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Insolvency and Economic Development: Regional Variation and Adjustment

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Motu Working Paper 03-18
Motu Economic and Public Policy Research

February 2004

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Acknowledgements

We wish to thank the Ministry of Economic Development for making this work possible (particularly Ross van der Schuyff for providing insolvency data), and the Foundation for Research, Science and Technology for funding the Motu research programme Understanding Adjustment and Inequality to which this work contributes. We also thank Nick Davis and Dave Maré for their helpful comments on earlier drafts. None of the above organisations or people has any responsibility for the contents.

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 ISSN 1176-2667.

Abstract

This paper examines the determinants of the rate of forced insolvency in New Zealand. The study incorporates two key features. First, we use regional as well as national data to explain insolvencies. The data cover six regions which have had a variety of economic experiences over the sample period (1988–2003). Second, we explain the total rate of forced insolvency in New Zealand, including both personal bankruptcies and involuntary company liquidations. We find that increases in regional economic activity and regional property values (the latter representing collateral effects) reduce regional insolvencies. An increase in credit provision (increased leverage) raises the rate of insolvencies. In a low-inflation environment, a rise in the inflation rate reduces insolvencies, but this effect disappears in a high-inflation environment. We show that interactions between economic activity, leverage and property price shocks provide a rich understanding of how region-specific shocks can compound into significant localised economic cycles.

JEL classification
G33, O18

Keywords
Insolvency; liquidation; bankruptcy; collateral; regional economy

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1 Introduction

In the firm life cycle, a great number of firms do not reach maturity. Of those that survive childhood, some may live to middle age (and may or may not prosper), while a few successful firms may survive with great longevity. Two types of studies have been undertaken in order to analyse the likelihood and/or the determinants of firm survival. The first type looks at individual firms and explains the factors that determine the likelihood of firms dying or progressing from one stage of the life cycle to the next (Bartelsman and Doms, 2000). The second type examines what determines the failure rate at the aggregate level, and explains the proportion of firms that fail over time (Wadhwani, 1986; Platt and Platt, 1994; Vlieghe, 2001).

This study is of the second type, incorporating two key features. First, we use regional as well as national data to explain insolvencies. We disaggregate New Zealand insolvency statistics into six regions which have had a variety of economic experiences over the sample period (1988Q1–2003Q2). The period starts at the mid-point of New Zealand's major economic reforms, which included removal of agricultural subsidies, reduction of industry protection, labour market deregulation, privatisation, social welfare reform, fiscal consolidation and anti-inflationary monetary policies (Evans et al, 1996). Regional experiences differed greatly during and after this reform period. The major urban centres (Auckland in particular) grew quickly, while many peripheral areas either declined or grew only gradually. (Grimes et al, 2003, documents the effects of these developments on regional property prices.) This diversity of experience helps us analyse the determinants of insolvency, treating the regional data as a panel.

Second, we seek to explain the *total rate of forced insolvencies* in New Zealand. Total forced insolvencies include personal bankruptcies[1] as well as involuntary company liquidations. We group the two together since many personal bankruptcies are related to small business failures, where the business loan is secured over personal assets (Ministry of Economic Development [MED], 2001).

[1] In what follows, we interpret personal bankruptcies as being "forced" although in some cases bankruptcy is "voluntary". We do so since voluntary bankruptcies are most likely to be the result of an adverse financial situation which would otherwise lead to forced bankruptcy.

New Zealand in particular has a large proportion of micro businesses—86% of all enterprises employ five or fewer full-time equivalent employees (MED, 2003)—making personal bankruptcies especially relevant.

Our work is informed by a number of other studies, especially Vlieghe (2001) and Platt and Platt (1994). Vlieghe's theoretical approach, which we adapt, is laid out in Section 2. Platt and Platt employ a simple theoretical model, applying it as a panel to the states of the USA. They find that they can combine states into four groups; the failure rate of each group is driven by similar variables but with different elasticities. There are four variables that determine the (log of the) corporate failure rate in their model. They are the per cent change in state employment, the per cent change in profits earned by sole proprietorships, the (log of the) state real wage, and the per cent change (over two years) in the state business formation rate. The first two variables relate to business activity and revenues, the third is a component of business costs and the fourth reflects the fact that business start-ups have a higher failure rate than do established businesses.

Platt and Platt (1994) emphasise the business formation rate. This may be relevant to New Zealand. As in the US, the failure rate of young firms in New Zealand is higher than that of older firms. Firms established in New Zealand in 1995 had an average annual conditional failure rate of 25.8% over the first two years, dropping to 16.0% in the third year and to 12.3% over the next four years (MED, 2003).[2]

We build on these studies by estimating long-run and dynamic models using panel data methods that explain total insolvencies at the regional level. We compare these estimates to an aggregate national model. This comparison indicates that the national model fails to detect crucial relationships captured by the regional data. This finding is in keeping with those of Platt and Platt.

[2] These figures refer to the failure rate for firms which were established with five or fewer employees in 1995; these firms comprised 93.6% of all firms established that year.

In Section 2, we outline our model and the data we used for estimation. Section 3 estimates the long-run and dynamic models at the aggregate and regional levels. We find that increases in regional economic activity and regional property values (which we used to represent the effects of collateral) reduce regional insolvencies. An increase in credit provision (increased leverage) raises the rate of insolvencies. In a low-inflation environment a rise in the inflation rate reduces insolvencies, but this effect disappears in a high-inflation environment.

We discuss the implications of our results in Section 4. We focus especially on implications for the nature of regional adjustment to national and regional shocks. We also look at the implications for the finance-constraint literature, which posits that financial variables, possibly unrelated to firm performance, may contribute to firm failure (Greenwald and Stiglitz, 1993). We estimate regional vector error correction models (VECMs) incorporating these features. Insolvencies interact with regional activity and property price shocks to provide rich regional dynamic adjustment processes in response to local shocks.

2 Model and data

A firm becomes insolvent when it cannot meet its financial obligations. Following Vlieghe (2001) and Wadhwani (1986) we model the probability of a firm becoming insolvent as the probability that the firm's beginning—of—period assets and/or collateral plus current period profits are insufficient to meet its end of period financial obligations.

For many small firms, the owner's personal assets (often in the form of residential property) will form the bulk of the firm's collateral asset backing since the owner will be required to post a personal guarantee over any loan that finances the business. PriceWaterhouseCoopers (2003) shows that 65% of the value of bank loans to small and medium-sized businesses (SMEs) were collateralised through personal property (house), compared with just 10% financed through fixed assets. For total business, the proportion collateralised through personal property (house) was 30% (again the largest category) compared with 21% financed through fixed assets.

Firm k is illiquid, in the absence of refinancing, if:

$$iD_k > A_k + P_k \qquad (1)$$

where:

- i is the nominal interest rate
- D_k is the k'th firm's (beginning-of-period) stock of nominal debt
- A_k is the k'th firm's (beginning-of-period) stock of realisable assets/collateral
- P_k is the k'th firm's (pre-interest) profits through the period, including any revaluations on beginning-of-period assets

Time subscripts are suppressed for convenience.

If the firm is illiquid, creditors may choose either to place the firm into liquidation or to extend further credit. For expository purposes, we assume that creditors place the firm into liquidation, but the model applies equally if some positive proportion of illiquid firms are placed into liquidation.

We model P_k as the difference between the k'th firm's revenue and its costs, comprising wages and material inputs, in which case condition (1) becomes:

$$iD_k > A_k + R_k - (W_k + M_k) \qquad (2)$$

where:

- R_k is the k'th firm's revenue
- W_k is wages
- M_k is material inputs

Using lower case letters to denote real (deflated) variables (while maintaining i as the nominal interest rate) gives:

$$id_k > a_k + r_k - w_k - m_k \qquad (3)$$

We model r_k as a linear function[3] of real economic activity[4] (y), the exchange rate, the inflation rate and a random variable. Thus:

$$r_k = \alpha_1 y + \alpha_2 e + \alpha_3 \pi + \varepsilon_k \qquad (4)$$

where:

- y is real economic activity
- e is the exchange rate
- π is the inflation rate
- ε_k is a random variable (with properties discussed in the text below)

The activity term reflects a "Phillips Curve" type of relationship. Thus a positive effect of y on r_k, and hence a positive effect on profits and a negative effect on firm insolvency, is expected.

The exchange rate reflects the likelihood that an exchange rate appreciation adversely impacts on exporters' revenue. It will also have an impact in reducing imported material costs, so the direct effect on profits is ambiguous. For firms competing in monopolistically competitive export markets, thus facing a downward sloping demand curve, an exchange rate appreciation will also tend to reduce output. Overall, therefore, a rise (appreciation) in the domestic currency is expected to impact negatively on both revenue and profits.

To determine the effect we expect inflation to have on revenue it is necessary to consider a number of factors. The inflation term reflects the fact that inflation results in changes to the value of inventories and other beginning-of-period assets. Positive inflation has a positive nominal balance sheet effect which is reflected in asset revaluations, therefore raising profits.

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[3] The linear function is for expositional purposes only. We revert to a more general specification subsequently and subject empirical estimates to a Ramsey RESET test for functional form.

[4] Revenue may be best modelled as a function of gross sales rather than value added (GDP). In practice, we use a measure of economic activity which is compiled from a number of expenditure series (including retail sales) plus measures of activity in the labour market and elsewhere, and is therefore a combination of an expenditure and a production measure. We enter a deterministic time trend separately from economic activity and from other variables to reflect the combined trend effects of all included variables. Hence each variable, including economic activity, can be considered to be de-trended using a deterministic time trend. We do not model trend activity using some other filter (e.g. via a Hodrick-Prescott filter) owing to the relatively short timespan of data that we have.

Debt is normally denominated in nominal terms and so is not similarly revalued, although debt servicing rises if the expected inflation rate is reflected in the interest rate. This latter effect is accounted for independently through the interest rate term in (3) and so does not need to be considered separately. The inventory/asset revaluation effect indicates that inflation should have a positive impact on r_k where r_k includes revaluation effects. An additional effect of inflation on profits may arise if there is an asymmetric timing of cost versus output price increases in the presence of high inflation.[5] The effect of such timing impacts on profits is ambiguous in sign. Overall, therefore, the effect of inflation on r_k is ambiguous, but is expected to be positive if the revaluation effect dominates.

The random variable (ε_k) reflects other factors affecting r_k, such as individual firms' business practices (Fabling and Grimes, 2003). We assume that $\varepsilon_k \sim (\mu_1, \sigma_1)$ for recently established "start-up" firms and $\varepsilon_k \sim (\mu_2, \sigma_2)$ for firms that have been established longer. We hypothesise that $\sigma_1 \geq \sigma_2$, reflecting the potential for greater uncertainty in the revenue stream of start-ups. We also hypothesise that $\mu_1 \leq \mu_2$, reflecting lower initial expected profits for start-up firms relative to established firms.

Combining (4) and (3), firm k is modelled as being insolvent if:

$$\varepsilon_k < a_k + \alpha_1 y + \alpha_2 e + \alpha_3 \pi - w_k - m_k - id_k \qquad (5)$$

Thus the probability of failure of firm k (PF_k) is a function, $p_1(.)$, of the variables that appear on the right hand side of (5):

$$PF_k = p_1(a_k, y, e, \pi, w_k, m_k, i, d_k) \qquad (6)$$

Aggregating across all firms, and noting that the proportion of start-up firms in the economy, s, will have an impact on the aggregate rate where $\sigma_1 > \sigma_2$ and/or where $\mu_1 < \mu_2$, the total insolvency rate of firms across the economy (TIR) is given by the function (p_2):

[5] Our estimation period (1988–2003) covers primarily a low-inflation era. However, we also estimate a longer term bankruptcy equation over the 1978–2003 period, and over two sub-periods (1978–1987 [high inflation] and 1988–2003 [low inflation]), to test whether the inflation effect differs across inflation regimes.

$$\text{TIR} = p_2(a_k, y, e, \pi, w_k, m_k, i, d_k, s, \mathbf{X}) \quad (7)$$
$$- \quad - \quad + \quad ? \quad + \quad + \quad + \quad + \quad +$$

Expected signs indicated by the model above are shown below the variables in (7). **X** is a vector of non-stochastic variables relating to legislative changes over time pertaining to insolvency;[6] **X** also includes a time trend to account for trends in the underlying data (e.g. demand relative to potential output) and seasonality. Thus:

$$\mathbf{X} = [\text{DUM, TIME, S1, S2, S3, S4}] \quad (8)$$

where:

- DUM is a dummy variable = 0 to 1994(2) and 1 thereafter to account for legislative change;
- TIME is a linear time trend to account for deterministic trends in the underlying variables;[7]
- S1–S4 are seasonal dummies taking the value of 1 in the relevant quarter and 0 otherwise.[8]

We proxy the variables in (7) as follows.

TIR is the total rate of forced insolvencies, that is, the sum of bankruptcies plus involuntary liquidations handled by both the Ministry of Economic Development and non-government agencies (source: Insolvency and Trustee Service, MED), expressed as a ratio of the total number of companies registered by the Companies Office.[9] The data does not include voluntary liquidations. Thus we are not explaining the total rate of company failure, restricting our attention to forced failure.

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[6] There was a change to New Zealand's insolvency legislation via the Companies Act 1993. There was no intent in this Act to materially alter insolvency numbers, but we subject this to statistical test.

[7] We also tested a second time trend, TIME2 = 0 to 1994(2) and = a linear time trend thereafter (starting at 1 in 1994(3)), to test whether the deterministic trend breaks at the time of legislative change, but this variable was never significant, indicating that the coefficient on TIME is stable across sub-samples.

[8] Because we include four seasonal dummies, we have no separate constant term.

[9] In place of total number of companies, we would prefer to use the total number of units registered for GST since this measure would also include unincorporated businesses, but this data was not available.

It is possible that some variables which appear in (7) may contribute to the overall failure rate but not to the forced failure rate. We have calculated the annual number of voluntary company deregistrations for 1989–2003 (June years) and related these to the annual number of personal bankruptcies and forced company liquidations. The correlation coefficient between annual percentage changes in bankruptcies and forced liquidations is 0.47, supporting our decision to group these two series together as total forced insolvencies. Voluntary deregistrations are negatively correlated with total forced insolvencies (the correlation is –0.28). It is possible that voluntary deregistrations occur faster after business difficulty than do forced liquidations, and the correlation between total forced insolvencies and lagged voluntary deregistrations is positive (0.26). In either case, the loose link between voluntary deregistration and forced insolvency needs to be borne in mind in interpreting our results.[10]

Total insolvency data is available nationally and on a regional basis for six regions (based on the location of the nearest administrative office): Auckland, Hamilton, Napier, Wellington, Christchurch, and Dunedin. All regional data is subscripted j where j = 1,…,6 corresponding to the (north-south) order of these regions as listed above.

TIR, as described above, is our theoretically preferred specification for the insolvency variable since it measures the involuntary death rate of firms. However, the company information is only available nationally and so cannot be used at a regional level. As an alternative specification, LTI is the (natural) logarithm of the number of insolvencies. This specification is used at the regional level. We test it also at the national level, finding similar results to the use of TIR, providing assurance that its use at the regional level does not materially affect the results.

The regional insolvency data (LTI_j) is graphed in Figure 1 (indexed, in each case, to 100 in 1988(1)). Appendix A lists the data for personal bankruptcies and company liquidations (our estimation uses the sum of the two) for each of the six regions and in aggregate across New Zealand.

[10] This is especially important in relation to the impact of business start-ups on the subsequent insolvency rate.

The mean number of insolvencies across the sample varies from lows of 62 and 64 in Dunedin and Napier, to 313 in Auckland. Regional variation across time is similar, with the coefficient of variation in each region lying between 20% and 33%.

From Figure 1, some differences and similarities in trends are apparent across the six regions. Over the first half of the sample, Auckland insolvencies increase considerably more than for the other five regions but subsequently, Napier and Christchurch "catch up".[11] Hamilton varies around a consistent level, while Wellington and Dunedin insolvencies both tend to fall away, especially towards the end of the sample. The correlation coefficients between each pair of regions for the quarterly percentage change in total insolvencies are all positive, with the majority lying between 0.2 and 0.5. This level of correlation indicates some similarity in regional insolvency patterns across time, but also a material degree of difference in regional experience.

The start-up rate (SR) is measured at national level by the number of newly registered firms with the Companies Office as a proportion of the total number of firms (source: MED).[12] We have no regional breakdown of this information.

Given that personal bankruptcies dominate insolvency statistics, a relevant measure of a_k is the previous period's value of residential housing available as collateral. From the PriceWaterhouseCoopers (2003) study, personal housing is also relevant as a collateral measure for small and medium-sized enterprises. We use a measure, derived from Quotable Value New Zealand data, for the median value of the residential house price in each regional council nearest to the insolvency office (source: Motu[13]). The real regional property price, LPR_j, is given by the logarithm of the regional house price deflated by the national Consumers Price Index (CPI)[14] (source: Statistics New Zealand [SNZ]). The average value of house prices across regions each quarter is used to proxy the national property price.

[11] This "catching up" refers only to the insolvency level relative to insolvencies at the start of the sample; we do not have the data to ascertain whether regional insolvency *rates* converge or not.
[12] This measure includes genuine new entrants and existing unincorporated businesses that choose to incorporate. These two groups of firms may display different properties with respect to ε_k and this should be considered when interpreting the estimated effect of SR on TIR.
[13] Grimes et al (2003).
[14] Regional dispersion in consumer prices is minimal.

The proxy for y is the logarithm of the National Bank of New Zealand (NBNZ) Regional Economic Activity index for each regional council, LEA_j (i.e. Auckland, Waikato, Hawkes Bay, Wellington, Canterbury, Otago).[15] To maintain consistency, the NBNZ national series for Economic Activity is used at the aggregate level (source: NBNZ).[16]

π is measured by the national rate of CPI inflation, excluding the effects of interest and GST (measured in per cent p.a.) for the latest four quarters (source: SNZ and Reserve Bank of New Zealand [RBNZ]), denoted INFL.

The logarithm of the real wage rate (LWR), our proxy for w_k, is measured as average hourly earnings (source: RBNZ) deflated by the CPI (excluding interest and GST).

LPPI, our proxy for m_k, is the logarithm of the ratio of Producer Price Index (Inputs) to Producer Price Index (Outputs) (source: SNZ). This variable captures input costs relative to producers' output prices and so more closely mirrors the conceptual nature of the variable than would deflating by the CPI.[17]

Three alternative exchange rate measures were tested (all expressed as logarithms): the New Zealand/Australia exchange rate LNZDAUD (source: RBNZ), the NZD/USD rate, and the trade weighted index (TWI). Inflation in the relevant countries has been similar over the sample, so the nominal exchange rate is the primary determinant of volatility in the real exchange rate. Neither the NZD/USD nor the TWI had any explanatory power, while the NZD/AUD had some influence and so is preferred below. The NZD/AUD may be most relevant since Australia is New Zealand’s dominant market for exchange-rate sensitive elaborately transformed manufactures and other non-commodity exports.

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15 We tested whether groups of regions have greater explanatory power than a single region (e.g. using Gisborne and Hawkes Bay to explain Napier insolvencies) but in each case the single region performed better, or as well as, grouped regions.

16 The NBNZ National Economic Activity Index is closely correlated with official SNZ GDP.

17 We also tested the logarithm of the inverse of the terms of trade, which is conceptually linked with LPPI and empirically correlated with it, but this variable was not significant. Our proxies for both w_k and m_k are relative price variables with no quantity component, reflecting an assumption that firms can make decisions on input quantities, but are price takers. Given the logarithmic form of our equations, scale effects are picked up through the activity variable.

The debt measure, denoted LPSC, is the logarithm of real private sector credit (private sector credit/consumers price index) lagged one period to reflect the beginning-of-period debt stock (consistent with LPR_j). The national measure is used since no regional measure of leverage is available. I90 is the 90-day bank bill rate (sources: RBNZ, SNZ, NBNZ).[18]

All data is available from 1988(2)–2003(1), so this period constitutes our estimation period for all long-run equations. Equations are extended to 2003(2) where data availability allows.

We have tested the aggregate data for the presence of unit roots using Augmented Dickey-Fuller (ADF) tests (reported in Appendix B). The tests indicate that a unit root cannot be rejected at the 10% level for each of I90, LEA, LWR, LPSC, TIR, LTI and LPR (with or without deterministic trend as appropriate), so these variables are regarded as non-stationary, I(1). LPPI and LNZDAUD are indeterminate (i.e. a unit root cannot be rejected at the 1% level but can be rejected at the 10% level). The tests indicate that INFL is stationary, I(0), at the 1% level (although it is indeterminate if a deterministic time trend is included). Over a longer time period (1978–2003) an ADF test on INFL indicates that we only reject a unit root at the 8.8% level.

Given the indication that a unit root is present in the dependent variable (i.e. insolvencies expressed both as TIR and LTI) and that all independent variables either possess a unit root or are indeterminate in this respect, we estimate each of our relationships using a two-step Engle-Granger procedure.[19] The long-run equation for TIR (and LTI) is estimated as a function of the levels of the variables listed in (7) and (8). Changes in TIR (LTI) are then modelled as a function of the lagged long-run residual and current and lagged changes in the explanatory variables. This process is followed both for the aggregate data and for the regional data treated as a panel.

[18] Most debt in New Zealand over the estimation period is floating rate, implying that a short-term interest rate should be used in the estimation.

[19] With respect to the variables which have indeterminate tests for stationarity, we note that if an I(0) variable is included in a co-integrating equation it does not give rise to inconsistent estimates (Banerjee et al, 1993), reinforcing our decision to include these variables given our theoretical model.

For the regional data, we treat the parameters on the economic variables as identical across regions on the basis that similar economic forces are at work. We assess the cross-equation restrictions in the long-run equations by testing whether co-integration holds for each region; if so, we take the specification as a valid set of long-run equations. Restrictions within short-run equations are tested formally and we also check whether the equations meet the statistical diagnostic checks. The panel estimates with cross-equation restrictions considerably enlarge the degrees of freedom available to us, especially since regions have experienced quite different economic conditions at times through the sample period. This enables us to discriminate more sharply between different potential determinants of insolvencies.

3 Results

3.1 Aggregate

Initially, we estimate (7) at the aggregate (New Zealand) level, using the insolvency rate (TIR) as the dependent variable. We then re-estimate the equation using the log of insolvencies (LTI) to check the robustness of our results for the alternative specification of the dependent variable.

The long-run estimates for TIR are presented as (9a), those for LTI are presented as (9b).[20] In each case we have excluded variables with p-values on t-statistics that are greater than 0.025 (noting that p-values, shown below coefficients, overstate the significance of a variable when dealing with non-stationary variables). We also exclude one variable (SR, start-up rate) which, relative to our theoretical model, has the wrong sign (discussed further below).

$$\underset{}{TIR_t} = \underset{(0.000)}{-0.0179 \cdot LEA_t} \underset{(0.000)}{- 0.0007 \cdot INFL_t} \underset{(0.021)}{+ 0.0145 \cdot LPPI_t} \underset{(0.000)}{+ 0.0052 \cdot LPSC_{t-1}} \quad (9a)$$

Sample: 1988(2)–2003(2) [n = 61] ADF = –5.618

$$LTI_t = \underset{(0.000)}{-3.628 \cdot LEA_t} \underset{(0.000)}{- 0.109 \cdot INFL_t} \underset{(0.010)}{+ 3.196 \cdot LPPI_t} \underset{(0.000)}{+ 1.728 \cdot LPSC_{t-1}} \quad (9b)$$

Sample: 1988(2)–2003(2) [n = 61] ADF = –5.791

[20] Seasonals are included in the specification, and are jointly significant, but are not reported for clarity.

ADF test statistics for (9a) and (9b) indicate that each equation has a stationary residual (a unit root can be rejected at the 1% significance level using the critical values of Davidson and MacKinnon, 1993). Consequently, we take (9a) and (9b) as valid long-run aggregate specifications for the two dependent variables.

We initially estimated the dynamic equations with current and lagged changes in all hypothesised variables entered; in the final equations we retain only variables which are significant at the 5% level. The resulting equations are presented as (10a) and (10b), where RES is the residual from the corresponding long-run equation.

$$\Delta TIR_t = -\underset{(0.001)}{0.428} \cdot RES_{t-1} - \underset{(0.002)}{0.0223} \cdot \Delta LEA_{t-1} \tag{10a}$$

Sample: 1988(3)–2003(2) [n = 60] $R^2 = 0.66$

Breusch-Godfrey LM test for serial correlation: p = 0.38[21]

$$\Delta LTI_t = -\underset{(0.000)}{0.527} \cdot RES_{t-1} - \underset{(0.013)}{3.734} \cdot \Delta LEA_{t-1} \tag{10b}$$

Sample: 1988(3)–2003(2) [n = 60] $R^2 = 0.69$

Breusch-Godfrey LM test for serial correlation: p = 0.17

In interpreting this set of equations we note, first, the close similarity of results between the TIR and LTI specifications, both with respect to the variables that are included and their individual significance levels. (Scale effects mean that absolute coefficient estimates are not comparable.) The explanatory power of each equation is similar.[22]

[21] The equation also passes tests for normality, ARCH processes, functional form, and parameter stability (with a mid-sample break-point) with a minimum p-value of 0.30.

[22] We do not report the R^2 for the long-run equations because they relate to I(1) variables, but as usual with the first stage of a two-step regression, they are 0.99 and 1.00 respectively.

Second, three variables—economic activity (LEA), inflation (INFL) and private sector credit (LPSC)—are highly significant in the long-run equations; a fourth—relative producer prices (LPPI)—is included, although its true significance (given it is an I(1) variable) is not so clear. When the exchange rate (LNZDAUD) is added to (9a) it has the correct sign (positive) and a t-statistic of 1.91; it is also positive when added to (9b) but has a t-statistic of just 1.00. Given its lack of significance we do not include it in the final equations. Property, wage, interest rate and time trend variables do not appear significantly in either specification.

Third, the (lagged) start-up rate (SR) appears significantly when added to each specification, but with a negative sign. If taken at face value, this would imply that an increase in start-ups decreases the firm failure rate, which is at odds with the micro evidence on firm failure. The reason for this finding is likely to be that the firm start-up rate rises in anticipation of good economic conditions. If those conditions eventuate as expected, the subsequent aggregate insolvency rate will diminish, thus establishing a negative correlation between TIR and lagged SR.[23] We attempted to solve this problem by modelling SR separately as a function of forward-looking variables, and then including the residual from this equation in the TIR equation as a measure of "over-expansion" of new firms in circumstances where economic conditions did not evolve as expected. This procedure removes the significance of the negative coefficient of SR in the TIR equation, but did not establish a significant positive relationship. Coefficients on other variables are little changed by the inclusion or exclusion of SR.

It is also possible that failure of newly established firms occurs more frequently through voluntary liquidation rather than through forced liquidation or bankruptcy, especially if people starting them can at first only access external finance that is well collateralised. Our earlier analysis of the link between voluntary company deregistrations and forced insolvencies is consistent with this explanation.

[23] In addition, the mix of newly incorporated firms (between genuine start-ups and previously unincorporated businesses) may change as economic conditions change, confounding the estimated impact of SR on TIR.

A further possibility is that our data, which includes personal bankruptcies as well as forced company liquidations, masks the impact of company start-ups on company insolvencies, but when we restrict our attention solely to forced company insolvencies the negative relationship between SR and insolvencies remains. As Figure 2 shows, there is also strong collinearity between the rate of start-ups and the ratio of private sector credit to economic activity during our sample, and this may have clouded the estimate for the effect of the start-up rate on TIR.

Fourth, the dynamic specifications indicate the importance of recent changes in economic activity, as well as the long-run economic climate, on insolvencies. Other long-run influences impact quickly on the insolvency rate, with approximately half of the adjustment to the long run occurring within a quarter. The short-run equations explain approximately two-thirds of the quarterly variation in forced insolvencies.

The aggregate forced insolvency equations ((9) and (10)) cover the period 1988–2003. We have data for aggregate personal bankruptcy, but not for company liquidations, from March 1976 (also listed in Appendix A; the earlier bankruptcy data comes from SNZ). We have re-estimated the equations in (9b) and (10b) in identical fashion using this data from 1977 onwards (given availability of other data) to test the robustness of our estimates over a longer time period. The extended time period contained major economic shocks, including the second oil shock and the initial post-1984 economic reform measures. The equations estimated over the full period are listed as (11) and (12a) below (where LTB is the logarithm of total bankruptcies and LGDP is the logarithm of real GDP[24]).

$$\underset{}{LTB_t} = \underset{(0.000)}{-4.155 \cdot LGDP_t} - \underset{(0.000)}{0.025 \cdot INFL_t} + \underset{(0.004)}{3.062 \cdot LPPI_t} + \underset{(0.000)}{2.525 \cdot LPSC_{t-1}} \qquad (11)$$

Sample: 1977(4)–2003(2) [n = 103] ADF = –3.59

[24] We use SNZ's Real GDP data in place of National Bank Economic Activity and have backdated the PSC data using the Reserve Bank's historical series to 1986 with the intervening 1986–1988 data linked using the intervening quarters' data for M1. Other data is as described earlier.

$$\Delta LTB_t = -0.240 \cdot RES_{t-1} \; - 3.140 \cdot \Delta LGDP_{t-1} \quad (12a)$$
$$\qquad (0.001) \qquad\qquad (0.003)$$

Sample: 1978(1)–2003(2) [n = 102] $R^2 = 0.40$

Breusch-Godfrey LM test for serial correlation: p = 0.001

The estimates in (11) and (12a) are similar to those of (9b) and (10b), despite a different dependent variable, a different measure for economic activity and a longer time period. All variables that are significant over the shorter period are also highly significant over the longer period. The effects of economic activity, materials prices relative to output prices, and credit provision all remain similar in size to those of the previous estimates.

The only coefficient that changes materially in size is that on inflation. The 1977–1987 period was characterised by high inflation in New Zealand (averaging 13.4% p.a. over this period, compared with an average 3.0% p.a. in 1988–2003). The estimates in (11) imply either that the effect of high inflation on insolvencies differs from the effect of low inflation, or else that personal bankruptcies are much less affected by inflation than are company liquidations.

To distinguish between these explanations, we re-estimated (11) over split samples: 1977–1987 and 1988–2003, the latter being our sample for LTI. In the latter sub-sample, the coefficient on INFL was –0.021 (p = 0.012) which is considerably smaller than the –0.109 estimated for the LTI equation. This comparison indicates that inflation has had a greater positive impact on company survival than on personal bankruptcies over the recent period. In the earlier period, the coefficient on inflation drops further, to –0.013 (p = 0.057), which is not even statistically significant (especially in a long-run equation). This result suggests that the effect of inflation on insolvency disappears entirely in a high-inflation environment. The disappearance of this effect over the early sub-sample is consistent with sustained inflation affecting inflation expectations, and thence being reflected in nominal interest rates, more so in a high-inflation regime than in a low-inflation regime. Thus inflation has offsetting effects on the insolvency rate in a high-inflation environment which are absent, or less pronounced, in a low-inflation environment.

The residuals of (12a) exhibit significant first order autocorrelation. We have re-estimated the dynamic equation using current and lagged changes of all variables, plus the lagged residual; equation (12b) reports the resulting equation after dropping terms not significant at the 5% level. The LM test rejects the presence of serial correlation in the residuals. Again, changes in economic activity are shown to affect the dynamics of aggregate insolvencies (bankruptcies).

$$\underset{}{\Delta LTB_t} = \underset{(0.021)}{-0.158 \cdot RES_{t-1}} - \underset{(0.000)}{0.386 \cdot \Delta LTB_{t-1}} - \underset{(0.032)}{2.346 \cdot \Delta LGDP_t} - \underset{(0.000)}{3.543 \cdot \Delta LGDP_{t-1}} \quad (12b)$$

Sample: 1978(1)–2003(2) [n = 102] $R^2 = 0.50$

Breusch-Godfrey LM test for serial correlation: p = 0.24

3.2 Regional panel

We now use the additional information available from the regional data to estimate (7) and its dynamic counterpart at the regional level, treating the regional data as a panel. We have six regions over 60 quarters,[25] giving 360 observations. Because the error terms may be correlated across regions, we use seemingly unrelated regressions to estimate the panel. The log of regional insolvencies (LTI_j) is the dependent variable.

In estimating the panel, we test whether we can restrict the coefficients on all variables, other than those in **X**, to be identical across regions. We do so initially by examining whether each individual long-run equation is co-integrated after imposition of the cross-equation restrictions. Rejection of a unit root (acceptance of a co-integrating vector) implies it is valid to consider that firms in each region are impacted similarly by the economic variables under consideration. Rejection of the cross-equation restrictions implies either that region-specific reactions to the included variables differ materially or else that the equations suffer from omitted (non-stationary) variables. Seasonality and trends in the underlying data may differ across regions and the effect of legislative change may also have differed across regions,[26] so we do not impose cross-equation restrictions on the **X** vector.

[25] We drop the second quarter of 2003 as LPR (real regional property price) is available just to 2002(4).
[26] In the event, our estimates indicate that legislative change had no effect on either the level or trend of insolvencies in any of the regions.

The results of estimating the long-run panel equation are given in Table 1. LEA (regional economic activity) and LPR (property prices) are measured regionally, while other explanatory variables are national. The same criteria for choosing to retain or omit variables are used here as in the aggregate case.

Table 1: Long-run regional determinants of LTI_j

	AUCK	HAM	NAP	WELL	CHCH	DUN
$LEA_{j,t}$	–4.580	–4.580	–4.580	–4.580	–4.580	–4.580
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$INFL_t$	–0.094	–0.094	–0.094	–0.094	–0.094	–0.094
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$LPSC_{t-1}$	1.614	1.614	1.614	1.614	1.614	1.614
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$LPR_{j,t-1}$	–0.323	–0.323	–0.323	–0.323	–0.323	–0.323
	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)	(0.022)
$TIME_t$	0.014	0.017	0.015	0.000	0.027	0.006
	(0.024)	(0.009)	(0.010)	(0.941)	(0.000)	(0.350)
ADF	–5.505	–6.039	–10.679	–7.122	–5.438	–6.712

Sample: 1988(2)–2003(1) [n = 360]
Coefficients on $LEA_{j,t}$, $INFL_t$, $LPSC_{t-1}$, and $LPR_{j,t}$ are restricted to be identical across regions.

The estimates in Table 1 are similar to those in equation (9b), with the inclusion of economic activity (here at a regional level), inflation and real private sector credit as before. One variable from (9b), relative producer prices (LPPI), is not significant at the regional level, and that was the least significant variable in the aggregate specification. The time trend is significant in four of the six regions and, for consistency, we include it for all six regions.

One new stochastic variable appears: lagged property prices (LPR). Inclusion of this variable is in keeping with the importance of collateral—measured at the regional level—for avoiding forced insolvency.

The ADF tests indicate that we can reject a unit root in the residuals at the 1% level for each equation. This indicates that the cross-equation restrictions (on LEA, INFL, LPSC and LPR) are consistent with a valid long-run specification for each region. An F-test of the combined long-run and dynamic cross-equation restrictions follows after the dynamic estimates are reported in Table 2.

When the equations in Table 1 are estimated without imposing cross-equation restrictions, we find generally consistent parameter estimates. All six regional estimates for the inflation (INFL) parameter lie between –0.07 and –0.12; five of the estimates on private sector credit (LPSC) lie between 1.2 and 3.1; and four of the estimates on activity (LEA) lie between –4.1 and –5.8. The coefficient estimates on property prices (LPR) are less consistent, with the restricted estimate being driven primarily by Napier (–1.3), Dunedin (–1.0) and Hamilton (–0.5); the other three LPR estimates are not significantly different from zero. We have also examined long-run parameter stability across regions by estimating the system dropping each region in turn (i.e. estimating six systems, each comprising five regions). The resulting estimates on LEA range from –4.252 to –5.006; on INFL from –0.088 to –0.102; on LPSC from 1.409 to 1.817; and on LPR from –0.116 to –0.460. All coefficient estimates have $p < 0.025$ except for three of the LPR estimates (one of which has $p = 0.065$).

Dynamic equations, based on the restricted long-run estimates, are presented in Table 2.

Table 2: Short-run regional determinants of LTI_j

	AUCK	HAM	NAP	WELL	CHCH	DUN
$\mathbf{RES_{j,t-1}}$	–0.863	–0.863	–0.863	–0.863	–0.863	–0.863
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$\mathbf{\Delta LEA_{j,t}}$	–2.427	–2.427	–2.427	–2.427	–2.427	–2.427
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
$\mathbf{\Delta INFL_t}$	–0.071	–0.071	–0.071	–0.071	–0.071	–0.071
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$\mathbf{R^2}$	0.60	0.58	0.57	0.55	0.33	0.47
Rho[p]	0.615	0.615	0.615	0.615	0.615	0.615

Sample: 1988(3)–2003(1) [n = 354]
Coefficients on $RES_{j,t-1}$, $\Delta LEA_{j,t}$, and $\Delta INFL_t$, and Rho[p] are restricted to be identical across regions.

Rho[p] is the p-value of the coefficient on the lagged short-run residual where the short-run residual is regressed on the lag of itself plus the variables appearing in Table 2 (with cross-equation restrictions). This test is similar to the single equation Breusch-Godfrey serial correlation test. The test indicates no significant autocorrelation (even in the presence of cross-equation restrictions).

Explanatory power of the equations is similar to that for the aggregate equation for four of the regions, despite the greater noise-to-signal ratio that is normally found in regional compared with national data.

As with the aggregate short-run equation, contemporaneous economic conditions impact significantly on the dynamics of regional failure rates. A rise in the rate of regional economic growth and in the inflation rate both reduce the change in forced insolvencies. Adjustment to the long run is much faster with the regional estimates than is indicated by the aggregate equation, being almost complete within one quarter. This finding is consistent with an aggregation bias effect reported by Imbs et al (2002) with respect to product aggregation and real exchange rate adjustment to fundamentals; where regional shocks are not perfectly correlated with one another, the aggregate adjustment equation may be mis-specified.

The estimates in Table 2 incorporate sets of restrictions to each of the long-run and short-run parameters of the system. We formally test the complete set of restrictions and the short-run restrictions by estimating: (a) the combined system in a completely unrestricted fashion, and (b) an unrestricted dynamic system incorporating the long-run restrictions. In estimating (a), the variables in the long-run specification are each included with a one-period lag in place of $RES_{j,t-1}$, noting that a linear combination of these variables is stationary. An F-test on the 35 parameter restrictions included across the entire system (i.e. system (a) compared with the system incorporating both long and short-run restrictions) yields an F-statistic of 1.56, which is identical to the 5% critical F-value. Testing just the long-run restrictions, by comparing system (b) with system (a), yields an F-statistic of 0.87, compared with a 5% critical value of 1.84. A test of just the short-run restrictions, through a comparison of system (b) with the system incorporating both long and short-run restrictions, yields an F-statistic of 2.57, compared with a 5% critical value of 2.07 and a 1% critical value of 2.87. Together, these tests indicate that we cannot reject the long-run cross-equation restrictions (consistent with the prior co-integration findings), although the short-run cross-equation restrictions are borderline significant.

4 Discussion and interpretation

Area-specific shocks impact on incomes and asset values within regions. Our analysis indicates that shocks to regional activity and property values, as well as national developments in inflation and credit provision, affect the prevalence of regional company failures. Specifically, changes in regional economic activity impact on revenues and thence on the probability of individual company failure, while changes in property prices impact on collateral values. Regional economic activity has a direct effect on property prices (Grimes et al, 2003) but so do other variables (such as interest rates and new housing supply). Thus house prices incorporate the effects of shocks over and above the effect of economic activity, and act on insolvency rates through a different channel than does economic activity. Faced with a rise in the price of a property used for collateral, a creditor is less pressured to force a debtor into insolvency since the risk to loan repayment is reduced.

Conversely, a negative shock to regional property prices results in increased regional insolvencies. Given that undischarged bankrupts are not allowed by New Zealand law to enter into business alone, be a company director or take part in management of a company (normally for a period of three years after initial bankruptcy), the effect of a regional property price downturn, with its associated increase in insolvencies, may be to inhibit regional entrepreneurship, at least for a period. Thus an initial regional downturn can have a magnified—and/or prolonged—effect on regional economic outcomes, particularly if company closures are not matched during the same period of time by the start-up of new businesses and/or expansion of existing firms.[27]

[27] Existing firms and potential start-ups in a region are likely to be impacted by the same events that led to the rise in insolvencies, so it is doubtful if new start-ups or surviving firms' expansion will offset the forced insolvency effect.

An illustration of the interactions between regional economic activity, regional house prices and regional insolvencies is given in Figures 3 and 4. We estimate unrestricted vector error correction models (VECMs) involving these three variables for each of the two smallest regions in our sample: Napier and Dunedin.[28] In each case, the VECM incorporates each of the variables included in the equations reported in Table 2 (LTI, LEA, LPR, INFL, LPSC, TIME, S1, S2, S3, S4). We treat the first three of these variables (insolvencies, economic activity and property prices) as endogenous within the VECM (each being regional variables); inflation and private sector credit are treated as exogenous (being aggregate variables); and the non-stochastic variables are also treated as exogenous. The specification includes four lags of the differenced variables plus a single co-integrating vector (CV). The Johansen co-integration test indicates a single CV for Dunedin and two CVs for Napier.[29] Therefore, for robustness, we also present results using two CVs in the VECM (Figures 5 and 6).

The impulse response functions for each endogenous variable in response to one standard deviation innovations in the endogenous variables are shown for a twenty-quarter horizon.[30] We focus on the response of economic activity (LEA) and property prices (LPR) to a rise (positive innovation) in insolvencies (LTI) and the response of LTI to rises in LEA and LPR.

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[28] Napier and Dunedin are chosen since these are region-specific VECMs. Developments in each of these regions are likely to have fewer flow-on effects to other regions or to aggregate variables (such as inflation and aggregate credit supply) and thence back to themselves than is the case for the larger regions. The region-specific specification is therefore more appropriate for these regions than for a larger region such as Auckland.

[29] For Napier, the results are consistent (two co-integrating vectors) for both the trace statistic and the maximum eigenvalue statistic, at both the 5% and 1% levels. For Dunedin, the results are consistent (one co-integrating vector) for each of these tests except for the trace statistic at the 5% level, which indicates three co-integrating vectors.

[30] The ordering of the Choleski decomposition in each case is LPR, LEA, LTI. The ordering does not materially alter the patterns of response.

A positive innovation to LEA (shown as lea_n and lea_d for Napier and Dunedin respectively) has a permanent (five-year) negative effect on LTI in Napier (with both one and two CVs); the effect in Dunedin is approximately zero (slightly negative with two CVs and slightly positive with one CV). A positive innovation to LPR has at least a transitory negative effect on LTI in each case, with a permanent effect in each of the single CV cases. The effects of a rise in LTI are more clear-cut. A positive innovation to LTI has permanent negative effects on LEA and LPR in each case. These effects are in keeping with the earlier estimates in this paper.

A permanent innovation to LTI may result from a change in legislation pertaining to insolvency. For instance, a change to the legal framework that facilitates increased business rehabilitation following a firm's difficulties (in cases where long-term survival of the firm is feasible) could induce a negative innovation to LTI.[31] In addition, a change to bankruptcy legislation that reduces the impact of becoming bankrupt on an entrepreneur's re-entry into entrepreneurial activities may lessen the effect of a given level of insolvencies on subsequent economic activity. In neither case, however, could we infer that the parameters estimated here would necessarily apply, since the nature of the innovation is different to that experienced historically; nevertheless, conceptually the direction of effect should be the same.

The VECM results and the collateral effects indicated by the earlier regional and aggregate equations help to increase our understanding of the role of financial factors in company insolvency. The estimates indicate that increased aggregate credit provision is a positive contributor to the rate of insolvencies. The New Zealand economy, in keeping with trends in other developed countries, has seen a considerable increase in leverage through the period under consideration.[32] This increase in debt has been coupled with a rise in the rate of business start-ups, in part financed by the greater availability of credit. The partial effect of these developments, exhibited through the importance of LPSC in explaining the insolvency rate, is to increase the rate of forced insolvencies.

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[31] A new business rehabilitation framework has recently been proposed in New Zealand (Dalziel, 2003).

[32] The ratio of real private sector credit to economic activity increased by 45% between 1993 and 2000 (see Figure 2).

To the extent that increases in real property prices cause real collateral values to keep up with the greater real value of credit, this leverage effect can be mitigated. Reflecting these offsetting effects, there has been no trend increase in aggregate insolvencies in New Zealand since the start of the 1990s despite the strong increase in credit provision.

A temporary increase in inflation is another avenue by which the impact of increased leverage on the insolvency rate can be mitigated. As inflation rises, asset values (including collateral and inventory values) rise and firms are better placed, in the short term, to service and/or repay their outstanding debt, thus reducing the insolvency rate. However, a longer-term increase in inflation will be reflected in increases in inflation expectations, nominal interest rates and debt servicing, offsetting the beneficial asset value effect. Our estimates over the high-inflation period indicate that a rise in inflation loses its beneficial impact on insolvencies under persistent inflationary conditions. The lack of inflation effect on the insolvency rate under these conditions, but significant effect with low inflation, is consistent with the thesis that higher inflation may have a short-term positive impact on company balance sheets but only when inflation is unanticipated or otherwise not incorporated into financial prices.

Overall, our work reiterates the findings of Platt and Platt, Vlieghe and others that economic activity is an important determinant of insolvencies. Financial market developments have played a major role through the greater provision of credit, contributing to greater leverage and thus greater risk of firms being unable to service and/or repay their debt. Regional developments interact with each of these effects, making regional activity and regional asset values key transmitters of area-specific shocks to regional insolvencies. The feedback of insolvencies on regional economic variables can then magnify and prolong regional economic cycles.

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Figure 1: Regional forced insolvencies (scaled to 1988Q1 = 100)

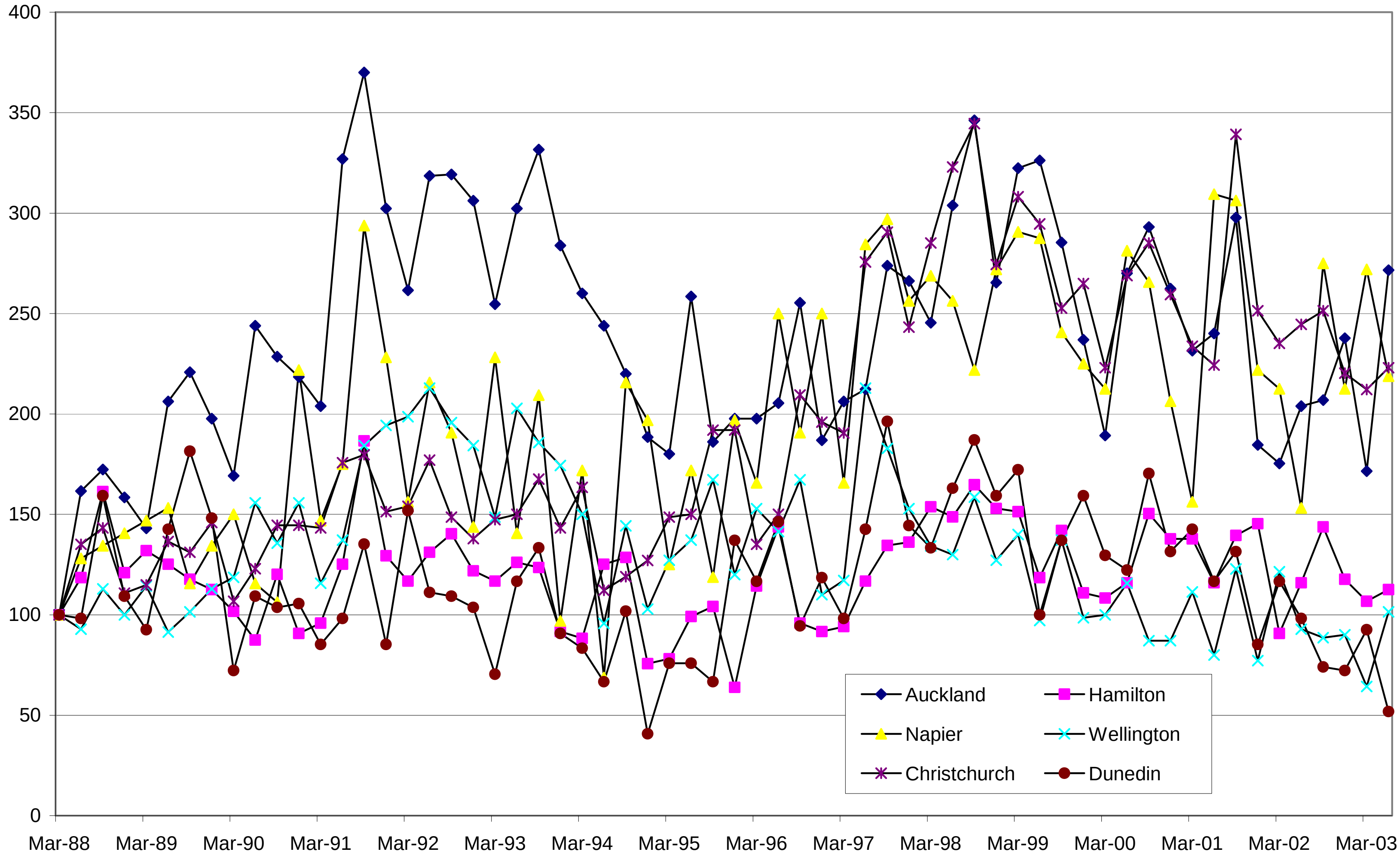


Figure 2: Private sector credit and company start-up rate

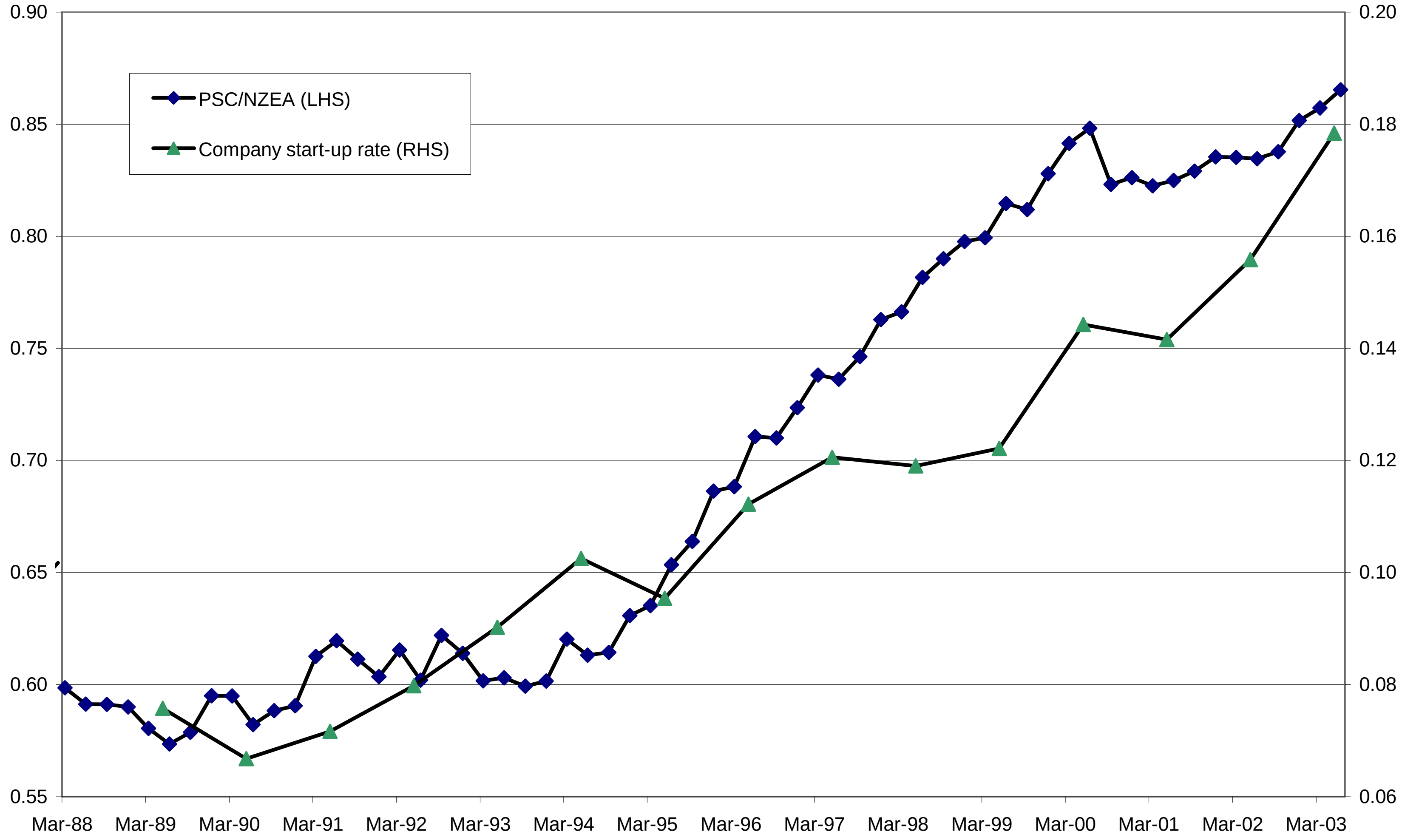


Figure 3: VEC impulses (Napier: one co-integrating vector)

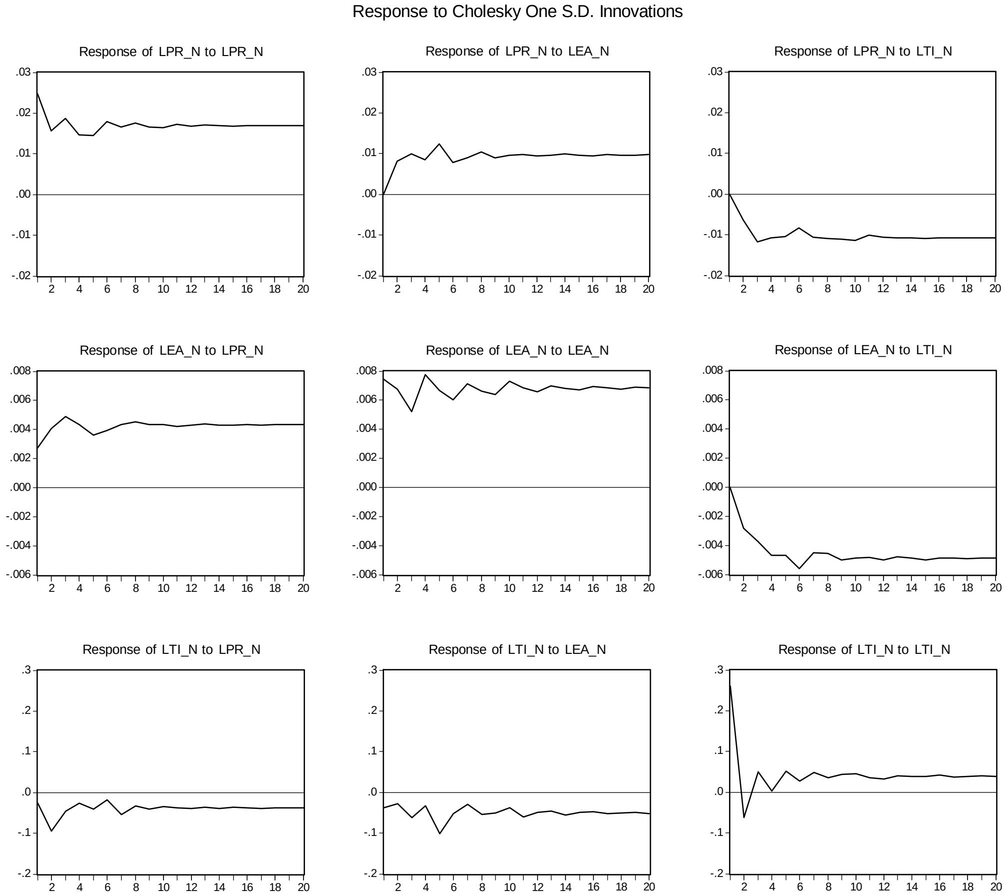


Figure 4: VEC impulses (Dunedin: one co-integrating vector)

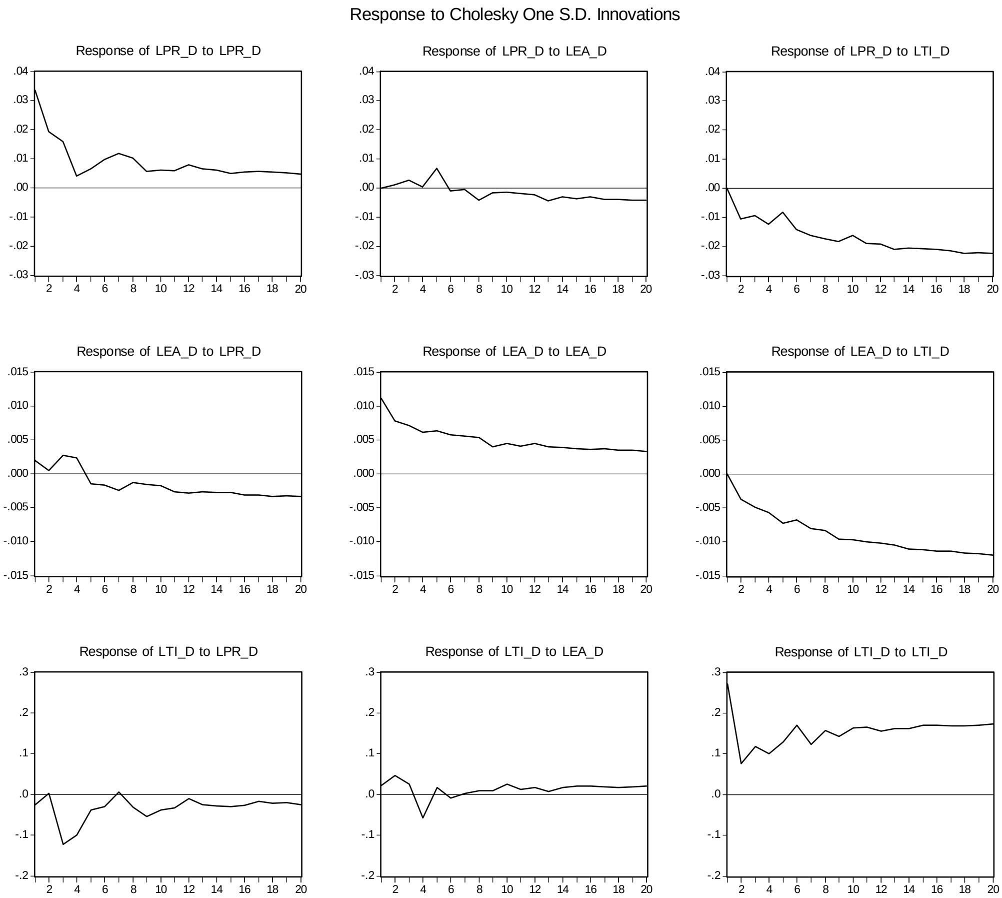


Figure 5: VEC impulses (Napier: two co-integrating vectors)

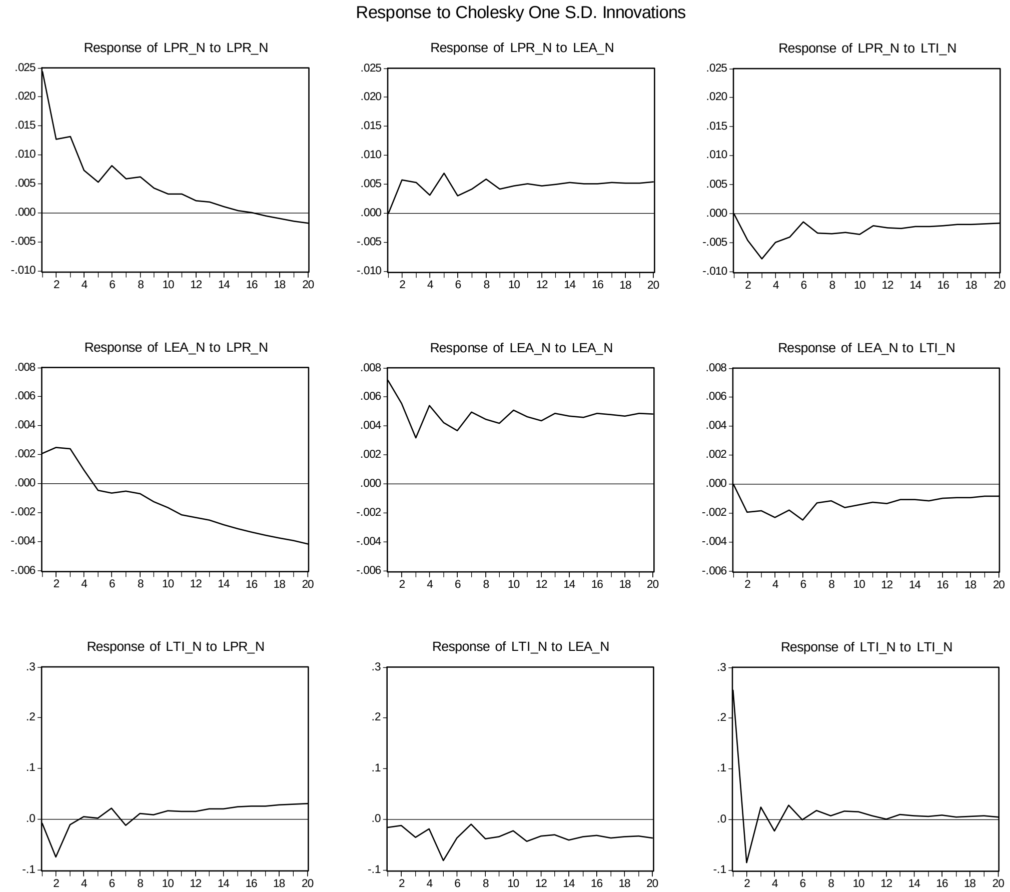
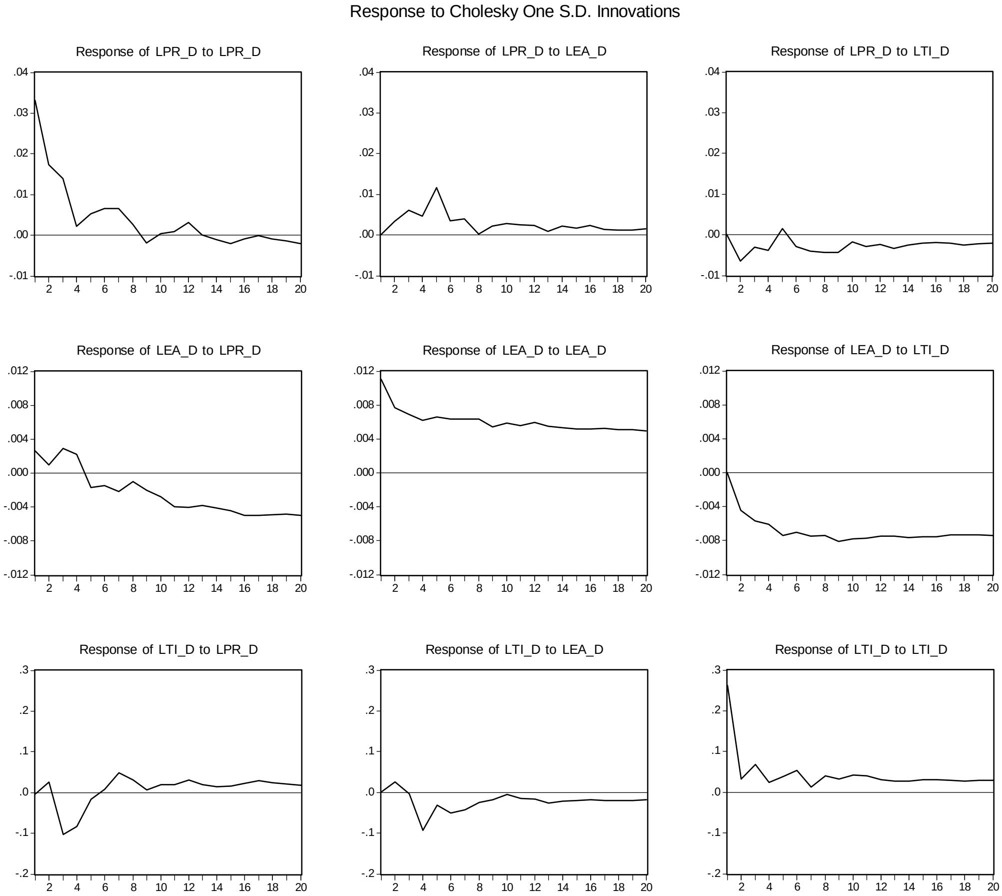


Figure 6: VEC impulses (Dunedin: two co-integrating vectors)



Appendix A: Bankruptcy and involuntary company liquidations

	Personal bankruptcies							Involuntary company liquidations						
	TOTAL*	**AUCK**	**HAM**	**NAP**	**WELL**	**CHCH**	**DUN**	**TOTAL**	**AUCK**	**HAM**	**NAP**	**WELL**	**CHCH**	**DUN**
Mar-88	**404**	70	97	25	48	61	52	**126**	60	22	7	22	13	2
Jun-88	**416**	100	99	30	42	68	49	**222**	110	42	11	23	32	4
Sep-88	**577**	113	159	32	54	83	77	**212**	111	33	11	25	23	9
Dec-88	**475**	99	123	34	46	64	51	**189**	107	21	11	24	18	8
Mar-89	**453**	82	125	38	60	61	47	**192**	104	32	9	20	24	3
Jun-89	**491**	127	105	40	36	71	64	**265**	141	44	9	28	30	13
Sep-89	**487**	113	102	29	34	73	88	**291**	174	38	8	37	24	10
Dec-89	**510**	132	112	29	43	74	67	**244**	125	22	14	36	34	13
Mar-90	**426**	117	90	33	50	53	35	**212**	103	31	15	33	26	4
Jun-90	**477**	154	82	20	64	63	48	**286**	163	22	17	45	28	11
Sep-90	**513**	156	95	25	63	80	47	**266**	141	48	9	32	27	9
Dec-90	**467**	136	82	56	65	82	46	**269**	148	26	15	44	25	11
Mar-91	**447**	152	91	32	49	83	40	**212**	113	23	15	32	23	6
Jun-91	**625**	246	119	51	58	102	49	**284**	179	30	5	38	28	4
Sep-91	**839**	318	190	74	84	107	66	**293**	163	32	20	45	26	7
Dec-91	**651**	226	131	65	90	97	42	**263**	167	23	8	46	15	4
Mar-92	**641**	225	110	40	98	98	70	**223**	115	29	10	41	16	12
Jun-92	**706**	293	124	51	75	106	57	**273**	121	32	18	74	25	3
Sep-92	**675**	279	127	40	90	84	55	**274**	136	40	21	47	26	4
Dec-92	**602**	261	112	36	77	74	42	**274**	137	33	10	52	28	14
Mar-93	**611**	242	109	53	76	94	37	**183**	89	30	20	28	15	1
Jun-93	**644**	256	126	36	78	93	55	**260**	137	24	9	64	18	8
Sep-93	**700**	275	127	53	85	99	61	**271**	156	20	14	45	25	11
Dec-93	**525**	230	75	22	74	81	43	**261**	139	34	9	48	25	6
Mar-94	**585**	235	82	42	86	101	39	**184**	103	23	13	19	20	6
Jun-94	**502**	222	103	18	52	75	32	**172**	95	46	4	15	8	4
Sep-94	**530**	193	112	48	68	66	43	**222**	93	41	21	33	22	12
Dec-94	**420**	160	76	53	47	67	17	**166**	85	14	10	25	27	5
Mar-95	**460**	160	77	38	60	85	40	**147**	74	16	2	29	25	1
Jun-95	**553**	228	92	39	61	98	35	**204**	108	26	16	35	13	6
Sep-95	**507**	164	99	30	72	112	30	**192**	78	25	8	45	30	6
Dec-95	**503**	165	58	52	57	108	63	**193**	92	18	11	27	34	11
Mar-96	**525**	163	96	46	83	84	53	**191**	94	40	7	24	16	10
Jun-96	**623**	180	141	66	75	97	64	**184**	87	30	14	24	14	15
Sep-96	**660**	247	95	49	90	135	44	**170**	85	19	12	27	20	7
Dec-96	**585**	188	89	66	66	117	59	**133**	55	20	14	11	28	5
Mar-97	**555**	192	91	49	62	116	45	**154**	76	21	4	20	25	8
Jun-97	**666**	170	106	72	96	158	64	**270**	106	33	19	53	46	13
Sep-97	**754**	194	118	77	99	167	99	**306**	162	42	18	29	48	7
Dec-97	**683**	224	126	60	79	127	67	**272**	122	36	22	28	53	11
Mar-98	**700**	211	137	73	72	142	65	**265**	108	46	13	22	69	7
Jun-98	**837**	279	152	74	63	190	79	**235**	116	25	8	28	49	9
Sep-98	**918**	313	170	65	79	194	97	**266**	137	26	6	32	61	4
Dec-98	**769**	245	143	73	65	163	80	**223**	100	39	14	24	40	6
Mar-99	**847**	281	159	89	68	164	86	**264**	138	21	4	30	64	7
Jun-99	**763**	296	122	78	50	169	48	**234**	128	19	14	18	49	6
Sep-99	**742**	249	128	72	70	153	70	**232**	122	41	5	26	34	4
Dec-99	**651**	189	110	61	46	167	78	**212**	119	22	11	23	29	8
Mar-00	**615**	188	110	61	51	146	59	**133**	58	19	7	19	19	11
Jun-00	**692**	213	121	81	61	154	62	**233**	138	17	9	20	45	4
Sep-00	**736**	233	151	80	39	152	81	**273**	148	28	5	22	59	11
Dec-00	**703**	222	152	63	46	152	68	**192**	119	12	3	15	40	3
Mar-01	**740**	253	156	44	70	143	74	**103**	48	8	6	8	30	3
Jun-01	**707**	232	131	89	44	148	63	**127**	80	7	10	12	18	0
Sep-01	**870**	279	146	88	63	224	70	**189**	108	20	10	23	27	1
Dec-01	**668**	196	161	66	52	147	46	**102**	44	12	5	2	39	0
Mar-02	**637**	173	104	64	74	159	63	**89**	55	4	4	11	15	0
Jun-02	**643**	199	130	41	55	166	52	**108**	66	8	8	10	15	1
Sep-02	**734**	219	160	83	56	176	40	**82**	50	11	5	6	10	0
Dec-02	**658**	224	129	63	59	146	37	**124**	85	11	5	4	17	2
Mar-03	**628**	170	123	82	46	157	50	**62**	53	4	5	0	0	0
Jun-03	**625**	223	84	68	68	154	28	**196**	130	50	2	3	11	0

*Between March 1988 and September 1990 “Total” includes bankruptcies not attributed to any region.

Total forced insolvencies is the sum of personal bankruptcies and involuntary company liquidations.

Total personal bankruptcies prior to March 1988 are listed below. The total series are directly comparable.

TOTAL Personal bankruptcies							
Mar-76	**79**	Mar-79	**96**	Mar-82	**130**	Mar-85	**204**
Jun-76	**68**	Jun-79	**131**	Jun-82	**106**	Jun-85	**224**
Sep-76	**86**	Sep-79	**133**	Sep-82	**164**	Sep-85	**192**
Dec-76	**76**	Dec-79	**140**	Dec-82	**169**	Dec-85	**249**
Mar-77	**94**	Mar-80	**125**	Mar-83	**188**	Mar-86	**207**
Jun-77	**92**	Jun-80	**162**	Jun-83	**222**	Jun-86	**219**
Sep-77	**112**	Sep-80	**157**	Sep-83	**225**	Sep-86	**284**
Dec-77	**117**	Dec-80	**164**	Dec-83	**229**	Dec-86	**255**
Mar-78	**117**	Mar-81	**127**	Mar-84	**167**	Mar-87	**300**
Jun-78	**127**	Jun-81	**137**	Jun-84	**184**	Jun-87	**260**
Sep-78	**140**	Sep-81	**143**	Sep-84	**244**	Sep-87	**345**
Dec-78	**125**	Dec-81	**150**	Dec-84	**219**	Dec-87	**324**

Source: Statistics NZ, series BALQ.SA.

Appendix B: ADF unit root tests—Aggregate variables

Variable	Level with trend and constant[1]	"t-statistic" on trend[2]	Level with constant only[1]	Implication[3]
INFL	0.046	0.22	0.002	I(0)
I90	0.271	1.56	0.144	I(1)
LEA	0.286	2.72	0.991	I(1)
LWR	0.794	1.54	0.882	I(1)
LPPI	0.220	0.95	0.047	I(0) or I(1)
LNZDAUD	0.096	0.79	0.024	I(0) or I(1)
LPSC	0.407	2.51	0.993	I(1)
TIR	0.150	2.13	0.130	I(1)
LTI	0.087	1.39	0.128	I(1)
LPR	0.314	2.46	0.874	I(1)

[1]ADF p-value.
[2]Value of t-statistic on Trend variable.
[3]Lag length for ADF test chosen using Schwartz Information Criterion.

Acronyms

Acronym	Page first mentioned	Definition
MED	9	Ministry of Economic Development
VECMs	10	Vector error correction models
SME	10	Small and medium-sized businesses
GDP	11	Gross Domestic Product (Real)
CPI	14	Consumers Price Index
NBNZ	14	National Bank of New Zealand
SNZ	14	Statistics New Zealand
RBNZ	15	Reserve Bank of New Zealand
ADF	15	Augmented Dickey-Fuller
TWI	15	Trade weighted index
M1	18	Money supply (narrow definition)
CV	23	Co-integrating vector
Variables		
TIR	12	Total insolvency rate
TIME	12	Time trend
LTI	13	(natural) logarithm of the number of insolvencies
SR	14	Start-up rate
LPR	14	Real regional property price (logarithm of the regional house price deflated by the national CPI)
LEA	14	Logarithm of the NBNZ Regional Economic Activity index for each regional council
INFL	15	Inflation in the consumers price index (CPI), excluding effects of interest and GST for the latest four quarters, (% p.a.)
LWR	15	Logarithm of the real wage rate (wage rate/CPI)
LPPI	15	Logarithm of the ratio of Producer Price Index (inputs) to Producer Price Index (outputs)
LPSC	15	Logarithm of real private sector credit (PSC/CPI)
I90	15	90-day bank bill rate
LTB	18	Logarithm of total bankruptcies
LGDP	18	Logarithm of real GDP
RES	19	Residual from corresponding long-run equation
S1, S2, S3, S4	23	Seasonal dummies taking a value of 1 in the relevant quarter and 0 elsewhere

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