EXPECTATIONS AND EMPLOYMENT DYNAMICS IN NEW ZEALAND MANUFACTURING

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Abstract

The characteristics of short-run employment dynamics in New Zealand manufacturing and the role of business expectations are examined for the period since the 1970s, including the post-1985 employment slump. Based on econometric estimation, using both business survey based estimates of expectations and cointegration methods applied to conventional manufacturing data, we conclude that labour hoarding is present in manufacturing firms, that the short-run dynamics can be modelled as an error-correction process, that manufacturers' output expectations have a crucial influence on these dynamics and appear more important than relative price expectations, and that understanding how manufacturers' output expectations evolve is crucial to understanding New Zealand's recent manufacturing employment history. These conclusions appear robust for measuring employment dynamics by total hours worked while for numbers employed there was evidence of structural change during the post-1985 periodfor reasons that warrant further investigation.

New Zealand was evidently one of the few OECD countries to experience falling employment during the late 1980s (Silverstone and Daldy, 1994). The number of people employed fell by approximately 85,100 between March 1986 and March 1992 (Statistics New Zealand, 1993), a 5.3 percent decline in the New Zealand workforce. People in fulltime employment fell by 90,200 while those on part-time employment increased by 5,100.

The most severe decline was in manufacturing where 87,100 jobs were lost during this seven year period, a 26.6 percent decline in the manufacturing workforce which is almost entirely accounted for by the decline in fulltime employment. Although a similar pattern is evident for total hours worked, the relationship between total hours worked and fulltime employment changed during the late 1980s as a result of rising part-time employment and a jump in average hours worked by fulltime employees. Hence, while dramatic, the percentage decline in total hours worked was smaller than for fulltime employment: 18.6 percent between March 1986 and March 1992[1].

A complete explanation of New Zealand's manufacturing employment history since the mid-1980s would require identification of the relevant policy and non-policy shocks that impacted on manufacturing during this period, an understanding of the short-run dynamic reaction of manufacturing to these shocks and the implications for long-term employment growth. This paper focuses on the short-run dynamics especially the contribution of business expectations. No attempt is made at this stage to estimate the employment functions jointly with other decision variables of the firm nor to link the manufacturing sector to other sectors in a general equilibrium context.

Employment and role of expectations

The basic ideas which provide a role for forward-looking expectations were advanced by Oi (1962). The argument is that if the marginal costs to firms of adjusting labour were constant then they could choose, in each period, the level of employment that maximised their profits without regard to future employment requirements. But if these marginal costs of adjusting employment increase as the size of the change to employment increases, then firms will wish to have regard to future labour requirements. This is because large changes in employment will be proportionately more costly than small changes, i.e. they face convex costs of adjustment. In these circumstances firms will only partially adjust their employment requirements to optimal levels. This implies they may be continuously aboveor below optimal employment in the current period but endeavouring to move gradually toward future employment requirements. Thus, expected future optimal employment will influence current employment. It therefore follows that those factors which are expected to determine the future optimal level of employment will have an influence on current employment.

These ideas are the theoretical basis for the derivation of what Nickell (1986) refers to as the 'fundamental employment equation':

(1) $N_t = \mu N_{t-1} + (1-\mu)(1-\alpha\mu)\sum_{s=0}^{\infty}(\alpha\mu)^s N^*_{t+s}$

where N_t is the firm's demand for labour in period t and N^*_{t+s} is the level of employment in period $t+s$ which would be desired in the absence of adjustment costs. N follows a partial adjustment process where the target level of employment in period t is a convex combination of all future expected values of N with the weights forming a geometric progression. Nickell shows that the speed of adjustment, $(1-\mu)$, is decreasing in the level of adjustment costs and consequently increases in adjustment costs imply relatively more significance is given to expected future values of variables that determine optimal employment.

Nickell's 'fundamental equation' formally illustrates that if the costs of increasing hours worked and hiring and firing employees are convex it will be in the firms interests to spread the adjustment of its labour force over time

This, in turn provides the theoretical basis for forward-looking expectations to have a role in determining current employment and for the existence of labour hoarding. For instance, if firms expect output to rise, they will not wish to hire too many additional workers if there is a possibility the firm will wish to eventually layoff workers. Similarly, if output is expected to fall, firms will be prepared to hoard labour if they expect that eventually the fall in output could be reversed. Thus current employment will be some convex combination of employment last period and the target level that would prevail if adjustment costs were linear.

A corollary of this partial adjustment process is that firms' expectations of the future values of variables important in determining optimal employment become the forcing variables.

The appropriate specification of the optimal level of employment in any period, N^*, depends on the formulation of the revenue function for firms which in turn will depend the market environment in which firms operate. For perfectly competitive firms it will include relative prices, for imperfectly competitive firms it will include industry demand, while for demand constrained firms it will include (exogenous) output. Thus, in general we can assume that for the manufacturing sector as a whole,

(2) $N^*_t = f\left(Y_t, \overline{W}_t, P\overline{M}_t\right)$

where Y_t is realised demand for real output, $\overline{W}_t$ is the real product wage, PM_t is the real price of intermediate materials. Moreover, each N^*_{t+s} is a future variable for s>0. Hence N^*_{t+s} can be specified in terms of expectations of $Y_{t+s}, \overline{W}_{t+s}, P\overline{M}_{t+s}$, and the fundamental employment equation takes the form

(3)

$$N_t = \mu N_{t-1} + (1-\mu)(1-\alpha\mu)\sum_{s=0}^{\infty}(\alpha\mu)^s f\left(E_t Y_{t+s}, E_t\overline{W}_{t+s}, E_t P\overline{M}_{t+s}\right)$$

where $E_t X_{t+s}$ denotes expectations formed in period t of the value of X in period $t+s$.

Adopting a log-linear functional form and introducing a log-linear trend term lt, the employment demand model can be estimated in the following form:

(4)

$$n_t = \alpha_1 n_{t-1} + \sum_{i=1}^{m}\alpha_{2i}E_t y_{t+i} + \sum_{i=1}^{m}\alpha_{3i}E_t\overline{w}_{t+i} + \sum_{i=1}^{m}\alpha_{4i}E_t\overline{pm}_{t+i} + \alpha_5 lt + \upsilon_t$$

where $\alpha_1, \alpha_2 > 0$ $\alpha_3 < 0$ $\alpha_4 > 0$ if materials and labour are substitutes in production; $\alpha_4 < 0$ if materials and labour are complements in production; and $\alpha_5 \gtrless 0$; $x_t = \log_e X_t$; and υ_t is a random disturbance term.

Techniques used to incorporate expectations in estimated employment functions include estimating reduced form relationships in which the value of an expected variable is based on some function of current and lagged values of that variable or more sophisticated modelling of expectations based on the rational expectations hypothesis, for example Muellbauer, (1979), Nickell (1984), and Henry and Wren-Lewis (1984). An approach used by Bond (1988) was to choose published economic forecasts by independent forecasters as a proxy for firms' expectations.

There are several well known difficulties associated with these procedures, some of which can be overcome by using survey based measures of expectations. Indeed, the papers by Wren-Lewis (1986), Illmakunnas (1989), and Pehkonen (1992) suggest the estimation of dynamic employment functions might be improved by incorporating business survey based information about firms' expectations. A further objective of this paper therefore is to examine whether information contained in survey based measures of business expectations can enhance our understanding of manufacturing employment dynamics and the decline in employment after 1985.

Understanding the role of business expectations is also important for interpreting the significance of policy credibility. According to the credibility hypothesis, if markets clear through continuous price and wage adjustments, the impact on employment of a disinflationary monetary policy will crucially depend on how that policy impacts on price and wage expectations. If markets do not clear continuously, the impact of policy on output expectations assumes greater significance. Therefore, the relative importance of expectations of future relative prices and future real output in firms' employment decisions has policy significance.

Time series properties of the data and the derivation of manufacturers' expectations

To estimate equation (4) in its present form requires the assumption that labour demand is equal to actual employment in each period. Estimation also requires measures for each expectation variable. The orders of integration of the data representing the variables in this model need to be evaluated to ascertain the appropriate form in which the model should be estimated in order to obtain meaningful coefficient estimates.

Time series properties of the data

The approach used to determine the order of integration was to first examine the autoregressive properties of the lags on the dependent variable then apply either the augmented Dickey-Fuller (ADF) test for a unit root (if an AR relationship is evident) or the Phillips-Perron (PP) test (which assumes an ARIMA relationship). Both tests were run on Shazam (1993). Evidently the ADF and PP tests can be sensitive to the chosen truncation lag parameter. Where the test statistic is close to the critical value other lag structures were applied and the lag length which minimised the Akaike Information Criterion was used as the basis for selecting the lag length, as suggested by Harris (1992). If, on the basis of this testing procedure, the null hypothesis of stationarity is rejected for the levels data, the series is differenced and retested using the same procedure. We concluded that total hours worked, numbers employed fulltime, numbers employed part-time, and all variables considered relevant to the determination of optimal employment, N^*, that is, manufacturing output and the relative price variables, real wages and real input prices[2], are all I(1).

Derivation of manufacturers' expectations

A rich source of data pertaining to firms' expectations of future change and perceptions of past change is available from the New Zealand Institute of Economic Research's (NZIER) quarterly survey of business opinion. Although this survey data is available only in qualitative form (ie, firms are only asked to report whether they expect a variable to go 'up' stay the 'same' or go 'down' and within these categories no information is provided on how much each firm expects output to rise or fall) several procedures are available to transform the survey responses into expected growth rates. Most of these procedures are based on the idea that individual firm responses about a variable x lie on some form of probability distribution[3]. The reply 'same' is assumed to relate to an 'indifference' interval around $x = 0$, where the probability distribution is continuous.

An important issue is the appropriate assumption about the form of the distribution for x. This in part depends on the nature of the question asked. If the survey questions refer to say a single aggregate variable which all firms are predicting then the distribution represents the combination of individual subjective distributions about possible outcomes for this aggregate variable. Provided these individual distributions have finite first and second moments the aggregate distribution will be normal, otherwise the distribution belongs to a family of 'stable laws' (Batchelor, 1981) which includes the normal but also skewed distributions. The NZIER survey questions refer to variables that are specific to the firm. The aggregate distribution will therefore also reflect the actual dispersion of individual firm variables around the average. In these circumstances statistical theory evidently provides little guidance on what distribution to assume for x.

Accordingly, in the absence of any clear guide, we follow the procedure used by Wren-Lewis (1985, 1986) which uses the sech^2 distribution which has the logistic function as its cumulant. If the indifference interval (ranging say from $-a$ to b) is assumed symmetric around zero (ie $a = b$) and constant through time, then the mean $\bar{x}$ can be calculated as follows:

$$\bar{x} = a\left(L_U + L_D\right) / \left(L_D - L_U\right)$$

where a is the lower point of the indifference interval, $L_U = \log(1-U) - \log U$, $L_D = \log D - \log(1-D)$, and U and D are the proportions of the firms replying 'Up' and 'Down' respectively.

This expression can then be applied to derive an estimate of $\bar{x}$ provided we have an estimate of the indifference interval 'a'. Again we follow the approach of Wren-Lewis, and also Illmakunnas (1989), whereby 'a' is estimated by relating the proportions obtained from firms responses to their perception of the change in their output (which is also available from the survey) to the official (Statistics New Zealand) estimates of actual values. This has the advantage of not requiring any assumption about the properties of expectations[4] but it does assume that the indifference intervals are the same for both the expectations and the perceptions questions[5].

The mean quarterly expected growth rates were then estimated using these respective values for 'a' and the proportions available from the NZIER survey. To check that the resulting estimated expectations were reasonable we compared the behaviour of the implied expectation errors (estimated as the difference between the estimated expected growth in a variable minus the estimated perception of the growth of that variable)[6] with the proportions of firms surveyed by the NZIER that made expectation errors (derived by Buckle, Assendelft and Jackson, 1989). The respective turning points and relative size of quarterly errors are very similar.

The output and selling price expectation errors revealed an interesting pattern. In the post-1985 period of policy disinflation there appears to be a clear change in the pattern of expectation errors for these two variables. There is a tendency for firms to persistently over-estimate output and over-estimate selling prices during the period of persistently declining manufacturing employment, a characteristic which is not evident in the data prior to 1985. This feature is not evident in the average cost expectation errors.

Estimation results

It was evident from the examination of the univariate characteristics of the time series data that econometric estimation of the employment demand function should be in first difference form. Additionally, consideration should be given to evaluating the cointegrating relationships between employment and the independent variables.

Estimation in first difference form:

Transformation of the log-linear functional form (equation 4) of the 'fundamental employment equation' into first difference form results in the following specification:

(5)

$$\Delta n_t = \alpha_1 \Delta n_{t-1} + \sum_{i=1}^{m} \alpha_2 E_t \Delta y_{t+i} + \sum_{i=1}^{m} \alpha_3 E_t \Delta \bar{w}_{t+i} + \sum_{i=1}^{m} \alpha_4 E_t \Delta \bar{pm}_{t+i} + \alpha'_5 + u_t$$

where $\alpha'_5 = \alpha_5 \Delta lt$ which is a constant, $\Delta x_{t+i} = x_{t+i} - x_{t+i-1}$, and $u_t = e_t - e_{t-1}$

Equation (5) was estimated for total hours worked, fulltime employment, and for fulltime equivalent employment in manufacturing, where all data was seasonally adjusted. Although expectations of next quarter's growth in real output could be derived from the survey data, there are no corresponding questions that enable separate estimation of firms' expectations of growth in real wages and real intermediate input prices. Expected changes in these relative prices were therefore captured by including expected growth in selling prices and average costs derived from the survey data.

Diagnostic tests applied to the OLS estimate of the total hours worked equation proved satisfactory apart from evidence of negative serial correlation of the errors. We therefore re-estimated the hours equation by modelling the errors as an autoregressive process using the options available on SHAZAM (1993) to estimate ρ_{t-i} for $i = 1, 2$. The second order autoregressive error process may be due to the fact that the hours worked function includes current and lagged expectations of output growth which in turn could be quite complex functions of past realised growth in output or hours worked. The estimation results are presented in table 1.

It is evident from table 1 that current expectations of next quarter growth in real output, $E_t \Delta y_{t+1}$, have a significant influence on current period growth in hours worked, h_t. Expectations of next quarter's growth in selling prices and average costs have no significant influence on current hours worked. The coefficient on lagged hours derived from the OLS estimate is insignificant, but when adjustment is made for serially correlated errors it is significant and the sign is consistent with Nickell's fundamental equation.

In view of the significance of expected growth in real output we allowed for the possibility that some firms may also make a correction to hours worked as a result of any perceived output growth expectation errors, ie output surprises measured as $(E_{t-1}\Delta y_t - P_t \Delta y_t)$, where P_t denotes the firm's estimated perception in period t of the growth rate that actually occurred in period t. The statistical significance of these errors implies that firms make a correction to total hours worked in quarter t as a result of errors in their expectations of output growth for quarter t formed in quarter t-1.

Expected output and output surprises are also significant in the estimated fulltime and fulltime equivalent employment functions (nf_t and nfe_t). Furthermore, the errors from the OLS estimates of these functions also display AR(2) processes. One difference is that the size of the coefficient on the lagged dependent employment variable is larger for the numbers employed than for hours worked implying a faster adjustment of hours worked compared to numbers employed.

Stability tests of the suitability of the equations over different sub samples such as the CUSUMSQ and sequential Chow tests were applied to each of the estimated employment functions. There was no evidence to suggest the hours worked function was unstable but there was evidence suggesting the estimated fulltime and fulltime equivalent functions are not structurally stable. For both functions, the cumulative sum of squared residuals exceeded the 5 percent confidence bounds at several points between 1985:2 and 1990:3 - the period during which employment fell dramatically, when hours worked per fulltime employee increased and when part-time employees increased as a share of total employees. This is also the period when the switch to a floating exchange rate regime occurred and when there was increased exchange rate variability, at least until 1989. However, experiments with alternative proxies for real exchange rate expectation errors based on different transformations of the nominal exchange rate produced mixed results and no clear evidence of a significant separate influence of the exchange rate on employment.

Another possible explanation for the instability of the numbers employed functions is the potential effect of the mid-1980s economic reforms on the costs of adjusting employment. The parameter μ in Nickell's fundamental employment equation is theoretically sensitive to changes in the real interest rate and employment technology. Changes in these conditions will in principle change the costs of hiring and firing labour and thus alter the speed of adjustment of employment to expectations affecting the parameter on lagged employment. However, a Chow test

Table 1. First difference estimation results: seasonally adjusted data (1978:3 to 1992:4)

Equations:		
	h_t	$\Delta h_t = \alpha_1 \Delta h_{t-1} + \alpha_2 E_t \Delta y_{t+1} + \alpha'_5 + \alpha_6 (E_{t-1} \Delta y_t - P_t \Delta y_t)$
	nf_t	$\Delta nf_t = \alpha_1 nf_{t-1} + \alpha_2 E_t \Delta y_{t+1} + \alpha'_5 + \alpha_6 (E_{t-1} \Delta y_t - P_t \Delta y_t)$
	nfe_t	$\Delta nfe_t = \alpha_1 nfe_{t-1} + \alpha_2 E_t \Delta y_{t+1} + \alpha'_5 + \alpha_6 (E_{t-1} \Delta y_t - P_t \Delta y_t)$

Estimated coefficients	Δh_t OLS	Δh_t AR(2)	Δnf_t OLS	Δnf_t AR(2)	Δnfe_t OLS	Δnfe_t AR(2)
α_1	- 0.2488**	0.3284	0.2330	0.5415	0.1995#	0.5441
	(0.1246)	(0.0911)	(0.1152)	(0.0908)	(0.1163)	(0.0923)
α_2	0.2866	0.1951	0.0640#	0.0975*	0.0584#	0.0911
	(0.0850)	(0.0397)	(0.0609)	(0.0411)	(0.0622)	(0.0413)
α_6	-0.2437*	-0.2026	-0.2526	-0.1758	-0.2611	-0.1732
	(0.0967)	(0.0522)	(0.0711)	(0.0551)	(0.0722)	(0.0554)
α'_5	-0.0065*	-0.0038	-0.0037	-0.0028*	-0.0037	-0.0025
	(0.0028)	(0.0011)	(0.0021)	(0.0012)	(0.0021)	(0.0011)
$\bar{R}^2$	0.27	0.48	0.37	0.41	0.31	0.39
see	0.0193	0.0159	0.0138	0.0131	0.0141	0.0134
Durbin h			-2.407		-2.306	
Ramsey reset test						
$^{(2)}F_{1,53}$	0.0002		0.0262		0.0146	
$^{(3)}F_{2,52}$	0.0688		0.5438		0.2184	
$^{(4)}F_{3,51}$	0.2178		0.3694		0.1429	
ρ_1		-0.8837		-0.4759		-0.4995
		(0.1162)		(0.1241)		(0.1230)
ρ_2		-0.4653		-0.3267*		-0.350
		(0.1162)		(0.1241)		(0.1230)
Jarque-Bera normality χ^2_2 test						
	0.6466	0.2322	1.3420	2.0894	2.0020	3.1359
Heteroscedasticity tests:						
- B-P-G: χ^2_3	0.268	0.831	2.037	0.321	2.371	0.206
- ARCH: χ^2_1	0.017	1.359	0.021	0.008	0.051	0.012
- Harvey: χ^2_3	0.072	1.325	0.330	2.185	0.547	1.478
- Glejser: χ^2_3	0.158	2.101	1.537	0.888	2.088	0.981

Notes: Standard errors are in parenthesis. All coefficients are significant at 1% level unless denoted *(significant at 5%); **(significant at 10%); ***(significant at 20%); # (not significant at 20%).
5% critical values are as follows: $F_{1,53}$=4.03; $F_{1,52}$=4.03; $F_{1,51}$=4.04; χ^2_1=3.84; χ^2_3=7.81.

revealed no significant change in the estimated coefficient on lagged employment pre- and post-1985:2.

Estimation using co-integration methods

An alternative estimation procedure involves using possible co-integration relations between the series. Where two or more series are I(1), these variables are said to be co-integrated if a linear combination of them can be combined to form a stationary variable. This phenomenon is of economic significance as it implies a longrun interdependence exists between the variables. Co-integration can therefore be tested by applying either the ADF or the PP test to the residuals of the co-integrating regression. If the residuals are found to be I(0), this implies that the non-stationary variables do not drift far apart over time and the interdependence remains stable over time.

Furthermore, the Engle and Granger (1987) representation theorem implies the existence of a dynamic relation between the first difference of co-integrated variables and the lagged error term from the co-integrating regression. In particular, the inclusion of the lagged error term may be interpreted as corresponding to an error correction mechanism. Accordingly, applying the Engle and Granger two-step procedure to estimate these employment equations using Statistics New Zealand levels data for real output and relative prices (defined in footnote 2) provides an interesting complement to the first difference results which were estimated using the NZIER survey data.

To facilitate comparison with the first difference estimation results it would be preferable to estimate error-correction models using seasonally adjusted data. Evidently seasonal adjustment filters can increase the persistence of the adjusted series relative to the unadjusted series and Ghysels (1990) and Ghysels and Perron (1993) point out that unit root tests may have low power when applied to seasonally adjusted data relative to unadjusted data. Table 2 therefore presents estimated co-integrating equations for total hours worked, fulltime employment, and fulltime equivalent employment using both actual and seasonally adjusted data.

For the actual data, all three employment variables were found to be cointegrated with a linear combination of real GDP, real wages and real intermediate input costs. For the seasonally adjusted data, only hours worked was found to be cointegrated with these variables. In view of this fact and the apparent structural instability of the estimated first difference form of the fulltime and fulltime equivalent employment equations, we did not proceed to estimate, using seasonally adjusted data, an error correction model for fulltime and fulltime equivalent employment.

Error-correction model for seasonally adjusted hours worked

The preferred estimated error correction equation for seasonally adjusted hours worked is shown in Table 3. The diagnostic test results are satisfactory and, as is the case for the first difference function for hours, the CUSUMSQ test reveals no evidence of significant structural instability. There are some interesting points of comparison between this model and the first difference function which was estimated using survey based measures of expectations. The error-correction model attempts to explain the short-run dynamics about an explicitly defined long-run condition. No such restriction is imposed on the first difference model. Curiously, the coefficient on lagged hours is negative, but is significant at the 10% level only. Otherwise, the form of the first difference and error-correction models are very similar.

The first difference function includes expected growth of real manufacturing output and the contemporaneous errors in expected output growth while the error-correction function includes contemporaneous changes in real manufacturing output, ($\Delta rgdp_t^s$), and the lagged errors from the cointegrating equation, ($errorh_{t-1}^S$). As noted previously, there was no evidence that expectations of relative price changes were significant in the first difference function. Similarly, the contemporaneous and lagged changes in the relative price variables included in the cointegrating equation were not significant in the error-correction equation, but they could have a role in so far as they enter the determination of the errors from the cointegrating equation. It would appear that while relative prices and real demand both influence the long-run equilibrium path for total hours, only changes in demand for real output have a significant influence in the short-run dynamic adjustment process; changes in relative prices do not.

To compare the ability of the first difference and cointegrating error-correction models to explain the short-run dynamic path of hours worked, we evaluated their out-of-sample forecasts over a two year period (1991:2 to 1993:1) and a three year period (1990:2 to 1993:1). On the basis of the relative RMSEs and Theil's inequality coefficients the error-correction model would appear to be a superior model. The proportion of the forecast errors due to bias is however higher for the error-correction model, a property which might be regarded as important from a forecasting point of view.

Error-correction models for actual hours worked and numbers employed:

For the actual (i.e. not seasonally unadjusted) data, all three employment variables were found to be cointegrated with a linear combination of real gdp, real wages and real intermediate input costs. We therefore estimated error-correction models using the actual data to provide further insights into the short-run dynamic adjustment process. The preferred equations are shown in Table 4.

The estimated models for the three employment measures have a structure which is very similar to that of the models estimated using seasonally adjusted data. Again, we found

Table 2. Co-integrating equations (1977:4 to 1993:1)

Cointegrating equation: $e_t = \beta_0 + \beta_1 rgdp_t + \beta_2 rw_t + \beta_3 rc_t + \beta_4 time + u_t$

where: $e_t = h_t, nf_t, nfe_t$,

Estimated coefficients	h_t	nf_t	nfe_t
Not seasonally adjusted:			
β_0	17.0050	11.3000	11.4040
	(1.1291)	(1.5453)	(1.5345)
β_1	0.8710	0.6570	0.6414
	(0.0746)	(0.1021)	(0.1014)
β_2	-0.3246*	-0.2318#	0.2351#
	(0.1480)	(0.2033)	(0.2019)
β_3	-0.8710	0.1469#	0.1143#
	(0.0746)	(0.3688)	(0.3657)
β_4	-0.0060	-0.0076	-0.0072
	(0.0003)	(0.0004)	(0.0004)
$\bar{R}^2$	0.9074	0.9027	0.8921
CRDW	1.199*	1.051*	1.039*
Phillips-Perron t-test	-5.0276*(lag=6)	-4.5387*(4)	-4.4993*(5)
Seasonally adjusted:			
β_0	9.7518	11.7160	11.7900
	(0.9767)	(1.2919)	(1.2902)
β_1	0.9010	0.7346	0.7209
	(0.0670)	(0.0887)	(0.0886)
β_2	-0.2934*	-0.3470*	0.3470*
	(0.1275)	(0.1686)	(0.1684)
β_3	-0.8050	0.1198#	0.1514#
	(0.2287)	(0.3025)	(0.3021)
β_4	-0.0060	-0.0077	-0.0072
	(0.0003)	(0.0004)	(0.0004)
$\bar{R}^2$	0.9332	0.9356	0.9276
CRDW	0.917*	0.525*	0.523*
Phillips-Perron t-test	-4.2747*(lag=6)	-3.0714#(=4)	-3.0505#(=5)

Notes: As for Table 1; and in addition: CRDW is the co-integrating regression Durbin-Watson test. * denotes that the CRDW statistic lies within the lower and upper confidence limits of 0.410 and 1.214 taken from Table 1 in Sargan and Bhargava (1983); The 10 % critical value for the Phillips-Perron t-statistic is -4.15. The variables *rgdp*, *rw*, and *rc* denote real gdp, real wages and real input costs as defined in Footnote 2.

Table 3. Error-correction equation for hours worked: Seasonally adjusted data (1978:3 to 1992:4)

$$\Delta h_t^s = \underset{(0.0020)}{-0.0049} - \underset{(0.0901)}{0.1725}\,\Delta h_{t-1}^s{}^{**} + \underset{(0.0659)}{0.4587}\,\Delta rgdp_t^s - \underset{(0.0794)}{0.4239}\, errorh_{t-1}^s$$

$\bar{R}^2 = 0.56$, see = 0.0146, h = -0.0265, Jarque-Bera normality test: $\chi_2^2 = 1.9284$

Ramsey reset test: $^{(2)}F_{1,53} = 1.2478$, $^{(3)}F_{1,52} = 0.6129$, $^{(4)}F_{1,51} = 0.4228$

Heteroscedasticity tests: B-P-G: $\chi_3^2 = 0.961$, ARCH: $\chi_1^2 = 0.321$

Harvey: $\chi_3^2 = 1.855$ Glejser: $\chi_3^2 = 0.900$

Notes: As for Table 1; and in addition: 5% critical values are: $F_{1,54}$=4,02; χ_2^2=5.99.

no evidence of changes in relative prices influencing the short-run dynamics over and above that which is captured by the cointegrating error component. Lagged employment was significant for all three models, contemporaneous changes in real manufacturing GDP are also significant as are the respective lagged cointegrating error components. For the fulltime and fulltime equivalent employment functions lagged changes in real manufacturing GDPwere also significant.

For the hours worked function the diagnostic tests were again satisfactory, with no evidence of structural instability despite the severity of the decline in hours worked during the late 1980s. But, as we found for the first difference functions, the CUSUMSQ test suggested that the numbers employed functions are structurally unstable, with the cumulative sum of the squared residuals again exceeding the 5% confidence bounds between 1985 and 1990. The possibility that this instability could be attributed to the changed exchange rate regime or a change in the coefficient on lagged employment was again tested but were not found to be sufficient to explain the apparent instability of the numbers employed functions.

Discussion and conclusion

There have been dramatic changes in manufacturing employment in New Zealand during the past decade. The objective of this paper is to uncover the characteristics of the short-run fluctuations in manufacturing employment and the economic forces that influence these fluctuations. Of particular interest is the role of business expectations.

The first difference and cointegration econometric results presented in this paper provide a consistent explanation of the short-run dynamics of employment in New Zealand manufacturing from 1977 to 1993. Both sets of results suggest that these dynamics can be represented as an error-correction process. That is, firms have some desired level of employment and any deviations from this inducesshort-run adjustments to employment. The task of the econometric part of this paper is to uncover the facotrs which influence these short-run adjustments. Furthermore, the estimates are consistent with the ideas advanced by Oi and Nickell that firms will hoard labour because of convex costs of adjustment, and firms will make only partial adjustments to employment based on their expectations of future employment requirements.

The cointegration results imply that firms make partial adjustments to employment in the short-run motivated by an optimal level of employment which is determined by a linear combination of real manufacturing output and real production input costs. The rate of short-run adjustment is influenced by contemporaneous changes in real output and the extent to which employment in the previous quarter deviated from optimal employment. A partial adjustment process is evident with hours worked adjusting faster than numbers employed.

The cointegrating error-correction model has the advantage of capturing the adjustment of employment to an explicit long-run equilibrium position defined by the cointegrating equation, but the role of expectations is implicit only. The first difference model utilises survey-based measures of manufacturers' expectations and can therefore shed further light on the role of expectations in determining manufacturing employment.

The results for estimation of the first difference model suggests that manufacturing expectations of real output growth and errors in those expectations significantly influence employment. The lack of any significant influence from expectations of relative price changes is consistent with the cointegrating error-correction result which found no evidence of contemporaneous or lagged changes in relative prices influencing the short-run dynamics, other than their role in influencing the size of the error derived from the long-run cointegrating equation. This result is important from the point of view of understanding the

Table 4. Error-correction equations: Seasonally unadjusted data (1979:1 to 1993:1)

Equations: $\Delta_4 e_t = \gamma_0 + \gamma_1 \Delta_4 e_{t-1} + \gamma_2 \Delta_4 rgdp_t + \gamma_3 \Delta_4 rgdp_{t-1} + \gamma_4 ecorre_{t-4} + v_t$
where $e_t = h_t, nf_t, nfe_t$

Estimated coefficients		$\Delta_4 h_t$		$\Delta_4 nf_t$	
γ_0		-0.0134		-0.0111	-0.0107
		(0.0030)		(0.0029)	(0.0030)
γ_1		0.4288		0.6437	0.6297
		(0.0704)		(0.0684)	(0.0713)
γ_2		0.4514		0.1921	0.1832
		(0.0502)		(0.0607)	(0.0633)
γ_3				0.1380*	0.1359*
				(0.0653)	(0.0676)
γ_4		-0.3522		-0.2086	-0.2300
		(0.1065)		(0.0687)	(0.0720)
$\bar{R}^2$		0.8323		0.8567	0.8387
see		0.0202		0.0176	0.0183
Durbin h		-0.1748		-0.0093	-0.0662
Ramsey reset test	$^{(2)}F_{1,51}$	0.0000	$^{(2)}F_{1,50}$	0.9678	0.6946
	$^{(3)}F_{2,50}$	0.8120	$^{(3)}F_{2,49}$	0.5127	0.3491
	$^{(4)}F_{3,49}$	1.0349	$^{(4)}F_{3,48}$	0.7057	0.6127
Jarque-Bera normality test	χ^2_2	2.8687		1.3924	3.1406
Heteroscedasticity tests:					
- B-P-G:	χ^2_3	3.796	χ^2_4	6.417	6.238
- ARCH:	χ^2_1	0.350	χ^2_1	1.729	1.818
- Harvey:	χ^2_3	3.983	χ^2_4	6.156	3.623
- Glejser:	χ^2_3	4.981	χ^2_4	6.913	7.126

Notes: As for Table 1; and in addition: 5% critical values are as follows: $F_{1,50}$=4,04; $F_{2,50}$=3.18; $F_{2,49}$=3.19; $F_{3,49}$ =2.79; $F_{3,48}$=2.80; χ^2_2=5.99; χ^2_4=9.49

short-run employment effects of macro-economic policies including, for instance, the employment effects of a disinflationary monetary policy, as discussed in Buckle (1988).

These conclusions are gleaned from econometric estimation of hours worked and numbers employed functions estimated over a period which includes the dramatic post-1985 employment decline. The hours worked function is the best approximation of total labour input in the production process for manufacturers and the structural stability of the alternative estimated hours worked functions is an encouraging outcome of this research. Although not a complete measure of total labour input, the numbers employed functions are nevertheless of interest from a wider social perspective because they reveal which factors influence changes in the number of people who have jobs.

Unfortunately, certain diagnostic tests point to structural instability of the estimated numbers employed functions. This may be due to one or more factors. The manufacturing employment slump coincided with the introduction of several regulatory changes and a change in the exchange rate regime which may have altered the costs of adjusting employment. However, a preliminary evaluation provided no clear explanation for the apparent change in the structure of the numbers employed functions. Then again, the quarterly numbers employed estimates have been compiled from three different data series so the combined series is more problematic than the hours worked series which is obtained from a single survey.

Turning to the post-1985 employment slump, the results in this paper identify a significant link between the deteriorating business expectations of real output growth and the decline in manufacturing employment between 1985 and 1992. Furthermore, a tendency for persistent and large over-estimation of real output growth during this period, noted in section II, implies that many manufacturing firms were persistently employing labour above their optimal levels. This in turn may have affected the financial viability of firms, the composition of employment in the manufacturing sector, and the longer term employment situation.

Future research

These results point to a significant influence by business expectations of real output in determining short-run adjustments to manufacturing employment. There is also evidence from the cointegrating results that relative price expectations, while not appearing to be important in influencing the short-run dynamics may, together with output expectations, be important in determining firms' perceived longer run employment requirements. Therefore, research which uncovers what determines business expectations of future output growth and relative prices would seem to be fruitful areas for further research.

The suggestion of structual instability of the numbers employed functions warrants further investigation. This problem may be due to the fact that a single series for fulltime employment had to be compiled from three separate series, or it may be due to a genuine change in the way firms decide on the number of people to employ.

The econometric results were estimated up to early 1993. Since then, total hours worked and numbers employed in manufacturing have recovered sharply to be almost back to the levels that prevailed prior to the post-1985 slump. Re-estimation of the employment functions to include the last two years would represent a good test of the robustness of these functions.

No attempt is made in this paper to jointly estimated the employment functions simultaneously with firms' other decision variables no to link the manufacturing sector to other sectors in a general equilibrium context. While that would represent a much more ambitious task, it is one that warrants investigation, especially if it also includes modelling and estimation of the factors that determine manufacturers' expectations. This research would also provide a basis for illuminating the role of the manufacturing sector in the New Zealand economy-wide business cycle fluctuations of recent years.

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Notes

1 The estimates of fulltime and part-time employment and total hours worked in manufacturing was obtained from several sources. Total hours worked in manufacturing is from the Quarterly Survey of Manufacturing (QSM). Total fulltime equivalent employment in manufacturing is measured as the sum of (fulltime employment) plus (0.35 * part-time employment), following Philpott (1990). Total number of people employed fulltime in manufacturing was derived by combining the information from three series, the Household labour force survey, the Employment in industry survey, the Half-yearly survey, in a manner similar to that applied by Gorbey, Briggs and Chapple (1993) whereby the HLFS estimate of fulltime employment in manufacturing was spliced onto the EMPS and HYS estimates to obtain a longer term series. Total number of people employed part-time in manufacturing are taken directly from Gorbey, Briggs and Chapple (1993).

2 Real manufacturing output, the real wage and real intermediate input prices were obtained from Statistics New Zealand (1993). The real wage is the prevailing wage rate index ÷ the producers' price index for outputs in manufacturing. The real intermediate input price is the manufacturing producers' price index for inputs ÷ the manufacturing producers' price index for outputs.

3 An exception is the procedure suggested by Pesaran (1985) but this procedure relies on information about the actual aggregate variable to derive an aggregate expectations series which imposes restrictions on the properties of the derived expectation errors. It also presumes that the variable forecast by firms is the aggregate, not the firm specific, variable.

4 For instance, Batchelor (1981) suggests relating the official data on actual outcomes against the scaled mean from the survey proportions pertaining to expectations. But this method implicitly assumes certain properties of expectations since it effectively chooses the value of 'a' that minimizes expectation errors.

5 Wren-Lewis (1986, p 305) notes that this assumption is supported by information provided by respondents to a CBI survey of United Kingdom firms.

6 The estimated perceived growth was derived in the same way as the estimated expected growth.

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