.49	0.013	-0.1769	-0.0209
L4.	-0.0325	0.0337	-0.97	0.334	-0.0984	0.0335
er						
L1.	-0.3479	0.1365	-2.55	0.011	-0.6154	-0.0804
L2.	0.1501	0.1437	1.04	0.297	-0.1317	0.4318
L3.	-0.1437	0.1418	-1.01	0.311	-0.4215	0.1341
L4.	0.0441	0.1269	0.35	0.728	-0.2046	0.2929
pr						
L1.	-0.1018	0.0928	-1.1	0.272	-0.2837	0.0800
L2.	-0.0270	0.1064	-0.25	0.8	-0.2355	0.1815
L3.	-0.0159	0.1060	-0.15	0.881	-0.2236	0.1918
L4.	-0.1876	0.0935	-2.01	0.045	-0.3708	-0.0043
wage						
L1.	-0.0682	0.1173	-0.58	0.561	-0.2982	0.1617
L2.	-0.2258	0.1341	-1.68	0.092	-0.4886	0.0371
L3.	0.2297	0.1341	1.71	0.087	-0.0332	0.4926
L4.	-0.0259	0.1171	-0.22	0.825	-0.2554	0.2037
hp						
L1.	0.0136	0.0325	0.42	0.676	-0.0502	0.0774
L2.	0.0372	0.0343	1.08	0.278	-0.0301	0.1046
L3.	0.0090	0.0346	0.26	0.794	-0.0587	0.0767
L4.	-0.0199	0.0327	-0.61	0.544	-0.0840	0.0443
_Iregion_2	0.0360	0.0109	3.3	0.001	0.0146	0.0574
_Iregion_3	0.0376	0.0180	2.09	0.036	0.0024	0.0729
_Iregion_4	0.0217	0.0105	2.07	0.039	0.0011	0.0423
_Iregion_5	0.0164	0.0092	1.79	0.074	-0.0016	0.0344
_Iregion_6	0.0081	0.0077	1.04	0.297	-0.0071	0.0232
_Iregion_7	0.0090	0.0081	1.12	0.264	-0.0068	0.0248
_Iregion_8	0.0265	0.0100	2.64	0.008	0.0068	0.0461
_Iregion_9	0.0044	0.0085	0.52	0.606	-0.0123	0.0211
_Iregion_10	0.0649	0.0272	2.39	0.017	0.0116	0.1181
_Iregion_11	0.0310	0.0108	2.88	0.004	0.0099	0.0521
_Iregion_12	0.0315	0.0100	3.14	0.002	0.0118	0.0511
_Iregion_13	0.0357	0.0102	3.51	0	0.0157	0.0556
_Iregion_14	0.0171	0.0093	1.84	0.066	-0.0012	0.0354
_Iregion_15	0.0352	0.0113	3.13	0.002	0.0131	0.0573
cons	-0.0301	0.0107	-2.82	0.005	-0.0511	-0.0092

	Coef.	Std. Err.	z	P>z	[95% Conf Interval]	
ereqn						
emp						
--.	0.0605	0.0076	7.92	0	0.0455	0.0755
L1.	0.0230	0.0091	2.52	0.012	0.0051	0.0409
L2.	0.0210	0.0093	2.26	0.024	0.0028	0.0393
L3.	0.0064	0.0095	0.67	0.5	-0.0122	0.0249
L4.	0.0096	0.0080	1.21	0.227	-0.0060	0.0253
er						
L1.	0.4069	0.0325	12.54	0	0.3433	0.4705
L2.	0.0035	0.0341	0.1	0.918	-0.0633	0.0703
L3.	0.1226	0.0336	3.65	0	0.0567	0.1884
L4.	0.0884	0.0301	2.94	0.003	0.0294	0.1473
pr						
L1.	0.0663	0.0220	3.01	0.003	0.0231	0.1094
L2.	-0.0984	0.0252	-3.9	0	-0.1477	-0.0490
L3.	0.0545	0.0251	2.17	0.03	0.0053	0.1038
L4.	-0.0160	0.0222	-0.72	0.472	-0.0595	0.0275
wage						
L1.	-0.0057	0.0279	-0.21	0.837	-0.0604	0.0489
L2.	-0.0431	0.0318	-1.35	0.176	-0.1055	0.0193
L3.	0.0748	0.0318	2.35	0.019	0.0124	0.1372
L4.	-0.0250	0.0278	-0.9	0.368	-0.0794	0.0294
hp						
--.	0.0067	0.0078	0.85	0.394	-0.0087	0.0220
L1.	0.0087	0.0082	1.07	0.284	-0.0072	0.0247
L2.	0.0083	0.0082	1.02	0.31	-0.0077	0.0244
L3.	-0.0077	0.0082	-0.93	0.352	-0.0238	0.0085
L4.	-0.0063	0.0079	-0.8	0.425	-0.0219	0.0092
_Iregion_2	0.0170	0.0026	6.52	0	0.0119	0.0221
_Iregion_3	0.0079	0.0043	1.86	0.063	-0.0004	0.0163
_Iregion_4	0.0093	0.0025	3.72	0	0.0044	0.0142
_Iregion_5	0.0112	0.0022	5.12	0	0.0069	0.0154
_Iregion_6	0.0065	0.0018	3.58	0	0.0030	0.0101
_Iregion_7	0.0090	0.0019	4.72	0	0.0053	0.0128
_Iregion_8	0.0117	0.0024	4.9	0	0.0070	0.0164
_Iregion_9	0.0110	0.0020	5.47	0	0.0071	0.0150
_Iregion_10	0.0130	0.0065	2.01	0.044	0.0003	0.0256
_Iregion_11	0.0141	0.0026	5.49	0	0.0090	0.0191
_Iregion_12	0.0157	0.0024	6.59	0	0.0111	0.0204
_Iregion_13	0.0136	0.0024	5.59	0	0.0088	0.0183
_Iregion_14	0.0153	0.0022	6.91	0	0.0109	0.0196
_Iregion_15	0.0166	0.0027	6.21	0	0.0114	0.0219
cons	-0.0119	0.0025	-4.69	0	-0.0169	-0.0069

	Coef.	Std. Err.	z	P>z	[95% Conf Interval]	
hpeqn						
emp						
--.	0.0085	0.0316	0.27	0.789	-0.0535	0.0704
L1.	-0.0030	0.0377	-0.08	0.937	-0.0769	0.0709
L2.	0.0117	0.0385	0.3	0.762	-0.0638	0.0871
L3.	0.0377	0.0391	0.97	0.334	-0.0388	0.1143
L4.	0.0427	0.0329	1.3	0.195	-0.0219	0.1073
er						
L1.	0.1267	0.1340	0.95	0.344	-0.1359	0.3894
L2.	-0.0519	0.1408	-0.37	0.713	-0.3277	0.2240
L3.	-0.0561	0.1388	-0.4	0.686	-0.3281	0.2160
L4.	-0.0515	0.1242	-0.41	0.678	-0.2950	0.1919
pr						
L1.	0.0332	0.0909	0.37	0.715	-0.1449	0.2113
L2.	0.0274	0.1041	0.26	0.792	-0.1766	0.2315
L3.	-0.0704	0.1037	-0.68	0.497	-0.2737	0.1329
L4.	-0.0085	0.0917	-0.09	0.926	-0.1882	0.1712
wage						
L1.	-0.2723	0.1148	-2.37	0.018	-0.4974	-0.0472
L2.	0.0458	0.1314	0.35	0.727	-0.2118	0.3035
L3.	0.1115	0.1315	0.85	0.396	-0.1461	0.3692
L4.	0.0407	0.1146	0.35	0.723	-0.1839	0.2653
hp						
L1.	-0.3396	0.0318	-10.66	0	-0.4020	-0.2772
L2.	-0.1298	0.0336	-3.86	0	-0.1957	-0.0639
L3.	0.1106	0.0338	3.27	0.001	0.0444	0.1769
L4.	0.2099	0.0320	6.55	0	0.1471	0.2727
_Iregion_2	0.0023	0.0107	0.22	0.829	-0.0187	0.0234
_Iregion_3	0.0156	0.0176	0.89	0.376	-0.0189	0.0502
_Iregion_4	0.0039	0.0103	0.38	0.704	-0.0163	0.0241
_Iregion_5	0.0036	0.0090	0.4	0.69	-0.0141	0.0212
_Iregion_6	0.0032	0.0076	0.42	0.674	-0.0116	0.0180
_Iregion_7	0.0021	0.0079	0.27	0.786	-0.0133	0.0176
_Iregion_8	0.0080	0.0099	0.81	0.419	-0.0113	0.0273
_Iregion_9	-0.0071	0.0083	-0.85	0.396	-0.0234	0.0092
_Iregion_10	0.0187	0.0267	0.7	0.483	-0.0336	0.0710
_Iregion_11	-0.0005	0.0106	-0.05	0.959	-0.0213	0.0202
_Iregion_12	0.0016	0.0099	0.16	0.874	-0.0177	0.0209
_Iregion_13	0.0031	0.0100	0.31	0.755	-0.0165	0.0228
_Iregion_14	0.0037	0.0091	0.41	0.684	-0.0142	0.0216
_Iregion_15	-0.0020	0.0111	-0.18	0.857	-0.0237	0.0197
cons	-0.0065	0.0105	-0.62	0.538	-0.0270	0.0141

	Coef.	Std. Err.	z	P>z	[95% Conf Interval]	
preqn						
emp						
--.	0.1823	0.0114	16.04	0	0.1600	0.2045
L1.	0.0348	0.0136	2.57	0.01	0.0083	0.0614
L2.	0.0217	0.0138	1.56	0.118	-0.0055	0.0488
L3.	-0.0017	0.0141	-0.12	0.903	-0.0293	0.0258
L4.	0.0003	0.0119	0.02	0.98	-0.0230	0.0235
er						
L1.	0.0622	0.0482	1.29	0.197	-0.0323	0.1568
L2.	-0.0142	0.0506	-0.28	0.78	-0.1134	0.0851
L3.	-0.0201	0.0499	-0.4	0.687	-0.1180	0.0778
L4.	0.0522	0.0447	1.17	0.243	-0.0354	0.1398
pr						
L1.	0.5343	0.0327	16.35	0	0.4703	0.5984
L2.	0.1224	0.0374	3.27	0.001	0.0490	0.1958
L3.	0.0973	0.0373	2.61	0.009	0.0242	0.1705
L4.	0.0578	0.0330	1.75	0.08	-0.0069	0.1224
wage						
L1.	-0.0442	0.0414	-1.07	0.286	-0.1254	0.0370
L2.	-0.1142	0.0473	-2.41	0.016	-0.2068	-0.0215
L3.	0.1016	0.0473	2.15	0.032	0.0089	0.1944
L4.	-0.0470	0.0412	-1.14	0.255	-0.1278	0.0338
hp						
--.	-0.0045	0.0116	-0.39	0.697	-0.0273	0.0182
L1.	-0.0039	0.0121	-0.33	0.745	-0.0277	0.0198
L2.	0.0095	0.0122	0.78	0.435	-0.0144	0.0334
L3.	-0.0146	0.0122	-1.19	0.233	-0.0386	0.0094
L4.	0.0023	0.0118	0.19	0.849	-0.0208	0.0253
_Iregion_2	0.0078	0.0039	2.02	0.043	0.0002	0.0154
_Iregion_3	0.0211	0.0063	3.32	0.001	0.0086	0.0335
_Iregion_4	0.0075	0.0037	2.02	0.043	0.0002	0.0148
_Iregion_5	0.0086	0.0032	2.67	0.008	0.0023	0.0150
_Iregion_6	0.0044	0.0027	1.63	0.102	-0.0009	0.0098
_Iregion_7	0.0016	0.0028	0.57	0.571	-0.0040	0.0072
_Iregion_8	0.0121	0.0035	3.42	0.001	0.0052	0.0191
_Iregion_9	-0.0037	0.0030	-1.24	0.214	-0.0096	0.0022
_Iregion_10	0.0390	0.0096	4.07	0	0.0202	0.0578
_Iregion_11	0.0102	0.0038	2.69	0.007	0.0028	0.0177
_Iregion_12	0.0073	0.0035	2.07	0.038	0.0004	0.0143
_Iregion_13	0.0097	0.0036	2.7	0.007	0.0027	0.0168
_Iregion_14	0.0051	0.0033	1.55	0.121	-0.0013	0.0116
_Iregion_15	0.0140	0.0040	3.52	0	0.0062	0.0218
cons	-0.0131	0.0038	-3.48	0.001	-0.0205	-0.0057

	Coef.	Std. Err.	z	P>z	[95% Conf Interval]	
wageeqn						
emp						
--.	-0.0031	0.0086	-0.37	0.715	-0.0200	0.0137
L1.	0.0007	0.0103	0.07	0.945	-0.0194	0.0208
L2.	-0.0076	0.0105	-0.73	0.467	-0.0282	0.0129
L3.	0.0071	0.0106	0.66	0.506	-0.0138	0.0279
L4.	0.0123	0.0090	1.37	0.17	-0.0053	0.0299
er						
L1.	-0.0220	0.0365	-0.6	0.547	-0.0935	0.0496
L2.	-0.0179	0.0383	-0.47	0.64	-0.0930	0.0572
L3.	0.0009	0.0378	0.02	0.981	-0.0731	0.0750
L4.	0.0860	0.0338	2.54	0.011	0.0197	0.1522
pr						
L1.	0.0705	0.0247	2.85	0.004	0.0220	0.1189
L2.	-0.0572	0.0283	-2.02	0.044	-0.1127	-0.0017
L3.	-0.0279	0.0282	-0.99	0.324	-0.0832	0.0275
L4.	0.0041	0.0250	0.17	0.869	-0.0448	0.0530
wage						
L1.	0.5361	0.0314	17.1	0	0.4747	0.5976
L2.	-0.0978	0.0358	-2.73	0.006	-0.1680	-0.0277
L3.	0.1521	0.0358	4.25	0	0.0819	0.2222
L4.	0.2685	0.0312	8.61	0	0.2074	0.3297
hp						
--.	0.0152	0.0088	1.73	0.084	-0.0021	0.0324
L1.	0.0074	0.0092	0.81	0.417	-0.0105	0.0254
L2.	0.0058	0.0092	0.63	0.527	-0.0122	0.0239
L3.	0.0006	0.0093	0.06	0.949	-0.0175	0.0187
L4.	-0.0022	0.0089	-0.25	0.806	-0.0197	0.0153
_Iregion_2	0.0012	0.0029	0.4	0.687	-0.0046	0.0069
_Iregion_3	0.0248	0.0048	5.16	0	0.0154	0.0342
_Iregion_4	0.0076	0.0028	2.7	0.007	0.0021	0.0131
_Iregion_5	0.0024	0.0025	0.98	0.325	-0.0024	0.0072
_Iregion_6	-0.0035	0.0021	-1.7	0.09	-0.0075	0.0005
_Iregion_7	-0.0023	0.0022	-1.05	0.294	-0.0065	0.0020
_Iregion_8	0.0051	0.0027	1.9	0.058	-0.0002	0.0104
_Iregion_9	-0.0056	0.0023	-2.45	0.014	-0.0100	-0.0011
_Iregion_10	0.0370	0.0073	5.1	0	0.0228	0.0513
_Iregion_11	0.0032	0.0029	1.13	0.26	-0.0024	0.0089
_Iregion_12	-0.0038	0.0027	-1.42	0.156	-0.0091	0.0015
_Iregion_13	0.0024	0.0027	0.88	0.378	-0.0029	0.0078
_Iregion_14	-0.0003	0.0025	-0.11	0.915	-0.0051	0.0046
_Iregion_15	0.0016	0.0030	0.53	0.598	-0.0043	0.0075
cons	-0.0097	0.0029	-3.41	0.001	-0.0153	-0.0041

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