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ABSTRACT

Within a modern business cycle framework, this paper utilises basic statistical techniques to re-examine stylised empirical facts associated with business cycles in New Zealand since the mid-1960's. The approach is essentially a bivariate one, and uses Hodrick-Prescott methodology for trend computations. Point estimates and GMM standard errors are presented for the amplitude of each variable's deviations from trend, degree of contemporaneous cyclical and phase shift. Many relationships change markedly over time and, at least with this methodology, it is not easy to establish many "regularities" with confidence. "Real variable regularity" in a broad sense is confirmed, but a number of our other stylised empirical facts and uncertainties are not consistent with outcomes usually associated with prominent theoretical business cycle models. In particular, domestic price fluctuations in New Zealand have been basically countercyclical, and the real net exports share of GDP does not seem to have moved countercyclically over the past decade. No systematic cyclical tendency has been discovered for fluctuations in government purchases, and the scale of changes affecting the monetary sector over the past decade continues to present difficulties for establishing "financial regularities".

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1 INTRODUCTION

The term business cycles has been used to cover "classical" and "growth" cycles (Boehm, 1990, p 28). *Classical cycle analysis* has a lengthy history. It has essentially been concerned with movements in actual economic time series, and the identification of expansions and contractions in absolute levels of (aggregate) economic activity. Its origins are in work by Mitchell (1913, 1927) and Burns and Mitchell (1946), and in recent decades its tradition has been continued as the "NBER approach" (Klein, 1990). Methodologically, its stance has been forecasting driven and has involved the use of two complementary techniques: leading indicator or index analysis, and the construction and use of (macro)econometric models. Koopmans (1947) initiated a lengthy major debate on this type of approach in its early stages, characterising it as "measurement without theory". However, its recent proponents argue their economic theoretic stance involves concern for "... a general eclectic theory of business cycles" (Boehm, 1990, p 38), including recognition where appropriate of traditional Keynesian and Monetarist elements.

In contrast, *growth cycle analysis* is more recent. It has focussed primarily on fluctuations in (aggregate) economic activity relative to an appropriate long term trend rate, and in its form of the past decade or so, it is often referred to as the "modern business cycle" approach. This involves defining the business cycle in terms of deviations of aggregate real output from trend, and then deducing key business cycle facts from the statistical properties of co-movements between the aggregate real output deviations and those of a wide range of real and nominal economic variables. Its major analytical methods are generally different from those for classical cycles. Also in contrast to the classical cycle approach, its economic theoretic underpinnings have to date tended to be more rigorous, more narrowly focussed, and more controversial. They have variously involved new-classical monetary misperception and real business cycle models, and new Keynesian based sticky price models. It is further fair to say that none of these theoretical models has been able to reflect modern business cycles sufficiently satisfactorily, and there has been increasing recognition that key empirical business cycle facts have been both changing in nature over time, and either overlooked or wrongly incorporated in theoretical models.

These concerns have led in recent years to a series of papers seeking to "revisit the stylised empirical facts" associated with business cycles, with a view towards postulating more satisfactory theoretical models. The papers have included those by: Greenwald and Stiglitz (1988) for the USA, Japan, West Germany, Great Britain and Australia; Danthine and Girardin (1989) for Switzerland, the UK, France and West Germany; Kydland and Prescott (1990) for the US; Englund, Persson and Svensson (1990) for Sweden; and Backus and Kehoe (1991) for ten countries. Although some of the "facts" to emerge from these studies are fairly well known, the new business cycle methodology has led to the questioning of some previously

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accepted business cycle relationships which influenced business cycle research in the 1970's. For example, Kydland and Prescott (1990) and Cooley and Ohanian (1991) claim the popular assertion of a procyclical price level for the postwar US economy to be a "myth", finding instead US prices to have been strongly countercyclical. The latter finding implies that those models of the business cycle featuring a positive relation between output and prices provide an inadequate representation of reality.

Hence, like the above papers, this paper is modern business cycle in approach. It utilises basic statistical techniques to re-examine stylised empirical facts associated with business cycles in New Zealand since the mid-1960's. Revisiting these stylised facts is seen as important for the following reasons:

- there has been no major systematic analysis of the properties of New Zealand business cycles since the work by Haywood (1972) and Haywood and Campbell (1976);
- like some of the aforementioned papers for other countries, the new methodology applied in this paper reveals the need to question the validity of some previously accepted relationships; and
- the facts deduced from the, as yet, limited number of studies cannot be presumed to be portable to all economies, as the observations in Greenwald and Stiglitz (1988) illustrate, and in contrast to the basic stance adopted by Lucas (1977). At the very least one might expect to find the "facts" for small open economies to be different to those for larger economies. For example, Danthine and Girardin (1989) find differences between Switzerland's business cycle and the cycles in other European countries and there are differences between European and US business cycles. They comment " [I]t is clear that these countries are not mere replicas of the US and business cycle idiosyncracies have surfaced that will be most interesting to relate to our prior knowledge of these economies. When better documented, these idiosyncracies will certainly form the basis for more discriminatory tests of business cycle theories" (p.47).

Towards these ends, section 2 provides a brief review of major modern business cycle theories, with a view to identifying major *a priori* relationships between key variables, impulse and propagation mechanisms. Section 3 outlines our essentially bivariate methodological approach, including Hodrick-Prescott computation of trends, and the calculation of point estimates and GMM standard errors for the amplitude of each variable's deviations from trend, degree of contemporaneous cyclicity and phase shift. Preliminary empirical results are also presented and evaluated, with significant attention being paid to sensitivity. Then, in section 4, these results are examined in a more focussed fashion, in the light of some key issues identified from section 2. Concluding comments appear in section 5.

2 MODERN BUSINESS CYCLE THEORIES

The dominant methodological approach to modern business cycle theorizing has its origins in the Frisch-Slutsky approach which views cycle analysis as two separate problems: the impulse problem and the propagation problem. According to the Frisch-Slutsky hypothesis, business cycles are the result of a series of shocks to a linear economic model that imparts cyclical oscillations which converge monotonically to a new equilibrium (Mullineux, 1990). This approach is implicit in traditional Keynesian macro modelling, as demonstrated by the simulation analyses of large scale econometric models in the 1970's. It is also implicit in the monetarist, and the new-classical monetary misperception and real business cycle model approaches to business cycle modelling, and in the emerging new-Keynesian approaches to explaining business cycles.

Historical reviews by Zarnowitz (1985) and Mullineux (1984 and 1990) suggest that this represents a new consensus in business cycle modelling. Zarnowitz observes that for a long time there was a substantial consensus in early business cycle analysis that "business cycles

have mainly endogenous explanations involving recurrent fluctuations in interrelated monetary and real variables, prices and quantities, expectations and realizations" (p 569). In the 1940's and 1950's there was interest in the dynamics of multiplier-accelerator interaction which yielded highly aggregated and purely endogenous models of linear and non-linear business cycles, although the monetary and expectational aspects of the cycle were largely neglected in this period. The current trend, however, is towards viewing business cycles as being driven by exogenous shocks rather than as an endogenous feature of the economy. This is not to say there are not important gaps in the theories nor that an entirely endogenous business cycle theory is required, but the predominant approach is one which translates certain kinds of exogenous shocks into fluctuations in macroeconomic aggregates.

Beyond this point there is little consensus. Modern theories of business cycles differ in their explanations of the principal impulses and in the form of the propagation mechanism. In this section we briefly review some key features of modern theories of business cycles, in particular the primary disturbances and propagation mechanisms, in order to identify and compare, where possible, key macroeconomic relationships predicted by each theory. Although the main focus of this paper is to identify characteristics of recent New Zealand business cycles, we are also interested to see which theories are not inconsistent with those facts. The purpose is similar to that expressed in a recent paper by Greenwald and Stiglitz (1988): to look for certain crucial business cycle facts and ask which of the theories are not inconsistent with those facts.

The *monetarist theory of the cycle* arose out of the work of Friedman and Schwartz (1963a, 1963b). Their work also had an important influence on the subsequent development of the new classical approach to business cycle modelling. In contrast to the early Keynesian models which attributed the main impulses to private investment behaviour, in the monetarist model the impulses are regarded as caused primarily by changes in the real money stock. Moreover, the early and still influential versions of this theory treated monetary changes as if they were predominantly exogenous, arising primarily from policy and institutional changes. This is a controversial view even for a closed economy, and from the point of view of a small open economy the validity of this argument will depend on the exchange rate regime and on the extent to which regulations apply to foreign exchange transactions.

By combining an adaptive expectations augmented Phillips curve with a stable demand for money function, these money supply shocks are capable of generating cyclical dynamics in real variables. Money supply shocks stimulate changes in demand for goods as a result of asset portfolio adjustments and changes to interest rates. On the supply side, the monetarist model maintains the neoclassical assumption of diminishing marginal productivity of labour, and therefore the requirement that the real wage decline for real output to respond to changes in demand. Friedman (1968) obtains this result by relying on information asymmetries.

Specifically, he argues that:

"because selling prices of products typically respond to an unanticipated rise in nominal demand faster than the prices of factors of production, real wages received have gone down - though real wages anticipated by employees went up, since employees implicitly evaluated the wages offered at the earlier price level. Indeed, the simultaneous fall *ex post* in real wages to employers and rise *ex ante* in real wages to employees is what enabled employment to increase. But the decline *ex post* in real wages will soon come to affect anticipations. Employees will start to reckon on rising prices of the things they buy and to demand higher nominal wages for the future. 'Market' unemployment is below the 'natural' level. There is an excess demand for labour so real wages will tend to rise towards their initial level.The rise in real wages will reverse the decline in unemployment, and lead to a rise, which will in turn return unemployment to its former level." (p10)

New-classical monetary misperception business cycle literature also emphasizes monetary shocks as a primary source of impulses (see Lucas 1977, Barro 1977 and 1978, Barro and Rush 1980), and imperfect information and information asymmetries are central to the propagation mechanism. However, the assumptions of continuous market clearing and rational

expectations mean that the propagation mechanism is fundamentally different. Adaptive expectations helped to explain the duration of cyclical movements in real variables in the monetarist model. This is foreclosed by the rational expectations hypothesis. Only random monetary impulses matter which, given flexible prices, lead to price surprises. In the new-classical monetary misperception approach, these price surprises are the crucial link between fluctuations in nominal demand and fluctuations in real output and labour supply.

The new-classical model developed by Lucas (1972) endeavours to account for movements in real macro variables as an optimizing response by firms and individuals to "observed comovements in prices" (Lucas, 1977). A key element is the 'Lucas supply hypothesis' in which intertemporally optimizing output decisions by firms and labour supply decisions by individuals are based on perceived relative price movements. Under rational expectations with restricted information, deriving from the Phelps' "islands market hypothesis", a signal extraction problem arises and firms and individuals will tend to respond to a rise in the price of output and labour by increasing supply, even if they are uncertain if the price rise is a relative or absolute one.

Critics identify the heavy explanatory burden placed on this single causal chain: random monetary shocks causing price misperceptions which induce 'wrong' production and labour supply decisions. Moreover, whereas Keynesian non-market-clearing models, such as those developed by Barro and Grossman (1971) Muellbauer and Portes (1978) and Neary and Stiglitz (1983) are able to rely on the interdependence of intermarket spillovers to generate multiplier effects of a change in nominal demand, this feature is assumed away in the new-classical monetary misperception model by the assumption of continuous market clearing. Hence the importance of the islands market hypothesis triggering supply reactions to price changes.

The result has been described by Lucas (1977):

"To recapitulate, our hypothetical producer is taken to face stochastic price variability, which is describable as a mix of transitory and permanent components, both unobserved. His optimal response to price movements depends on two factors: the way he interprets the information contained in these changes, and his preferences concerning intertemporal substitution of leisure and consumption. Under assumptions consistent with rational behaviour and available evidence, his response to an unforeseen price increase is a sizeable increase in labour supplied, a decline in finished goods inventory, and an expansion in productive capital accumulation of all kinds. This behaviour is symmetric; the responses to price decreases are the opposite." (p 19).

A number of propagation mechanisms have been suggested in order to convert these monetary shocks into persistent movements in macroeconomic aggregates. Lucas (1975) utilized a modified version of the accelerator principle so that price surprises not only change current employment and output but also the acquisition of capital. The intended result is that production capacity initially increases, raising labour productivity and temporarily increasing the demand for labour and the supply of goods. This process also retards the change in the general price level, thereby delaying the recognition and adjustment to the initial shock. Other suggested propagation mechanisms include the adjustment costs of rapid changes to employment and output rates which are presumed to cause firms and labour to respond with lags to the relative price changes they perceive.

Dissatisfaction with assumed signal extraction problems and informational asymmetries, and unfavourable empirical evidence encouraged the development of the *real business cycle approach* to equilibrium business cycle modelling. In contrast to the new-classical monetary misperception approach, the only forces that can cause economic fluctuations are those forces that change the Walrasian equilibrium. Thus, real business cycle theory embraces the classical dichotomy which means that monetary shocks are unimportant.

Real business cycle models derive decision rules for individuals that specify endogenous variables such as consumption, savings, leisure, and labour supply as functions of technology, preferences, predetermined capital stock variables, and market clearing prices and interest rates

for current and future periods. Changes in the exogenous variables will cause changes in current and future planned consumption, savings, leisure and labour supply and thus real output. The sources of persistence emphasised in real business cycle models are assumed serial and include cross-sectoral correlation properties of the shock, and the 'time to build' technology introduced by Kydland and Prescott (1982). The latter captures the idea that multiple periods are required to build new capital goods and only finished goods are part of the productive capital stock.

Early real business cycle models (eg Kydland and Prescott, 1982) emphasized "supply" shocks as the explanation for impulses to business cycles, in particular stochastic shifts in production technology. And since these are market clearing models, labour productivity, real wages and labour supply behaved procyclically. Controversy then emerged about the assumed properties of the technology shock, and whether technology shocks in fact occur in the form required for real business cycles to mimic real world cycles. This is a challenging area of research because the process governing the evolution of technology is not easily observable (see for example the work of Hall, 1986; Bernanke and Parkinson, 1991). These controversies have been a factor encouraging the development of models which consider other types of shocks such as government spending, changes to consumer preferences, resource endowments, etc. These models can generate different cyclical behaviour for labour productivity and real wages (see for example Christiano and Eichenbaum, 1990).

A criticism of real business cycle research is that it has focused almost exclusively on models which provide no role for money (see Mankiw, 1989). Indeed, since real business cycle models are intended to represent "fully articulated" economies, it appears necessary to motivate the use of money in these models by specifying some kind of transactions technology. Several papers have explored this possibility. King and Plosser (1984) incorporated a role for money that resulted in the money supply endogenously responding to fluctuations in output. They suggested that the transactions services of inside money, which is created by the banking sector, should be viewed as simply the output of a particular sector of the economy. An increase in productivity in any other sector will tend to increase the demand for transactions services and so the banking system responds by creating more inside money. In this way the money supply is endogenous and will display procyclical behaviour. The causal relationship between money and output is the reverse of what is assumed in the new-classical monetary misperception model. However, it is clear from the review by Huh and Trehan (1991) that there is little agreement on what constitutes the most acceptable way to include money in real business cycle models and, therefore, there is little agreement on the predicted behaviour of the money stock over the cycle.

Fluctuations in the money stock and the price level therefore have no role in the initiation of business cycles. Moreover, while there is a clear prediction of a procyclical price level in the new-classical monetary misperception model, there is no such requirement in real business cycle models since the behaviour of prices will depend on the type of shock and how money is treated.

A unifying theme of Keynesian economics is the belief that economic fluctuations reflect not the Pareto-efficient response of the economy to changes in technology and preferences, but rather some sort of market failure on a grand scale. *New-Keynesian literature* is concerned primarily with providing microeconomic foundations for the failure of prices to clear markets, and there is a wide range of such models. The modifications to traditional Keynesian macroeconomics can be grouped by the market on which they are focused. Within product markets there have been explanations for price rigidities in terms of adjustment (menu) costs and imperfect competition. Explanations for unemployment and wage rigidities are provided by implicit contracts, insider-outsider, and efficiency wage models of the labour market. Another set of theories focuses on credit markets, stressing the role of imperfect information because of adverse selection and moral hazard which give rise to credit and equity rationing.

Much of this new-Keynesian literature analyses single markets in a partial equilibrium framework and therefore overlooks the importance of intermarket spillovers, quantity constraints, and coordination failures which was the central feature of the earlier quantity-constrained general equilibrium macro models. An exception is the work of Cooper and John

(1988), who identify strategic complementarities as an important feature of Keynesian models and thus reaffirm the importance of coordination failures as a cause of macroeconomic disequilibrium. An attempt to selectively integrate this new-Keynesian literature into a general theory of business cycles can be found in two papers by Greenwald and Stiglitz (1987, 1988).

The model proposed by Greenwald and Stiglitz is based on efficiency wages, capital market imperfections and equity and credit rationing. Business cycles result from the impact of shocks on the stock of working capital of firms. They note that even if firms were not credit rationed, the willingness of firms to borrow would be limited by their willingness to bear risk. Given risk aversion, the fixed commitments associated with loan contracts implies that as the available working capital declines, the risk (bankruptcy probability) associated with any level of borrowing increases. Thus a reduction in working capital will lead to a reduction in firms' desired production levels; and it takes time to restore working capital to normal levels. The affect of aggregate shocks (like a decline in the money stock or the general price level) will therefore persist. They also argue that sectoral shocks (for instance, an oil price shock) will have redistributive effects via the influence on the stocks of working capital of firms in various sectors and, because it takes time to restore working capital to desired levels, there will be aggregate effects.

Business cycles can therefore be caused by demand or by supply shocks. Because working capital accumulates only slowly, there will be substantial persistence to either aggregate supply or aggregate demand disturbances. Since demand disturbances will be transmitted from firm to firm as each reduces output in response to unexpected equity losses, firm outputs will tend to move together. Furthermore, they argue that because deferring investment is one of the least costly ways to reduce the potential risk a firm bears as its financial position deteriorates, investment fluctuations, including inventories, will be procyclical and will be disproportionately large. A second factor cited as contributing to the relative volatility of investment in this working capital constrained model arises from "any permanent effect of a temporary disturbance on productivity, due, for example, to a decline in technology spillovers as firms reduce effective research and development activity" (Greenwald and Stiglitz, 1988, p 257). Changes in investment that affect future productivity will also cause business cycles to have long-lived effects on productive capacity.

To explain price rigidities, Greenwald and Stiglitz invoke the extensive literature on menu costs, in which the costs of disseminating new price information inhibit price changes, and interfirm interactions, in which the costs of price changes are associated with the possibility that competing firms may react to price changes in an undesirable way. But these theories do not imply that prices will be invariant to demand or supply shocks. Thus, as is the case with real business cycles, there is no clear prediction for the behaviour of prices over the business cycle. The reaction of prices will depend on the type of shock and on the perceptions of firms concerning the duration of the shock and the reactions of other firms to price changes.

Aggregate labour demand also depends on the level of aggregate working capital. Equilibrium in the labour market is then determined by the intersection of this labour demand function with an efficiency wage condition (as described, for example, in Shapiro and Stiglitz, 1984). The rigidities in the process of wage determination resulting from efficiency wage considerations create employment and unemployment fluctuations in response to shifts in the demand for labour. The efficiency wage relation should result in wages and employment varying procyclically, but Greenwald and Stiglitz suggest that if firms are more certain of the effects of labour force adjustments (because of efficiency wage considerations), then temporary cyclical adjustments to a firms working capital will fall more heavily on employment than wages.

The central idea of efficiency wage models is that labour productivity varies with the real wage because higher real wages improve worker effort. However, the implications of this idea for the behaviour of labour productivity over the business cycle will depend on the particular efficiency wage model. In the Shapiro and Stiglitz (1984) model for instance, worker effort can only take two values and the model identifies the real wage-employment relation required to maintain positive worker effort, implying that labour productivity would not vary with employment if firms paid the equilibrium efficiency wage. However, if the model was extended to allow for heterogeneity of workers (Blanchard and Fischer, 1989, p 461) the

efficiency wage model could generate procyclical labour productivity. Implicit contract theories and labour hoarding can provide a similar result. If the labour force cannot be costlessly adjusted in the short-run, it may pay firms to smooth labour over the cycle i.e "hoard" labour in downturns. With hoarded labour, firms utilize their labour more intensively in booms than in recessions.

This review has been deliberately brief, with a primary aim of attempting to identify and compare the impulse and propagation mechanisms emphasised in modern business cycle theories and to identify the predicted behaviour of key macroeconomic aggregates over the cycle. Table 1 summarises some of these relationships. Although not the main emphasis of this paper, the Table does identify key characteristics which may provide a basis for discriminating between alternative theoretical explanations for business cycles. The predicted behaviour of the money supply, real consumption, real investment and employment is similar for all models. Cyclical behaviour of prices, real wages and labour productivity can vary across models and these variables would seem to offer greater potential for discriminating between models.

The table is necessarily incomplete: partly because the development of real and, in particular, new-Keynesian models of the business cycle are in their infancy; but also because there are still few credible theoretical business cycle models which have been developed explicitly for small open economies. Significant exceptions in the context of real business cycle models, however, are recent papers by Kim (1991), Mendoza (1991), and Backus, Kehoe and Kydland (1991). Kim emphasises the differential effects on the balance of trade from productivity shocks in the traded and non-traded goods sectors. Mendoza's real business cycle model is specified and calibrated to reflect two key stylized facts: namely, that national or domestic savings are positively correlated with investment and that the balance of trade has tended to move countercyclically. Backus *et al.* provide a parameterised two-country extension of Kydland and Prescott's (1982) closed economy real business cycle model, allowing countries to experience different technology shocks each period, transport costs to exist, and agents to participate in international capital markets.

3 KEY NEW ZEALAND TRENDS AND FLUCTUATIONS

3.1 The Basic Methodological Approach¹

The basic methodological approaches developed over the past decade or so for modern business cycle analysis are based on fluctuations being represented by deviations of aggregate real output from an appropriate trend. See, for example, Lucas (1977), Hodrick and Prescott (1980), Danthine and Girardin (1989), and Kydland and Prescott (1990).

For the purpose of this paper, this requires: firstly, establishing an appropriate trend (or growth component) for real GDP; secondly, calculating the cyclical component as the deviation of actual real GDP from its trend; thirdly, repeating the trend and cycle computations for all other time series relevant to the business cycle analysis; and fourthly, computing for each variable an appropriate range of basic statistical measures of cyclical behaviour. The latter should include: the magnitude or amplitude of the fluctuations; the nature and degree of contemporaneous cyclical behaviour of each variable relative to real GDP fluctuations; the extent of each variable's phase shift, relative to real GDP; and standard errors for each of these measures.

Our application utilises the longest set of comprehensively consistent macroeconomic data readily available for New Zealand. They are from the Reserve Bank of New Zealand (RBNZ) Model XII data base, and are defined in Brooks and Gibbs (1991, Appendix 1). Each relevant time series (apart from those for the two percentage share of real GDP and two interest rate yield gap variables) was expressed in logarithmic form, and all were seasonally adjusted using the well-known X-11 US Bureau of Census method. Our basic approach to trend calculation involved the now commonly used Hodrick-Prescott (HP) method, though as illustrated below

¹ Multivariate, unit root and cointegration based work (eg Campbell and Mankiw, 1987, Stock and Watson, 1988, and King, Plosser, Stock and Watson, 1991) is left for detailed consideration in further research.

our sensitivity analysis also involved comparison of results from the HP method with those from linear trend and first difference analysis.

The HP approach (eg Danthine and Girardin, 1989, pp 32-33, 36, 37; and Kydland and Prescott, 1991, pp 8-9) requires computation of the trend component, τ_t , of a (seasonally adjusted) actual variable, x_t , from the expression:

$$\min_{\{\tau_t\}} \sum_{t=1}^T (x_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

for an appropriately chosen positive value of λ . The first term is the sum of squared deviations of τ_t from x_t , or degree of fit of τ_t . The second term involves the sum of squares of the trend component's successive differences, reflects the degree of smoothness of the trend component, and penalises variations in the trend growth rate at the rate λ . Most of our full sample results are based on a λ of 1600, the value favoured by Kydland and Prescott for their quarterly US analysis, though a range of values for λ as low as 400 and as high as 6400 was also used for sensitivity analysis purposes.

As will be evident from Tables 2 to 11, the amplitude of fluctuations (or volatility) in the deviation of each variable x_t from its trend is represented by its percentage standard deviation. Its degree of contemporaneous cyclicalness is obtained by examining the sign and magnitude of the cross correlation of its cyclical deviation with that of real GDP. Thus in the columns headed $x(t)$, a positive number close to one would reflect very strong procyclicality, a negative correlation would indicate countercyclicality, and a number close to zero would mean a variable uncorrelated with the aggregate cycle. Phase shift is represented by the highest leading or lagged cross correlation coefficient. If this were in column $x(t-5)$, it would reflect a variable leading the cycle by 5 quarters. Similarly, a figure in column $x(t+2)$ would indicate the variable lags the aggregate cycle by 2 quarters.

In previous studies of this type, almost no attention has been paid to the degree of uncertainty associated with the various statistical measures reported. A partial exception is the paper by Backus and Kehoe (1991), where standard errors are presented for % standard deviations and contemporaneous cross correlations, but are then not commented on further. Like them, we utilise a version of Hansen's (1982) Generalised Method of Moments (GMM) procedure, as explained in Christiano and Eichenbaum (1990), to compute our standard errors. Additionally, however, we present standard errors for the non-contemporaneous cross correlations, and take t -statistic degree of reliability into account in reaching our overall conclusions.

Specifically, for each detrended variable (x) permitted to lead or lag by up to 5 quarters, we let Ψ denote the vector of 13 population moments:

$$\Psi = \{ \sigma_x, \sigma_y, \rho_{-5}, \rho_{-4}, \rho_{-3}, \rho_{-2}, \rho_{-1}, \rho_0, \rho_1, \rho_2, \rho_3, \rho_4, \rho_5 \};$$

where σ_x is the standard deviation of x , σ_y is the standard deviation of detrended real GDP (y), and the ρ_i ($i = -5, -4, \dots, 4, 5$) are cross correlations of y with the various x . In estimating Ψ , we exploit the following 13 unconditional moment restrictions:

$$E[y_t^2 - \sigma_y^2] = 0 \quad (1)$$

$$E[x_t^2 - \sigma_x^2] = 0 \quad (2)$$

$$E[x_{t+i} y_t - \rho_i \sigma_x \sigma_y] = 0 \quad (3)$$

Defining $X_t = \{y_t, x_{t+i}, i = -5, -4, \dots, 4, 5\}$, (1) - (3) can be written as:

$$E[H(X_t, \Psi^0)] = 0, \quad \text{for all } t,$$

with Ψ^0 being the true value of Ψ , and $H(\cdot, \cdot)$ being the 13×1 vector valued function whose elements are the left hand sides of (1) - (3) before expectations are taken. If g_T is then denoted as the 13×1 vector valued function:

$$g_T(\Psi) = \frac{1}{T} \sum_{t=1}^T H(X_t, \Psi),$$

it follows from Hansen (1982) that the estimator Ψ_T defined by the condition, $g_T(\Psi_T) = 0$, is a consistent estimator of Ψ^0 .

Now, let D_T denote the matrix of partial derivatives:

$$D_T = \frac{\partial g_T(\Psi_T)}{\partial \Psi},$$

evaluated at Ψ_T . It then follows from results in Hansen (1982) that a consistent estimator of the variance - covariance matrix of Ψ_T is given by

$$\text{Var}(\Psi_T) = \frac{[D_T]^{-1} S_T [D_T']^{-1}}{T},$$

where S_T is a consistent estimate of the spectral density matrix of $H(X_t, \Psi^0)$ at frequency zero. Standard errors of the estimates of the population moments are then obtained from the square roots of the diagonal elements of $\text{Var}(\Psi_T)$.

3.2 The Benchmark New Zealand Real GDP Trend

Although our full sample analysis, for all except certain interest rate and the trade weighted exchange rate index (TWDI) variables, used data for the period 1966(4) to 1990(1), actual real GDP observations were available through to 1991(2). The extra observations were therefore used in calculation of that variable's trend. The actual and trend real GDP series are presented in Chart 1, for $\lambda = 1600$. Visual inspection of the chart indicates that a single linear in logarithms time trend would be inappropriate for the whole sample period, as probably would be two or more successively different linear trends.

Chart 2 shows the sensitivity of the trend line to λ values of 400 and 6400. The value of 6400 seems inappropriate, taking the trend closer towards linearity and failing completely to reflect any of the recent downturn in real aggregate activity. The trend based on $\lambda = 400$ captures slightly more of the recent downturn, relative to that for the $\lambda = 1600$ series, and also gives a stronger weight to activity of greater variability such as that experienced during the 1970's.

In both Kydland and Prescott (KP), and Danthine and Girardin (DG), it is emphasised that there is no agreed procedure for choosing a most appropriate or 'optimal' value for λ . Both chose $\lambda = 1600$ as their preferred value, with one of KP's key selection criteria being that "The

trend component for real GNP should be approximately the curve that students of business cycles and growth would draw through a time plot of this time series" (p 8). This was probably also the major factor behind DG's proceeding with $\lambda = 1600$, though additionally supportive evidence was introduced by comparing for alternative λ 's, the stability of autocorrelation coefficients, the volatility of detrended series, and the stability over time of contemporaneous co-movements with real GNP. In the absence of a good reason to the contrary, therefore, we also proceeded with detrended series for real GDP and our other variables based on a λ of 1600.

3.3 A Preliminary Full-sample Picture

More detailed analysis of the empirical results is left till section 4, but a preliminary view on certain key issues can be formed from an examination of the basic statistics presented in Tables 2 to 5, and the summary comments presented in Tables 6 to 8. It is useful to set this preliminary view within a series of specific questions, which come out of the theoretical material presented in section 2 as follows:

- Are fluctuations in New Zealand's real GDP similar to those in "world" aggregate real output?
- Do fluctuations in major real output, expenditure and factor input variables move together, in discernable regular patterns? And does the real balance of trade tend to move pro- or countercyclically?
- Do prices move pro- or countercyclically?
- Are real wages, average labour productivity and real unit labour costs pro- or countercyclical, or uncorrelated with real GDP fluctuations?
- What roles do nominal monetary variables play, and do either monetary aggregates or interest rates lead cycles?

Bearing in mind the standard errors of relevant point estimates, general observations worth making at this juncture for each of these areas are:

- On the relationship between aggregate real New Zealand and "world" GDP fluctuations, the key initial point is that the amplitude of fluctuations in New Zealand's real GDP is very high by world standards. Its percentage standard deviation of 3.64 is over 2.5 times that of the RBNZ's world variable, and significantly greater than the figures of 1.8 for the US and 2.4 for Switzerland calculated for a not dissimilar sample period by Danthine and Girardin (1989, p 42). This volatility is also very high relative to the broadly comparable figures of 1.8 for Japan, 1.7 for Great Britain, 1.6 for West Germany, and 1.5 for Australia, presented in Greenwald and Stiglitz (1988, Table 1). Accompanying New Zealand's high volatility, though, is a procyclical contemporaneous correlation with world GDP which is very weak (.18) and an only marginally greater maximum procyclical correlation (.24) leading by three quarterly periods; neither value is statistically significant at the 5% level.
- Results summarised for domestic real variable fluctuations in Table 6 confirm in a broad sense "real variable regularity" (Backus and Kehoe, 1991, Kydland and Prescott, 1990). All statistically significant real expenditure variable fluctuations (except for exports of goods and the share of net exports), and all those for factor input variables, and capacity utilisation are procyclical. These relationships are all coincident, except that for the capacity utilisation variable which leads the cycle by one quarter. However, as one would expect, there are also very considerable variations in the volatility and strength of each influence: some are very different from corresponding US variables; and the phase shift outcomes point towards considerable complexities and uncertainties in the

relationships involving government expenditure, exports and imports variables. In particular, whether the balance of trade is pro- or countercyclical is far from clear.

- Results for domestic price variable fluctuations are summarised in Table 7. Most cross correlation point estimates suggest some degree of countercyclicality, but their associated standard errors reveal considerable uncertainty about magnitude. For example, the value of $-.31$ for the market price GDP deflator is significant at the 1% level, and that for the CPI ($-.20$) is significant at the 5% level, but values for neither producer price index variable are significant at 1%.
- Real wage fluctuations are contemporaneously procyclical, but weak in magnitude ($.15$ or $.24$) and statistically not significant. In contrast, average labour productivity fluctuations are surprisingly strong ($.79$ or $.69$), especially relative to figures for the US. Nominal and real unit labour costs are noticeably contemporaneously countercyclical.
- Interest rate variable fluctuations have been particularly volatile. However, not surprisingly, the full sample cross correlation results for the nominal money aggregates, velocity and interest rate variables are not sufficiently definitive. Results from appropriate variation over time analysis are clearly necessary if further light is to be shed in this area.

3.4 Basic Sensitivity Analysis

Sensitivity analysis has been undertaken in three broad areas: alternative detrending; alternative seasonal adjustment; and stability over time.

3.4.1 Alternative Detrending

This took the form of comparing results from the HP method, with those from linear trend and first difference analysis. Within the HP approach, five alternative values were chosen for λ and representative results for volatility, cyclicity and phase shift are presented in Table 9. There are clearly some differences in numerical magnitudes across the alternative methods, but as will shortly become apparent, there are no significant sign reversals and qualitative conclusions are broadly the same. More specifically with respect to volatility, the % standard deviations for each of the 7 cases are reported across row 1. Volatility *relative* to real GDP then appears in the next seven rows, so that rankings can be read off more quickly. Two key observations can be made. The first is that, in almost every case (ie except for exports and imports), volatility is highest for the linear case, thereby supporting the view expressed above that a linear trend is unlikely to be the most credible trend; the second is that volatility rankings remain virtually unchanged across the 7 cases: the most volatile is always private fixed investment, with imports, government purchases, exports and the (market price) GDP deflator all always being more volatile than real GDP. Private consumption fluctuations are always less than those for real GDP.

On the matter of direction of cyclicity, the GDP deflator turns out negatively cross correlated (contemporaneously countercyclical) in each case, and the six real variables are virtually always positively cross correlated. The greatest differences in magnitude are between the linear trend and first difference cases, but within the HP cases, consumption, investment and imports variable differences are not great. The government purchases variable is by far the most sensitive to detrending method.

Conclusions in the phase shift area are also surprisingly consistent, even for the government purchases variable. The GDP deflator remains uniformly contemporaneously countercyclical, and private consumption and fixed investment remain contemporaneously procyclical. There is some variation around a one period lag in the phase period for procyclical imports, and between a three and five period lag for government purchases. But there is no clear message from the exports results.

Phillips-Perron $Z(\alpha)$ and $Z(t_\alpha)$ unit root test statistics are presented in Table 9 for the real GDP deviations from trend computed for the seven alternative detrendings. The HP method is known to be stationary inducing for difference stationary stochastic processes (Christiano and Eichenbaum, 1990, p.12), and our test results confirm that the hypothesis of $\alpha = 1$ for one unit root versus none is rejected for the five alternative values of λ . Additionally, though, the hypothesis is rejected for the first difference and even the linear case as well.

Overall, therefore, there is nothing substantial in the above results to support a departure from using the HP method, with $\lambda = 1600$, for the rest of our analysis.

3.4.2 Alternative Seasonal Adjustment

Basic numerical results obtained from using the X11 seasonal adjustment method and presented in Tables 2 to 5 were compared with those from the less well-known SPlus method, presented in Tables 10 and 11. No major numerical differences were apparent.

3.4.3 Stability Over Time

The extent to which the numerical values for our basic business cycle statistics are stable over time will not only potentially influence our stylised business cycle facts, but more importantly could lead to different conclusions about the nature of modern open economy business cycles and the (theoretical) economic models judged best able to capture them.

This is an area which should be the subject of very considerable in-depth study on its own, so what follows should be regarded as preliminary analysis only. A two-stage approach is warranted, results from only one of which are reported here. The first stage involves getting a broad picture of the variability over time, through the use of "moving windows" methodology (eg Englund, Persson and Svensson, 1990; Wolf, 1991). It involves calculating average % standard deviations and contemporary cross-correlations for successive periods of appropriate length, and plotting them as in Charts 3 to 7. Our analysis is based on 5-year (21-quarter) overlapping periods, with any point read horizontally on the graphs being the mid-point of the 5-year overlap. Approximate time-periods of major difference thereby become apparent in a simple but effective way. A second stage could involve trying to test more precisely for "structural" breaks, by conducting formal statistical tests: eg testing for breaks in the volatility measure, using Bartlett homoscedasticity tests (eg Danthine and Girardin, 1989, pp 42-43); and testing for significant changes in the cross-correlations, using Chow/F-tests.

The preliminary results from Charts 3 to 7 are, nevertheless, of considerable interest, as there is clear evidence that each variable's % standard deviation and cross correlation have moved very considerably over time. Further detailed comment is provided in section 4, but here it can be noted:

- The moving *standard deviations* presented for the 5 real variables on the left hand side of Chart 3 are broadly similar. Volatility of the real GDP, private consumption, exports, imports and the net exports share fluctuations is above average between 1971(3) and 1977(1), and thereafter below average. This is also the case for the change in business inventories share. The net exports and business inventories shares, private consumption and real GDP are also all below average from 1969(2) to 1971(2), further emphasizing strong contemporaneous linkages. The volatility of two other key domestic real variables is, however, different: as is evident from the top two panels on the right hand side of Chart 3, private fixed investment's volatility generally moved in the opposite direction to the above during (centred) 1974-75, and from late 1980 onwards; and the volatility of government purchases has on most occasions been distinctively different and of opposite strength to that of the others. The volatility of real world GDP is somewhat different from that for New Zealand, especially during the 1980's. Volatility of the two domestic price variables represented in the bottom two panels on the right hand side of Chart 3 is

notable not only for its considerable variation but also for their being entirely different in character from each other.

- For the moving contemporary *cross correlations*, the major matter of interest is whether the variables in Charts 5 to 7 remain consistently pro- or countercyclical, or not.
 - Procyclicality is maintained throughout the period for real private consumption, the business inventories share and investment, though the strength of the private investment correlation has fallen remarkably since the (centred) mid-1970's. Real exports and imports are almost always pro-cyclical, but the real net exports share is substantially countercyclical during at least two periods, and especially from 1972(1) to 1977(2).
 - The segment of Chart 5 depicting real government purchases is particularly important, if further progress is to be made in understanding the role of government expenditure. It will be examined further in section 4, but here it can be noted that it shifts no fewer than five times between pro- and countercyclical, thereby making a full-sample average correlation virtually meaningless.
 - Average hourly labour productivity has been consistently pro-cyclical, except for a short period in the late 1970's/early 1980's when a conspicuous countercyclical spike is evident (see Chart 5). Close to mirror images of this behaviour are reflected in the primarily countercyclical private sector nominal (and real) unit labour cost movements shown in Chart 6.
 - Fluctuations in the two summary price variables (see Chart 6) exhibit consistent countercyclicality with fluctuations in real GDP, except during the late 1970's and early 1980's. For the GDP deflator, this is from 1979(3) to 1981(1), and for the CPI over the somewhat longer period from 1977(1) to 1981(3). Fluctuations in the nominal and real trade weighted exchange rate indexes have also been primarily countercyclical throughout their shorter sample period from 1976 (4).
 - Further variables which have exhibited significant periods of both pro- and countercyclicality, and which therefore need further investigation, are the real wage, real world GDP, the terms of trade variable, the nominal M3 aggregate, and four of the five nominal interest rate variables.

4 KEY EMPIRICAL ISSUES

A series of questions, emanating from the theoretical material of section 2, were posed at the beginning of sub-section 3.3. A number of general and more specific empirical points then emerged during the rest of section 3. It is therefore now appropriate to try to associate our empirical results more formally with the theoretical work, in five broad areas: Are there clearly established regularities involving real variable fluctuations? What role in cycles do domestic prices and real wages play? What roles do nominal monetary variables such as monetary aggregates, velocity and interest rates play? Is it possible to establish separate roles for demand and supply factors, including any role for technological change? And can one establish sufficiently clearly the roles and relative importance of various open economy factors?

4.1 Regularities involving Real Variables

Do fluctuations in major real output, expenditure and factor input variables move procyclically together, and is "real variable regularity" thereby established? From the general points made in sub-section 3.3, the broad answer is yes, as all expenditure component and factor input fluctuations (except for the net exports share) are positively contemporaneously correlated with fluctuations in real GDP. This considerable generalisation must also, however, be seen in the

context of a number of more specific outcomes and the lack of statistical significance of some relationships:

- The *volatility* of fluctuations in New Zealand's real GDP (ie 3.64%) is very high by international standards, being more than 2.5 times that of the RBNZ's real world GDP variable (1.41%). Key contributors to this volatility are: Private fixed residential and nonresidential investment (10.53% and 10.20%); imports of services and of goods (11.03% and 9.51%); and central government expenditures on investment and "goods" (13.66% and 9.76%). Exports of goods and of services (6.59% and 5.22%), and private expenditure on consumption durables (4.92%) are also more volatile than real GDP, leaving only private consumption expenditure on nondurables and services, local government expenditure, and factor input variables as less variable.
- The *strength and reliability of individual procyclical influences*, whether regarded as primarily impulse or propagation in nature, varies widely. For example,
 - fluctuations in aggregate private consumption and investment, and their disaggregated components, show clear contemporaneous procyclicality of medium strength (.48 to .62). They are generally substantially below the comparable magnitudes (.52 to .91) reported by Kydland and Prescott (1990, p 11) for the US.
 - changes in the share of business inventories in real GDP (at .67) are, however, in line with those for the US, and provide (along with aggregate and private average labour productivity) the highest contemporaneous cross correlations for New Zealand.
 - the point estimates for fluctuations in government expenditure reflect weak contemporaneous procyclicality (.12 to .22) over the full sample period. The figure of .22 for local government is broadly in line with that for the US (.25), and the weak figures for central government can be seen against a finding of nil correlation for the US. But these values need to be further clarified in the light of statistical significance, phase shift correlations (see Tables 2, 6) and stability over time analysis (see Chart 5). None of the five contemporaneous correlation magnitudes in Table 2 are significant at the 5% level, but both the three period lagged outcomes for aggregate real government purchases and real central government investment are significant at the 1% level. Stability over time analysis confirmed that the behaviour over time of fluctuations in these two variables has been very similar. In particular (as shown in Chart 5 for real government purchases), their moving windows correlations have shifted no fewer than five times during the sample period, between pro- and countercyclicality. The latter is consistent with Backus and Kehoe's (1991) finding for ten countries over one hundred years that government purchases exhibit no systematic cyclical tendency. There is also preliminary evidence that fluctuations in New Zealand's real government purchases varied considerably until around (centred) late 1983, and that since then fluctuations have been approximately contemporaneously uncorrelated with real GDP.
 - the picture in the area of external activity seems even more complex and uncertain. Real world GDP fluctuations at first sight seemed to lead New Zealand's real GDP fluctuations in a weakly procyclical (.24) fashion by around three quarters, but then turned out to be overall not significant at the 5% level. Individually, aggregate exports and imports initially seem generally procyclical, but with such considerably varying strength over time (and in the case of exports also with a lack of significance at the 1% level) as to make average full sample period magnitudes virtually meaningless. This is confirmed when one examines the moving net exports share correlation. The average quite weakly countercyclical correlation (-0.35) with lag 2 periods disguises a substantial contemporaneous rise since (centred) 1983 from uncorrelation to quite strong procyclicality (.60), and a considerable period of countercyclicality from (centred) 1972 to 1976 inclusive. The increased procyclicality since (centred 1983) can be associated (see Chart 5)

with fluctuations in aggregate real exports having become increasingly procyclical and aggregate real imports fluctuations moving from weakly procyclical to weakly countercyclical.

- Factor input fluctuations are shown in Table 6 to be procyclical on average. The three period lagged capital input correlation of .55 is reasonably strong, but the two period lagged labour hours input correlations are surprisingly weak (.19 and .24), especially by US standards (.71 to .92), and lack sufficient statistical significance. The generally strong procyclical behaviour of average hourly labour productivity was commented on above in sub-section 3.4.3.

4.2 The Role of Domestic Prices, Real Wages and Unit Labour Costs?

Have fluctuations in aggregate domestic prices and in unit labour costs been pro- or countercyclical, have real wages moved procyclically, and what has been their stability over time? Broadly representative answers would be that: fluctuations in aggregate domestic price levels have been weakly contemporaneously countercyclical; fluctuations in private sector unit labour costs have overall been quite strongly and consistently countercyclical; fluctuations in real (hourly private sector) wage rates exhibit overall weak and not particularly reliable contemporaneous procyclicality; and there has been considerable variation over time.

However, for the two aggregate domestic price level variables, four additional features should be noted:

- Behaviour of the GDP (market price) deflator is somewhat different from that of the CPI. It has an average volatility (5.12%) over double that of the CPI, and volatility of the two changes in an approximately mirror image fashion over time.
- The full period average contemporaneous countercyclicity of the GDP deflator is significant at the 1% level, but that of the CPI only at the 5% level.
- As shown in Chart 6, the two become procyclical for somewhat different periods of time between 1977(1) and 1981(3), though both move from countercyclicity to procyclicality and back again. This is the reverse of Wolf's (1991, p 25) finding for the US, of procyclicality for the 1960's, countercyclicity until 1981, and then procyclicality again.
- Their cyclicity is also different in strength. The countercyclicity of the CPI can be regarded in the weak to medium strength range, whereas that of the GDP deflator has become increasingly strong (to a most recent cross correlation of over -.6).

The direction and strength of cyclicity of the real wage variable (see Chart 6) has also varied markedly, and probably contributed towards neither aggregate nor private real compensation real wages being significant at the 1% level. The private sector measure exhibits three quite strong procyclical peaks between 1972 and 1981, and two periods of significant countercyclicity from (centred) 1969(3) to 1971(4) and from 1982(3) to 1984(3).

4.3 Roles for Nominal Monetary Variables?

Whether the nominal monetary variable of greatest relevance is a monetary aggregate, a velocity measure or some interest rate measure, key matters for resolution are: whether the monetary variable fluctuations are procyclical or not cyclically correlated, and whether any procyclical variable leads, lags or is coincident with the real aggregate cycle. Answers in both areas can influence whether the monetary influence should be impulse or propagation in nature, and hence the form of the most appropriate underlying theoretical model.

Empirically for New Zealand, as for all countries which have undergone significant financial sector deregulation and adopted a form of non-fixed exchange rate regime, there are potential intrinsic difficulties in establishing "regularities" in this area.

Analysis for the relevant full sample periods (see Table 8) established only that nominal interest rate variable fluctuations have been particularly volatile, and that for all three categories of variable the evidence is contradictory on whether the relatively weak and frequently statistically insignificant influences are pro- or countercyclical and leading or lagging.

Some relatively limited stability over time analysis has thrown further light on these matters, but is still far from having established stable or "regular" roles for any of the nominal monetary variables examined. Worth noting for further work of a multivariate nature, however, are that: M3 fluctuations were essentially procyclical prior to (centred) 1977 and have been generally countercyclical since; nominal M3 velocity has been consistently procyclical and statistically significant over the full sample period, but very variable in magnitude around a cross correlation value of about .35; and the interest rate variables have displayed significantly different cross correlations with real GDP. For example: the nominal trading bank lending rate has been weakly (-.25) contemporaneously countercyclical for almost the full sample period; nominal 90-day commercial bill rates have been consistently countercyclical only since (centred) 1983 (3), and medium-term government bond rates have over the same period moved from being weakly pro-cyclical to weakly countercyclical and back again. Relationships for the latter two variables were not significant at the 1% level, and little extra light comes from looking at the two yield-gap and one real interest rate variables.

4.4 Relative Roles of Demand and Supply Factors?

Empirically, it is difficult to establish in a clear cut fashion separate roles for demand and supply influences, despite much theoretical analysis being deliberately structured in this way to assist. Major reasons for the difficulty are that: a number of key empirical measures, such as inventory changes and variations in capacity utilisation, reflect both demand and supply side decisions; and that the relative *strength* of each will depend on whether the variables act in an impulse or propagation fashion, and how they behave in a full macroeconomic model context.

Subject to these *caveats*, evidence from the above sub-sections and from our Tables and Charts suggests that:

- The highest contemporaneously procyclical cross correlations involve average labour productivity (substantially supply side in nature?) and changes in the share of business inventories (reflecting both demand and supply side influences).
- The next highest cross correlations (of no greater than medium strength) are the contemporaneously procyclical demand side consumption and investment variables, the countercyclical (supply side) private unit labour cost variables, and the procyclical supply side capital stock variable lagged three periods. Volatility of the latter is particularly low (.8%).
- The volatility of capacity utilisation fluctuations (which reflect both demand and supply influences) is surprisingly low, and its one period leading procyclical correlation with real GDP fluctuations at around .36 is not particularly strong.

Technological change based supply shocks are considered capable of playing an important role in theoretical real business cycle models, but it is not obvious how one would capture such an influence within the methodology used in this paper, especially seeing that the productivity measure available to us is not total factor productivity but average labour productivity.

4.5 Relative Importance of Open Economy Influences?

In attempting to establish the relative importance of various open economy influences in a business cycle context, relatively little guidance can be provided by the limited number of theoretical contributions. The approach taken here is therefore more in keeping with that often

adopted by macroeconomic modelbuilding analyses: namely, what is the role and strength of often exogenous real external influences; and what is the role and impact of primarily exogenous "foreign price", including terms of trade, influences. The important issue of whether the nature of the exchange rate regime affects the nature of economic fluctuations (eg Baxter and Stockman, 1989) is not tackled explicitly in this paper.

In this area, too, our results to date are far from convincing. However, it can be said that:

- The evidence on the role of quantity variables has been summarised above in subsection 4.1, and there it was emphasised that relationships for the full sample period were generally lacking in certainty. However, particularly from the moving cross correlations, there is some evidence for the most recent decade that: real world GDP may continue to lead (but with declining strength) New Zealand's business cycle; and fluctuations in the real net exports share variable is pro- rather than countercyclical. The latter contradicts the countercyclical relation required for Mendoza's (1991) theoretical open economy real business cycle model, and the empirical results found in the majority of Backus and Kehoe's (1991) cases. However, it is consistent with the procyclical current account variable result for Sweden, obtained by Vredin and Warne (1991 pp 523, 528) from their preferred common stochastic trends model.
- In the "foreign price" variable area, key points to note are that:
 - *average values from full sample analysis* are not particularly helpful. The greatest average volatility of fluctuations is shown by the terms of trade (8.54%), the least by the RBNZ's world price index (1.75%), and in between (for a shorter sample period) is the TWI at 4.56%. However, the moving amplitudes of fluctuation for all three variables have deviated very significantly over time from average, and each contemporaneous cross correlation with real GDP is either weak or negligible and not significant at the 1% level.
 - *phase shift results based on the full period average* (such as those presented in Tables 4 and 7) don't seem any more useful, as there is no highest cross correlation which is statistically significant and either leading or coincident with real GDP fluctuations.
 - *preliminary moving cross correlation analysis* (see Chart 6) shows that:
 - world price fluctuations have almost always been procyclical, though with correlation strengths which have fallen very considerably from around .6 in (centred) 1977 to negligible more recently;
 - terms of trade fluctuations have moved often from pro- to countercyclical and back again, displaying occasional spikes of medium strength on both sides of the spectrum; and
 - both nominal and real TWI fluctuations have generally been countercyclical and, since around (centred) 1982, have had relatively stable medium strength magnitude of about -.3 to -.4.

5 CONCLUDING COMMENTS

The primary aim of this paper has been to use some very basic statistical techniques within a modern business cycle framework, to re-examine stylised empirical facts associated with business cycles in New Zealand since the mid-1960's. The approach is basically a bivariate one, with a view to helping underpin subsequent research which utilises more sophisticated and discriminatory econometric methods in a multivariate context. It has not been a specific aim to

establish a series of aggregate or partial leading indicators, or to consider the role of expectations variables. These will be the subject of further papers.

So, within the primary focus of this paper, preliminary empirical findings are that:

- The amplitude of fluctuations in New Zealand's real GDP has been very high by world standards.
- There is confirmation, in a broad sense, of "*real variable regularity*". All statistically significant real expenditure variable fluctuations (except for the share of net exports), and all those for factor input variables, and capacity utilisation are procyclical. There are, however, substantial variations in the volatility and strength of each influence, and considerable complexities in relationships involving government expenditure and the current account of the balance of payments. In the latter two areas, evidence from preliminary stability over time analysis suggests that:
 - the volatility of total government purchases has on most occasions been opposite in degree from that of real GDP and other real expenditure variables. Moreover, during our full sample period its moving windows contemporaneous correlation shifted no fewer than five times between pro- and countercyclical. Aggregate government purchases have therefore probably exhibited no systematic cyclical tendency, especially since around (centred) 1983.
 - individually, aggregate exports and imports seem to have displayed noticeable periods of procyclical, but overall this has been with such varying strength over time and with such lack of significance as to make average full sample period magnitudes virtually meaningless. Similarly for the net exports share, the average full sample weak countercyclical disguises substantial subperiods of pro- and countercyclical. However, since around (centred) 1982, there is some evidence consistent with the real net exports share having become increasingly pro-cyclical.
- *Domestic price fluctuations* have been basically countercyclical, except during the late 1970's and early 1980's. This finding is broadly consistent with recent overseas findings and in contrast to behaviour produced by some prominent theoretical business cycle models. It should additionally be noted, however, that periods of pro- and countercyclical are not consistent across countries, and that the volatility and strength of cyclical of New Zealand's GDP deflator and CPI series has been markedly different over time.
- Fluctuations in *average labour productivity* have basically been contemporaneously procyclical, and noticeably strong in magnitude, especially relative to those for the United States; they are also a surprisingly clear mirror image for the generally countercyclical behaviour of (real) private sector *unit labour costs*. In contrast, fluctuations in the *real compensation wage rate* are at best weakly procyclical, and probably do not provide sufficiently reliable evidence to assist in differentiating between alternative theoretical business cycle models.
- The scale of changes affecting the *monetary sector* over the past decade continues to present difficulties for establishing "regularities". No credible new findings are offered, and further work will be required to establish the extent to which this has been due to our use of bivariate methods or to our choice of sample period. Further bivariate work restricted to more recent observations will be undertaken, but it is also likely that an appropriate multivariate (structural) approach will have to be used to capture key relevant monetary transmission mechanisms properly.
- Empirically, it is difficult to establish in a clear cut fashion separate roles for *demand and supply influences*, no matter what methodological stance is taken. Within the framework of this paper, it is additionally not obvious how (best) to capture the influence of technological change based supply shocks. Nevertheless, there is suggestive evidence that:

- the highest contemporaneously procyclical cross correlations involve average labour productivity (substantially supply side in nature?) and changes in the share of business inventories (reflecting both demand and supply influences).
- cross correlations of no greater than medium strength are the contemporaneously procyclical demand side consumption and investment variables, and the procyclical supply side capital stock variable lagged three periods.
- the volatility of capacity utilisation fluctuations (which reflect both demand and supply influences) is surprisingly low, and its procyclical correlation with real GDP fluctuations is not at all strong.
- With respect to the roles and relative importance of *open economy influences*,
 - whilst there is some evidence of real world GDP being a leading procyclical indicator, it is also clear that this relation is not significant at the 5% level and has been far from consistent over time. It has, if anything, become weaker since the early 1980's.
 - Mendoza's (1991) real business cycle model is specified to capture a small open economy's balance of trade moving countercyclically, but that stylised fact is not consistent with the moving correlation of New Zealand's net exports share over the past decade.
 - perhaps due to the bivariate nature of our study, no credible full period of relationships have been established for fluctuations in real GDP and any of world prices, the terms of trade, and the nominal or real TWI. However, since around (centred) 1982, fluctuations in the TWI variables have shown weak contemporaneous countercyclicality.

In a more general sense, a common thread through the above preliminary analysis is the extent to which relationships change markedly over time and "regularities" are not easy to establish with confidence. This means that forms of bivariate and other approaches to business cycle analysis which imply constancy over time in relationships will generally not be sufficiently credible for time periods involving often quite rapidly and sometimes fundamentally changing economic circumstances and relationships.

Finally, although our stylised empirical facts derived to date are preliminary, it seems worthwhile to summarise possible linkages back to the stylised theoretical views presented in section 2 and Table 1. Table 1 shows that fluctuations in each of the money supply, real consumption and investment, and employment variables are considered procyclical for all models. Significantly procyclical empirical results do not therefore assist differentiation between models. In contrast, fluctuations in the aggregate price level, the real (compensation) wage, and labour productivity are seen in Table 1 as variously pro-, counter-, not- and indeterminately cyclical, and significant empirical results could therefore assist differentiation between models.

There are obvious dangers in placing too much credibility on linking stylised facts from an essentially bivariate analysis back to properties of structural models. Nevertheless, one important overall message is that, through a combination of conceptual measurement problems (eg for technological change and productivity movements), and empirical relationships changing in strength and direction over time, many of the key features from the theoretical business cycle models are not consistent with our empirical stylised facts and uncertainties. The major exception to this is the confirmation of a reasonable degree of "real variable regularity", with aggregate real private consumption and investment having been consistently pro-cyclical. However, empirical features which are not consistent with requirements for particular variables in Table 1 are:

- As has been found for other countries, price level fluctuations have not been consistently pro-cyclical. Rather they have generally been weakly and variably countercyclical: a finding which is consistent with certain real business cycle and new Keynesian models, but not with earlier Keynesian, monetarist, and new-classical monetary misperception models.
- The compensation real wage variable is also potentially useful for helping to differentiate between theoretical models, but it is significant only at the 5% level and then only for the private sector. Within the context of this uncertainty, it has generally been weakly contemporaneously procyclical, and therefore not inconsistent with technology shocked real business cycle and new Keynesian models. However, it has also shown periods of countercyclicality, and could therefore be not inconsistent with models having new-classical monetary misperception and preference shocked real business cycle features.
- For the post-1983 period in particular, the procyclical moving cross correlation of New Zealand's real net export share variable is not consistent with the countercyclical real balance of trade property, stressed by Mendoza as very important for an open economy real business cycle model.

There continue to be empirical difficulties in the way of establishing "regularities" for nominal monetary aggregate and productivity variables. Productivity is a further variable which has the potential to assist in differentiating between models. Our empirical finding of generally continuous procyclicality of average labour productivity is consistent with both a technology shocked real business cycle model and a New Keynesian model, but not with a monetarist, new-classical monetary misperception or preference shocked real business cycle model.

Our essentially bivariate-based analysis has therefore produced a wide range of useful findings. But it has also confirmed that it is not a substitute for the next research stage: that of conducting more formal tests on multivariate models specified to be consistent with our stylised empirical facts.

References

- Backus, D.K and P.J Kehoe (1991) "International evidence on the historical properties of business cycles", Research Department Staff Report 145, Federal Reserve Bank of Minneapolis.
- Backus, D.K, P.J Kehoe and F.E Kydland (1991) "International Real Business Cycles", Research Department Staff Report 146, Federal Reserve Bank of Minneapolis.
- Barro, R.J (1977) "Unanticipated Money Growth and Unemployment in the United States", *American Economic Review* **67**, 101 - 115.
- Barro, R.J (1978) "Unanticipated Money, Output and the Price Level in the United States", *Journal of Political Economy* **86**, 549 - 580.
- Barro, R.J and H.I Grossman (1971) "A general disequilibrium model of income and employment", *American economic review*, **61**, 82 - 93.
- Barro, R.J. and M. Rush. (1980) "Unanticipated Money and Economic Activity", in S. Fischer, editor, *Rational Expectations and Economic Policy*, Chicago, University of Chicago Press for the National Bureau of Economic Research, 23 - 48.
- Baxter, M and A.C Stockman (1989) "Business Cycles and the Exchange Rate Regime: Some International Evidence", *Journal of Monetary Economics*, **23**, 377 - 400.
- Bernanke, B.S and M.L Parkinson (1991) "Procyclical labour productivity and the competing theories of the business cycle: some evidence from interwar US manufacturing industries", *Journal of political economy*, **99**, No 3, 439 - 459.
- Blanchard, O.J and S. Fischer (1989) *Lectures on Macroeconomics*, Cambridge, MIT Press.
- Boehm, E.A (1990) "Understanding Business Cycles Today: A Critical Review of Theory and Fact", in *Analyzing Modern Business Cycles: Essays Honoring Geoffrey H. Moore*, ed. Philip A. Klein, New York, M.E Sharpe Inc., 25 - 56.
- Brooks, R. and D.T. Gibbs (1991) "The Reserve Bank Econometric Model of the New Zealand Economy: Model XII", Research Paper No 42, August, RBNZ.
- Burns, A.F and W.C Mitchell (1946) *Measuring Business Cycles*, New York, NBER.
- Campbell, J.Y and N.G Mankiw (1987) "Permanent and Transitory Components in Macroeconomic Fluctuations", *The American Economic Review*, **77**, 111 - 117.
- Christiano, L.J and M. Eichenbaum (1990) "Current real business cycle theories and aggregate labour fluctuations", Discussion Paper 24, Federal Reserve Bank of Minneapolis.
- Cooley, T.F and L.E Ohanian (1991) "The cyclical behaviour of prices", *Journal of Monetary Economics*, **28**, 25 - 60.
- Cooper, R. and A. John (1988) "Coordinating coordination failures in Keynesian models", *Quarterly journal of economics*, August, **100**, 441 - 463.
- Danthine, J.P and M Girardin (1989) "Business cycles in Switzerland", *European economic review*, **33**, 31-50.
- Englund, P., T. Persson and L.E.O Svensson (1990) "Swedish business cycles: 1861 - 1988", Institute for International Studies, Seminar paper No 473, pp 33.
- Friedman, M. (1968) "The role of monetary policy", *American economic review*, March, **58**, 1 - 17.

- Friedman, M. and A. Schwartz (1963a) "Money and business cycles", *Review of economics and statistics*, February, **45**, 32 - 64.
- Friedman, M. and A. Schwartz (1963b) *A monetary history of the United States: 1867 - 1960*, Princeton, Princeton University Press for NBER.
- Greenwald, B. and J.E. Stiglitz (1987) "Keynesian, New Keynesian and New Classical economics", *Oxford economic papers*, **39**, 119 - 132.
- Greenwald, R.J and J.E Stiglitz (1988), "Examining alternative macroeconomic theories", *Brookings papers on economic activity*, **1**, 207 - 260.
- Hall, R.E (1986) "Market structure and macroeconomic fluctuations", *Brookings papers on economic activity*, **2**, 285 - 322.
- Hansen, Lars P (1982) "Large sample properties of generalised method of moments estimators", *Econometrica*, **50**, 1029 - 54.
- Haywood, E (1972) "The dating of post War business cycles in New Zealand: 1946-70", Wellington, Reserve Bank of New Zealand Research Paper, No 4, March, pp 15.
- Haywood, E and C Campbell (1976) *The New Zealand economy: measurement of economic fluctuations and indicators of economic activity, 1947-74*, Wellington, Reserve Bank of New Zealand Research Paper, No 19, March, pp 31.
- Hodrick, R.J and E.C Prescott (1980) "Postwar U.S. business cycles: An empirical investigation", Discussion Paper 451, Carnegie-Mellon University.
- Huh, C. and B. Trehan (1991) "Real business cycles: a selective survey", *Federal Reserve Bank of St Louis Economic Review*, Spring, 3 - 17.
- Kim, K.H (1991) "Real business cycles in a small open economy" in *Long-run Perspectives on the New Zealand Economy: Volume II*, eds. L.T Evans, H.J Poot and N.C Quigley, Wellington, New Zealand Association of Economists, 325 - 337.
- King, R.G and C.I Plosser (1984) "Money credit and prices in a real business cycle", *American economic review*, **74**, June, 363 - 380.
- King, R.G, C.I Plosser, J.H Stock and M.W Watson (1991) "Stochastic Trends and Economic Fluctuations", *American Economic Review*, September, **81**(4), 819 - 840.
- Klein, P.A (1990); ed., *Analyzing Modern Business Cycles: Essays Honoring Geoffrey H Moore*, New York, M E Sharpe Inc.
- Koopmans, T.C (1947) "Measurement without Theory", *Review of Economic Statistics*, **29**, 161 - 172.
- Kydland, F.E and E.C Prescott (1982) "Time to build and aggregate fluctuations", *Econometrica*, November, **50**, 1345 - 1370.
- Kydland, F.E and E.C Prescott (1990) "Business cycles: real facts and a monetary myth", *Federal Reserve Bank of Minneapolis Quarterly Review*, **14**, Spring, No 3 - 18.
- Lucas, R.E (1972) "Expectations and the neutrality of money", *Journal of economic theory*, April, **4**, 103 - 124.
- Lucas, R.E (1975) "An equilibrium model of the business cycle", *Journal of political economy*, December, **83**, 1113 - 1144.

- Lucas, R.E (1977) "Understanding business cycles", in *Stabilization of the domestic and international economy*, vol 5 of Carnegie-Rochester Series on Public Policy, eds K. Brunner and A. H. Meltzer, Amsterdam, North-Holland Publishing Company, 7 - 29.
- Mankiw, N.G (1989) "Real business cycles: a New Keynesian perspective", *Journal of economic perspectives*, 3, Summer, 79 - 80.
- Mendoza, E.G (1991) "Real business cycles in a small open economy", *American Economic Review*, September, 81(4), 797 - 818.
- Mitchell, W.C (1913) *Business Cycles*, Berkeley, University of California Press.
- Mitchell, W.C (1927) *Business Cycles: The Problem and its Setting*, New York, NBER.
- Muellbauer, J. and R. Portes (1978) "Macroeconomic models with quantity rationing", *Economic journal*, 88, 788 - 821.
- Mullineux, A.W (1984) *The business cycle after Keynes*, New Jersey, Wheatsheaf.
- Mullineux, A.W (1990) *Business cycles and financial crises*, Ann Arbor, The University of Michigan Press.
- Neary, J.P and J.E Stiglitz (1983) "Towards a reconstruction of Keynesian economics: expectations and constrained equilibria", *Quarterly journal of economics* Supplement 97, 199 - 228.
- Shapiro, C and J.E Stiglitz (1984) "Equilibrium unemployment as a worker discipline device", *American Economic Review*, 74, 433 - 444.
- Stock, J.H and M.W Watson (1988) "Variable trends in economic time series", *Journal of Economic Perspectives*, Summer, 2(3), 147 - 174.
- Wolf, H.C (1991) "Procyclical prices: a demi-myth?", *Federal Reserve Bank of Minneapolis Quarterly Review*, 15, Spring, No 2, 25 - 28.
- Vredin, A and A. Warne (1991) "Current account and macroeconomic fluctuations", *Scandinavian Journal of Economics*, 93(4), 511 - 530.
- Zarnowitz, V (1985) "Recent work on business cycles in historical perspective: a review of theories and evidence", *Journal of economic literature*, 23, June, 523 - 530.

Table 1: Impulse and propagation mechanisms in modern business cycle theories

Model	Impulse	Propagation mechanisms	Predicted behaviour of some key variables ¹						
			Money Supply	Price Level	Real Wage	Real Consumption	Real Investment	Employment	Labour Productivity
Traditional Keynesian	Demand	Keynesian demand multiplier (and accelerator)	Pro	Nil	Nil	Pro	Pro	Pro	?
Keynesian/neoclassical synthesis	Demand	Demand multiplier and relative prices	Pro	Pro	Counter	Pro	Pro	Pro	Counter
Monetarist	Money supply	Relative prices and asset yields	Pro	Pro	Counter	Pro	Pro	Pro	Counter
New-classical monetary misperception	Money supply	Price misperception and intertemporal substitution (accelerator and adjustment costs)	Pro	Pro	Counter	Pro	Pro	Pro	Counter
Real business cycle	Technology	Intertemporal substitution and	Pro ²	?	Pro	Pro	Pro	Pro	Pro
	Preferences	'time to build'	Pro ²	?	Counter	Pro	Pro	Pro	Counter
New Keynesian	Demand or supply	Credit rationing and Keynesian demand multiplier	Pro	?	Pro	Pro	Pro	Pro	Pro

1. Defined in terms of their trend deviations, relative to fluctuations in real gdp

2. Assuming an endogenous money supply, as in King and Plosser (1984)

Table 2
Cyclical Behaviour of Key Real Output and Expenditure Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
X11 Seasonal Adjustment

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Real Gross Domestic Product												
New Zealand	3.64 (.29)	-0.04 (.10)	-0.10 (.10)	0.19 (.11)	0.17 (.10)	0.30 (.12)	1.00 -	0.30 (.11)	0.17 (.10)	0.19 (.11)	-0.10 (.10)	-0.04 (.10)
World	1.41 (.11)	0.09 (.13)	0.19 (.12)	0.24 (.13)	0.09 (.13)	0.15 (.10)	0.18 (.11)	0.08 (.11)	0.02 (.10)	-0.06 (.10)	-0.22 (.11)	-0.25 (.11)
Components of Expenditure on Real GDP												
Private Consumption	2.77 (.30)	0.04 (.08)	0.08 (.08)	0.27 (.09)	0.28 (.11)	0.45 (.13)	0.62 (.08)	0.34 (.12)	0.15 (.12)	0.05 (.12)	-0.05 (.10)	-0.03 (.10)
Nondurables and Services	2.47 (.24)	-0.09 (.09)	-0.02 (.09)	0.21 (.09)	0.24 (.11)	0.42 (.12)	0.58 (.08)	0.34 (.10)	0.17 (.11)	0.10 (.12)	0.08 (.09)	0.07 (.09)
Durables	4.92 (.39)	0.13 (.09)	0.17 (.08)	0.27 (.09)	0.28 (.11)	0.37 (.12)	0.52 (.08)	0.28 (.11)	0.13 (.10)	0.05 (.09)	-0.09 (.10)	0.01 (.11)
Private Fixed Investment	9.37 (.61)	0.03 (.10)	0.15 (.09)	0.28 (.10)	0.33 (.10)	0.47 (.11)	0.56 (.09)	0.31 (.11)	0.24 (.10)	0.06 (.09)	-0.13 (.10)	-0.14 (.10)
Nonresidential	10.20 (.64)	-0.04 (.09)	0.07 (.09)	0.20 (.10)	0.23 (.10)	0.38 (.10)	0.48 (.09)	0.24 (.11)	0.24 (.10)	0.06 (.08)	-0.14 (.10)	-0.16 (.10)
Residential	10.53 (.76)	0.16 (.10)	0.27 (.10)	0.36 (.10)	0.41 (.10)	0.53 (.11)	0.58 (.08)	0.38 (.10)	0.17 (.10)	0.05 (.10)	-0.08 (.10)	-0.08 (.10)
Government	7.67 (.60)	0.05 (.08)	0.00 (.08)	-0.06 (.09)	-0.06 (.09)	0.01 (.08)	0.16 (.08)	0.12 (.10)	0.26 (.09)	0.39 (.10)	0.32 (.11)	0.39 (.11)
Central	11.14 (.83)	0.02 (.08)	-0.02 (.08)	-0.09 (.09)	-0.09 (.09)	-0.01 (.08)	0.14 (.08)	0.09 (.10)	0.22 (.09)	0.36 (.09)	0.30 (.10)	0.39 (.11)
Goods	9.76 (.76)	-0.04 (.12)	-0.01 (.10)	-0.11 (.09)	-0.19 (.11)	-0.07 (.11)	0.12 (.10)	-0.14 (.11)	-0.05 (.11)	-0.05 (.10)	-0.19 (.10)	0.13 (.09)
Investment	13.66 (1.02)	0.02 (.08)	-0.03 (.08)	-0.09 (.08)	-0.07 (.09)	-0.01 (.08)	0.12 (.08)	0.12 (.09)	0.25 (.09)	0.40 (.09)	0.35 (.10)	0.38 (.10)
Local	3.45 (.26)	0.15 (.09)	0.10 (.09)	0.09 (.08)	0.11 (.08)	0.15 (.09)	0.22 (.09)	0.29 (.11)	0.34 (.12)	0.26 (.13)	0.23 (.12)	0.13 (.12)
Exports	5.68 (.55)	-0.02 (.13)	-0.02 (.12)	-0.04 (.11)	-0.20 (.10)	-0.10 (.09)	0.29 (.12)	-0.11 (.10)	-0.31 (.12)	-0.08 (.13)	-0.19 (.11)	-0.02 (.09)
Goods	6.59 (.65)	-0.05 (.13)	-0.04 (.12)	-0.07 (.11)	-0.23 (.10)	-0.13 (.09)	0.23 (.12)	-0.16 (.10)	-0.35 (.12)	-0.09 (.13)	-0.21 (.11)	-0.04 (.09)
Services	5.22 (.34)	0.20 (.09)	0.14 (.08)	0.18 (.08)	0.13 (.09)	0.12 (.09)	0.36 (.08)	0.26 (.10)	0.10 (.09)	-0.05 (.09)	0.07 (.10)	0.10 (.10)
Imports	8.90 (.82)	-0.01 (.09)	0.04 (.09)	0.17 (.09)	0.17 (.10)	0.35 (.11)	0.37 (.12)	0.40 (.12)	0.27 (.12)	-0.03 (.11)	-0.12 (.11)	-0.23 (.11)
Goods	9.51 (.81)	-0.00 (.09)	0.05 (.09)	0.17 (.09)	0.15 (.10)	0.37 (.11)	0.40 (.11)	0.40 (.12)	0.29 (.12)	-0.02 (.11)	-0.13 (.11)	-0.21 (.11)
Services	11.03 (1.19)	-0.03 (.09)	-0.03 (.10)	0.12 (.11)	0.16 (.11)	0.14 (.12)	0.14 (.13)	0.25 (.10)	0.12 (.10)	-0.05 (.10)	-0.03 (.11)	-0.19 (.12)
Share of Expenditure on Real GDP												
Changes in Business Inventories (Mean 1.13%)	2.89 (.29)	-0.12 (.11)	-0.25 (.10)	0.06 (.10)	0.13 (.10)	0.21 (.11)	0.67 (.07)	0.34 (.13)	0.29 (.13)	0.08 (.13)	-0.14 (.12)	-0.31 (.13)
Net Exports (Mean -4.93%)	3.16 (.25)	0.00 (.09)	-0.06 (.11)	-0.15 (.10)	-0.22 (.10)	-0.31 (.10)	-0.09 (.15)	-0.34 (.13)	-0.35 (.12)	-0.01 (.12)	-0.00 (.11)	0.18 (.11)

Numbers in parentheses are GMM standard errors, computed as explained in Christiano and Eichenbaum (1990)

Table 3
Cyclical Behaviour of Key Real Input Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
X11 Seasonal Adjustment

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Labor Input												
Hours												
Aggregate	2.51 (.19)	-0.13 (.10)	-0.06 (.08)	-0.07 (.09)	-0.11 (.10)	0.12 (.07)	0.18 (.10)	0.08 (.10)	0.24 (.10)	-0.01 (.11)	-0.00 (.09)	0.09 (.09)
Private	3.32 (.26)	0.02 (.10)	0.05 (.08)	0.04 (.08)	-0.06 (.09)	0.05 (.07)	0.16 (.10)	0.15 (.09)	0.19 (.10)	0.06 (.09)	0.10 (.10)	0.02 (.11)
Employment												
Aggregate	1.10 (.07)	-0.11 (.08)	0.01 (.08)	0.14 (.10)	0.11 (.12)	0.27 (.11)	0.33 (.09)	0.40 (.11)	0.31 (.13)	0.24 (.10)	0.21 (.09)	0.07 (.10)
Private	1.43 (.10)	-0.06 (.08)	0.04 (.08)	0.15 (.10)	0.14 (.12)	0.29 (.11)	0.36 (.09)	0.41 (.11)	0.29 (.12)	0.24 (.10)	0.16 (.09)	-0.01 (.10)
Productivity												
Aggregate	4.13 (.30)	0.03 (.10)	-0.05 (.09)	0.21 (.09)	0.20 (.10)	0.18 (.12)	0.79 (.04)	0.22 (.10)	0.01 (.10)	0.18 (.11)	-0.11 (.10)	-0.07 (.09)
Private	4.61 (.32)	-0.06 (.10)	-0.11 (.09)	0.12 (.10)	0.17 (.10)	0.20 (.11)	0.69 (.06)	0.13 (.10)	0.00 (.09)	0.11 (.10)	-0.17 (.09)	-0.03 (.10)
Capital Input												
Nonresidential Stock												
	0.80 (.05)	-0.02 (.10)	-0.01 (.09)	0.03 (.09)	0.13 (.09)	0.21 (.09)	0.35 (.09)	0.42 (.10)	0.50 (.12)	0.55 (.12)	0.46 (.13)	0.39 (.12)
Inventory Stock												
	3.64 (.42)	-0.17 (.14)	-0.29 (.14)	-0.27 (.14)	-0.19 (.13)	-0.10 (.11)	0.20 (.11)	0.38 (.12)	0.50 (.14)	0.57 (.13)	0.49 (.13)	0.34 (.13)
Capacity Utilization												
	1.86 (.11)	0.05 (.10)	0.12 (.09)	0.19 (.09)	0.28 (.09)	0.36 (.10)	0.33 (.09)	0.24 (.10)	0.07 (.08)	-0.12 (.09)	-0.23 (.09)	-0.20 (.09)

Numbers in parentheses are GMM standard errors, computed as explained in Christiano and Eichenbaum (1990)

Table 4
Cyclical Behaviour of Key Price and Wage Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
X11 Seasonal Adjustment

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Domestic Price Level Variables												
GDP Deflator (Market Price)	5.12 (.48)	0.00 (.11)	-0.00 (.09)	0.01 (.10)	-0.11 (.09)	-0.19 (.12)	-0.31 (.10)	-0.19 (.13)	-0.22 (.12)	-0.18 (.10)	-0.11 (.10)	-0.17 (.10)
Private Consumption Deflator	2.62 (.16)	-0.10 (.08)	-0.14 (.08)	-0.25 (.08)	-0.28 (.09)	-0.32 (.10)	-0.37 (.09)	-0.19 (.11)	-0.11 (.12)	-0.10 (.12)	-0.02 (.10)	-0.01 (.09)
Consumer Price Index	2.32 (.16)	-0.11 (.09)	-0.14 (.09)	-0.16 (.09)	-0.18 (.09)	-0.20 (.09)	-0.18 (.08)	-0.04 (.08)	0.01 (.09)	0.01 (.09)	0.07 (.08)	0.05 (.08)
Producer Price Index												
Outputs	4.15 (.49)	0.19 (.16)	0.22 (.15)	0.21 (.13)	0.13 (.13)	0.07 (.11)	-0.02 (.10)	-0.15 (.12)	-0.28 (.13)	-0.34 (.13)	-0.31 (.13)	-0.27 (.13)
Inputs	2.58 (.17)	0.00 (.09)	0.06 (.09)	0.11 (.10)	0.09 (.09)	0.09 (.08)	0.03 (.09)	-0.02 (.11)	-0.08 (.12)	-0.17 (.12)	-0.17 (.13)	-0.16 (.11)
Wage Variables												
Average Hourly Real Compensation												
Aggregate	2.53 (.16)	0.11 (.08)	0.08 (.08)	0.06 (.08)	0.07 (.08)	0.13 (.09)	0.15 (.10)	0.06 (.12)	0.05 (.12)	-0.02 (.11)	-0.07 (.10)	-0.06 (.09)
Private	2.14 (.14)	0.02 (.08)	0.02 (.08)	0.08 (.08)	0.12 (.08)	0.23 (.09)	0.24 (.10)	0.11 (.12)	0.04 (.12)	0.00 (.11)	-0.04 (.10)	-0.05 (.10)
Private Unit Labour Costs												
Nominal	6.55 (.42)	0.00 (.09)	0.05 (.09)	-0.15 (.09)	-0.16 (.09)	-0.19 (.10)	-0.62 (.06)	-0.12 (.10)	-0.01 (.09)	-0.10 (.09)	0.14 (.09)	0.04 (.09)
Real	6.30 (.56)	0.00 (.11)	0.04 (.09)	-0.19 (.11)	-0.09 (.11)	-0.03 (.11)	-0.42 (.08)	0.02 (.12)	0.16 (.10)	0.00 (.10)	0.21 (.11)	0.17 (.11)
Foreign Price Variables												
World Prices	1.75 (.13)	-0.09 (.14)	-0.08 (.14)	-0.06 (.13)	0.01 (.12)	0.12 (.11)	0.21 (.09)	0.26 (.09)	0.25 (.10)	0.28 (.10)	0.28 (.12)	0.24 (.13)
Domestic Price of Exports of Goods	5.92 (.51)	0.19 (.13)	0.20 (.14)	0.24 (.12)	0.25 (.11)	0.24 (.11)	0.14 (.11)	0.04 (.10)	-0.16 (.12)	-0.34 (.13)	-0.36 (.13)	-0.34 (.12)
Domestic Price of Exports of Services	3.29 (.24)	0.02 (.09)	0.06 (.09)	0.03 (.09)	0.08 (.08)	0.15 (.08)	-0.00 (.08)	0.06 (.08)	0.04 (.09)	-0.02 (.09)	-0.03 (.09)	-0.04 (.09)
Domestic Price of Imports of Goods	6.37 (.47)	0.01 (.12)	-0.07 (.13)	-0.09 (.13)	-0.01 (.14)	0.04 (.12)	0.10 (.11)	0.21 (.10)	0.27 (.09)	0.21 (.09)	0.26 (.09)	0.32 (.11)
Domestic Price of Imports of Services	7.58 (.49)	-0.03 (.09)	-0.04 (.10)	-0.13 (.11)	-0.08 (.13)	-0.04 (.13)	-0.03 (.13)	0.00 (.12)	0.08 (.11)	0.10 (.09)	0.10 (.09)	0.22 (.11)
Terms of Trade	8.54 (.99)	0.13 (.14)	0.20 (.15)	0.24 (.15)	0.18 (.15)	0.14 (.13)	0.02 (.11)	-0.13 (.11)	-0.30 (.12)	-0.39 (.12)	-0.44 (.12)	-0.48 (.13)
Nominal Trade Weighted Exchange Rate Index*	4.56 (.42)	-0.03 (.12)	0.07 (.10)	0.04 (.10)	-0.14 (.11)	-0.21 (.12)	-0.17 (.13)	-0.16 (.12)	-0.09 (.09)	-0.06 (.10)	-0.14 (.09)	-0.27 (.11)
Real TWI*	5.03 (.52)	-0.17 (.12)	-0.09 (.10)	-0.06 (.09)	-0.14 (.11)	-0.05 (.17)	-0.01 (.17)	-0.11 (.11)	-0.11 (.08)	-0.14 (.08)	-0.13 (.09)	-0.19 (.13)

* 64 observations only, from 1974(2) to 1990(1).

Numbers in parentheses are GMM standard errors, computed as explained in Christiano and Eichenbaum (1990)

Table 5
Cyclical Behaviour of Key Monetary Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
X11 Seasonal Adjustment

Variable x	Volatility:	Cross Correlation of Real GDP with										
	% Std. Dev.	x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Nominal Monetary Aggregates												
M1	5.28 (.36)	0.20 (.10)	0.25 (.12)	0.29 (.12)	0.24 (.11)	0.20 (.11)	0.10 (.11)	-0.03 (.09)	-0.12 (.09)	-0.18 (.08)	-0.20 (.09)	-0.19 (.09)
M3	3.91 (.28)	0.05 (.10)	0.11 (.12)	0.15 (.12)	0.15 (.12)	0.10 (.11)	0.03 (.10)	-0.02 (.10)	-0.07 (.11)	-0.22 (.09)	-0.21 (.09)	-0.18 (.10)
M3 - M1	4.19 (.30)	-0.01 (.10)	0.04 (.11)	0.08 (.11)	0.09 (.11)	0.04 (.10)	-0.01 (.09)	-0.03 (.10)	-0.06 (.12)	-0.21 (.09)	-0.20 (.10)	-0.16 (.10)
Velocity												
M1	6.56 (.58)	-0.18 (.11)	-0.25 (.11)	-0.12 (.13)	-0.19 (.10)	-0.14 (.11)	0.24 (.10)	0.05 (.11)	0.03 (.09)	0.11 (.09)	0.00 (.09)	0.01 (.09)
M3	5.73 (.59)	-0.06 (.11)	-0.14 (.11)	0.03 (.12)	-0.10 (.10)	-0.05 (.11)	0.36 (.08)	0.04 (.11)	-0.04 (.10)	0.11 (.09)	-0.03 (.09)	-0.05 (.09)
Nominal Interest Rates												
Medium Term Government Bond*	10.87 (1.18)	-0.23 (.12)	-0.24 (.11)	-0.18 (.10)	-0.09 (.10)	-0.08 (.09)	-0.04 (.10)	0.00 (.09)	0.05 (.10)	0.02 (.11)	-0.02 (.12)	-0.08 (.12)
90 - day Comm./ RB Bill**	16.20 (1.33)	-0.18 (.14)	-0.30 (.15)	-0.30 (.15)	-0.29 (.14)	-0.24 (.12)	-0.05 (.10)	0.17 (.11)	0.31 (.14)	0.32 (.13)	0.17 (.10)	0.00 (.08)
Trading Bank Lending	7.35 (.71)	-0.11 (.08)	-0.15 (.09)	-0.18 (.08)	-0.17 (.09)	-0.21 (.08)	-0.25 (.06)	-0.17 (.07)	-0.12 (.08)	-0.08 (.09)	-0.03 (.10)	-0.05 (.09)
Yield Gap												
90-day Bill - MT Bond**	1.62 (.15)	-0.04 (.13)	-0.10 (.15)	-0.12 (.14)	-0.27 (.14)	-0.20 (.13)	-0.04 (.11)	0.19 (.10)	0.36 (.13)	0.33 (.13)	0.10 (.09)	-0.04 (.09)
Tr. Bank Lend .- MT Bond*	1.51 (.20)	0.07 (.13)	0.05 (.10)	-0.00 (.09)	-0.04 (.09)	-0.07 (.11)	-0.15 (.10)	-0.13 (.10)	-0.12 (.09)	-0.05 (.10)	0.02 (.08)	0.04 (.09)
Real 90-day Bill Rate**	2.07 (.15)	-0.16 (.13)	-0.23 (.13)	-0.21 (.13)	-0.19 (.14)	-0.11 (.11)	-0.00 (.11)	0.11 (.11)	0.22 (.13)	0.16 (.11)	0.05 (.12)	0.04 (.10)

* 65 observations only, to 1990(1).

** 61 observations only, to 1990(1).

Numbers in parentheses are GMM standard errors, computed as explained in Christiano and Eichenbaum (1990)

Table 6
Regularities Involving Real Business Cycle Variables
Full Sample Period: 1966(4) - 1990(1)

Variable	Amplitude of Fluctuations		Contemporaneous Comovement with Real GDP				Phase Shift Relative to Overall Business Cycle			
	% Std. Dev.	Std. Error	Cross Corr.	Std. Error	Cyclicality	Strength**	Highest Cross Corr.*	Std. Error	Cyclicality	Phase
Real Gross Domestic Product										
New Zealand	3.64	(.29)	1.00	-			-			
World	1.41	(.11)	0.18	(.107)††	Pro	Weak	0.24	(.126)	Pro	††
Components of Expenditure on Real GDP										
Private Consumption	2.77	(.30)	0.62	(.077)	Pro	Medium	0.62	(.077)	Pro	Coincident
Nondurables and Services	2.47	(.24)	0.58	(.079)	Pro	Medium	0.58	(.079)	Pro	Coincident
Durables	4.92	(.39)	0.52	(.081)	Pro	Medium	0.52	(.081)	Pro	Coincident
Private Fixed Investment	9.37	(.61)	0.56	(.086)	Pro	Medium	0.56	(.086)	Pro	Coincident
Nonresidential	10.20	(.64)	0.48	(.087)	Pro	Medium	0.48	(.087)	Pro	Coincident
Residential	10.53	(.76)	0.58	(.084)	Pro	Medium	0.58	(.084)	Pro	Coincident
Government	7.67	(.60)	0.16	(.080)†	Pro	Weak	0.39	(.099)	Pro	Lag 3 periods
Central	11.14	(.83)	0.14	(.081)††	Pro	Weak	0.39	(.106)	Pro	Lag 5 periods
Goods	9.76	(.76)	0.12	(.096)††	Pro	Weak	-0.19	(.099)	Counter	††
Investment	13.66	(1.02)	0.12	(.079)††	Pro	Weak	0.40	(.094)	Pro	Lag 3 periods
Local	3.45	(.26)	0.22	(.091)†	Pro	Weak	0.34	(.122)	Pro	Lag 2 periods
Exports	5.68	(.55)	0.29	(.116)†	Pro	Weak	-0.31	(.124)	Counter	†
Goods	6.59	(.65)	0.23	(.122)††	Pro	Weak	-0.35	(.124)	Counter	Lag 2 periods
Services	5.22	(.34)	0.36	(.083)	Pro	Medium/Weak	0.36	(.083)	Pro	Coincident
Imports	8.90	(.82)	0.37	(.118)	Pro	Medium/Weak	0.40	(.124)	Pro	Lag 1 period
Goods	9.51	(.81)	0.40	(.112)	Pro	Medium/Weak	0.40	(.112)	Pro	Coincident
Services	11.03	(1.19)	0.14	(.127)††	Pro	Weak	0.25	(.102)	Pro	†
Share of Expenditure on Real GDP										
Changes in Business Inventories	2.89	(.29)	0.67	(.072)	Pro	Medium	0.67	(.072)	Pro	Coincident
Net Exports	3.16	(.25)	-0.09	(.153)††	Counter	Very weak	-0.35	(.116)	Counter	Lag 2 periods
Labour Input										
Hours										
Aggregate	2.51	(.19)	0.18	(.103)††	Pro	Weak	0.24	(.100)	Pro	†
Private	3.32	(.26)	0.16	(.104)††	Pro	Weak	0.19	(.100)	Pro	††
Productivity										
Aggregate	4.13	(.30)	0.79	(.035)	Pro	Strong	0.79	(.035)	Pro	Coincident
Private	4.61	(.32)	0.69	(.058)	Pro	Strong	0.69	(.058)	Pro	Coincident
Capital Input										
Nonresidential Stock	0.80	(.05)	0.35	(.090)	Pro	Medium/Weak	0.55	(.120)	Pro	Lag 3 periods
Capacity Utilization										
	1.86	(.11)	0.33	(.092)	Pro	Medium/Weak	0.36	(.096)	Pro	Lead 1 period

* For $x(t-5)$ to $x(t+5)$.

** Refers to numerical value of cross relation

† Not significant at 1% level

†† Not significant at 5% level

Table 7
(Ir)regularities Involving Price and Wage Variables ?
Full Sample Period: 1966(4) - 1990(1)

Variable	Amplitude of Fluctuations		Contemporaneous Comovement with Real GDP				Phase Shift Relative to Overall Business Cycle			
	% Std. Dev.	Std. Error	Cross Corr.	Std. Error	Cyclicalit	Strength***	Highest Cross Corr.*	Std. Error	Cyclicalit	Phase
Domestic Price Level Variables										
GDP Deflator (Market Price)	5.12	(.48)	-0.31	(.104)	Counter	Medium/Weak	-0.31	(.104)	Counter	Coincident
Consumer Price Index	2.32	(.16)	-0.18	(.078)†	Counter	Weak	-0.20	(.090)	Counter	†
Producer Price Index										
Outputs	4.15	(.49)	-0.02	(.104)††	Not	Negligible	-0.34	(.133)	Counter	†
Inputs	2.58	(.17)	0.03	(.091)††	Not	Negligible	-0.17	(.124)	Counter	††
Wage Variables										
Average Hourly Real Compensation										
Aggregate	2.53	(.16)	0.15	(.100)††	Pro	Weak	0.15	(.100)	Pro	††
Private	2.14	(.14)	0.24	(.103)†	Pro	Weak	0.24	(.103)	Pro	†
Private Unit Labour Costs										
Nominal	6.55	(.42)	-0.62	(.058)	Counter	Medium	-0.62	(.058)	Counter	Coincident
Real	6.30	(.56)	-0.42	(.079)	Counter	Medium/Weak	-0.42	(.079)	Counter	Coincident
Foreign Price Variables										
World Prices	1.75	(.13)	0.21	(.094)†	Pro	Weak	0.28	(.104)	Pro	Lag 3 periods
Domestic Price of Exports of Goods	5.92	(.51)	0.14	(.106)††	Pro	Weak	-0.36	(.132)	Counter	Lag 4 periods
Domestic Price of Exports of Services	3.29	(.24)	-0.00	(.077)††	Not	Negligible	0.15	(.078)	Pro	††
Domestic Price of Imports of Goods	6.37	(.47)	0.10	(.105)††	Pro	Weak	0.27	(.113)	Pro	Lag 5 periods
Domestic Price of Imports of Services	7.58	(.49)	-0.03	(.125)††	Not	Negligible	0.22	(.112)	Pro	††
Terms of Trade	8.54	(.99)	0.02	(.114)††	Not	Negligible	-0.48	(.127)	Counter	Lag 5 periods
Nominal Trade Weighted										
Exchange Rate Index**	4.56	(.42)	-0.17	(.134)††	Counter	Weak	-0.27	(.109)	Counter	†
Real TWI**	5.03	(.52)	-0.01	(.168)††	Not	Negligible	-0.19	(.132)	Counter	††

* For $x(t-5)$ to $x(t+5)$.

** 64 observations only, from 1974(2) to 1990(1).

*** Refers to numerical value of cross correlation

† Not Significant at 1% level

†† Not significant at 5% level

Table 8
(Ir)regularities Involving Monetary Variables ?
Full Sample Period: 1966(4) - 1990(1)

Variable	Amplitude of Fluctuations		Contemporaneous Comovement with Real GDP				Phase Shift Relative to Overall Business Cycle			
	% Std. Dev.	Std. Error	Cross Corr.	Std. Error	Cyclicalities	Strength***	Highest Cross Corr.*	Std. Error	Cyclicalities	Phase
Nominal Monetary Aggregates										
M1	5.28	(.36)	0.10	(.105)††	Pro	Weak	0.29	(.117)	Pro	†
M3-M1	4.19	(.30)	-0.01	(.091)††	Not	Negligible	-0.21	(.091)	Counter	†
Velocity										
M1	6.56	(.58)	0.24	(.097)†	Pro	Weak	0.24	(.110)	Pro	†
M3	5.73	(.59)	0.36	(.085)	Pro	Medium/Weak	0.36	(.085)	Pro	Coincident
Nominal Interest Rate										
Medium Term Government Bond**	10.87	(1.18)	-0.04	(.095)††	Not	Negligible	-0.24	(.109)	Counter	†
90 - day Comm./ RB Bill***	16.20	(1.33)	-0.05	(.104)††	Not	Negligible	0.32	(.129)	Pro	†
Trading Bank Lending	7.35	(.71)	-0.25	(.064)	Counter	Weak	-0.25	(.064)	Counter	Coincident
Yield Gap										
90-day Bill - MT Bond***	1.62	(.15)	-0.04	(.114)††	Not	Negligible	0.36	(.132)	Pro	Lag 2 periods
Tr.Bank Lend. - MT Bond**	1.51	(.20)	-0.15	(.096)††	Counter	Weak	-0.15	(.096)	Counter	††
Real 90-day Bill Rate***	2.07	(.15)	-0.00	(.115)††	Not	Negligible	-0.23	(.135)	Counter	††

* For x(t-5) to x(t+5).

** 65 observations only, to 1990(1).

*** 61 observations only, to 1990(1).

**** Refers to numerical value of cross correlation

† Not Significant at 1% level

†† Not significant at 5% level

Table 9
Illustrative Sensitivity Analysis: Alternative Detrending Procedures
Full Sample Period, X11 Seasonal Adjustment

		Hodrick - Prescott Filter						
		Linear	$\lambda=6400$	$\lambda=3200$	$\lambda=1600$	$\lambda=800$	$\lambda=400$	First Diff.
Volatility of Real Gross Domestic Product (% Standard Deviation)		5.51	4.19	3.91	3.64	3.43	3.28	4.32
Volatility Relative to Real GDP								
Private Consumption		0.97	0.77	0.77	0.76	0.75	0.73	0.57
Private Fixed Investment		2.81	2.66	2.63	2.57	2.48	2.39	1.87
Government Purchases		2.32	2.29	2.21	2.11	2.00	1.91	1.51
Exports		1.19	1.44	1.50	1.56	1.60	1.63	1.65
Imports		2.19	2.34	2.40	2.44	2.44	2.40	1.82
GDP Deflator (Market Price)		1.46	1.32	1.36	1.41	1.43	1.44	1.44
Cyclicality (Contemporaneous Correlation with Real GDP)								
Private Consumption		0.79	0.69	0.66	0.62	0.59	0.57	0.42
Private Fixed Investment		0.58	0.63	0.60	0.56	0.52	0.49	0.32
Government Purchases		0.63	0.38	0.29	0.16	0.05	-0.02	0.21
Exports		0.18	0.17	0.22	0.29	0.36	0.42	0.54
Imports		0.57	0.43	0.40	0.37	0.34	0.31	-0.03
GDP Deflator (Market Price)		-0.61	-0.38	-0.34	-0.31	-0.27	-0.25	-0.16
Phase Shift (Cross Correlation with Real GDP)*								
Private Consumption		+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Private Fixed Investment		+ 0	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Government Purchases		+ Lag 3	+ Lag 3	+ Lag 3	+ Lag 5	+ Lag 5	+ Lag 5	+ Lag 3
Exports		+ 0	- Lead 8	- Lead 8	- Lead 8	+ 0	+ 0	+ 0
Imports		+ Lead 1	+ 0	+ Lag 1	+ Lag 1	+ Lag 1	+ Lag 1	+ Lag 2
GDP Deflator (Market Price)		- 0	- 0	- 0	- 0	- 0	- 0	- Lag 0
Phillips-Perron Unit Root Test Statistics for real GDP**								
Test	Lag							
α		0.670	0.470	0.389	0.299	0.218	0.156	-3.84
Z(α)	0	-29.22***	-47.01	-54.25	-62.35	-69.70	-75.31	-123.23
	6	-30.42	-55.07	-62.10	-66.96	-68.08	-67.19	-107.17
	12	-37.61	-62.87	-66.84	-65.83	-59.64	-53.26	-104.30
Z(t_α)	0	-4.20	-5.59	-6.18	-6.86	-7.51	-8.03	-14.23
	6	-4.27	-5.91	-6.45	-6.99	-7.48	-7.93	-16.37
	12	-4.66	-6.21	-6.61	-6.96	-7.34	-8.04	-17.12

* + indicates procyclical, - indicates countercyclical, 0 indicates coincident.

** Statistics are for one unit root vs none, for deviations from trend. Linear trend critical values at the 1% level for Z(α) and Z(t_α) are -29.50 and -3.96 respectively.

*** Rejected at the 5% level, for which the critical value is -21.80; also for "constant only" tests at the 1% level

Table 10
Cyclical Behaviour of Key Real Output, Expenditure and Input Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
SPlus Seasonal Adjustment

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Real Gross Domestic Product												
New Zealand	3.80	-0.03	-0.06	0.16	0.11	0.28	1.00	0.28	0.11	0.16	-0.06	-0.03
World	1.42	0.08	0.21	0.24	0.09	0.13	0.17	0.09	0.02	-0.08	-0.21	-0.23
Components of Expenditure on Real GDP												
Private Consumption	2.80	0.03	0.08	0.27	0.25	0.41	0.61	0.33	0.12	0.03	-0.02	-0.02
Nondurables and Services	2.54	-0.10	-0.01	0.22	0.20	0.38	0.57	0.34	0.13	0.07	0.10	0.09
Durables	5.05	0.10	0.16	0.28	0.27	0.32	0.50	0.28	0.12	0.03	-0.08	0.01
Private Fixed Investment	9.42	0.04	0.15	0.28	0.31	0.45	0.53	0.28	0.21	0.07	-0.11	-0.15
Nonresidential	10.26	-0.03	0.07	0.20	0.22	0.36	0.46	0.21	0.22	0.07	-0.12	-0.17
Residential	10.62	0.16	0.26	0.35	0.38	0.51	0.55	0.36	0.15	0.05	-0.07	-0.08
Government	7.72	0.04	0.00	-0.05	-0.06	0.01	0.16	0.12	0.25	0.38	0.30	0.37
Central	11.24	0.02	-0.02	-0.08	-0.08	-0.01	0.14	0.09	0.21	0.36	0.28	0.37
Goods	10.23	-0.04	-0.01	-0.12	-0.20	-0.05	0.10	-0.16	-0.05	-0.01	-0.17	0.10
Investment	13.75	0.02	-0.03	-0.08	-0.06	-0.01	0.12	0.12	0.24	0.38	0.33	0.37
Local	3.46	0.14	0.10	0.10	0.12	0.15	0.22	0.28	0.33	0.24	0.20	0.11
Exports	5.97	-0.03	-0.01	-0.02	-0.20	-0.11	0.31	-0.10	-0.33	-0.07	-0.14	-0.03
Goods	6.89	-0.05	-0.03	-0.05	-0.23	-0.14	0.26	-0.16	-0.36	-0.07	-0.16	-0.05
Services	5.50	0.18	0.13	0.19	0.10	0.10	0.38	0.27	0.06	-0.07	0.09	0.09
Imports	9.31	0.01	0.05	0.14	0.17	0.32	0.33	0.35	0.26	-0.01	-0.11	-0.21
Goods	9.95	0.01	0.06	0.13	0.15	0.34	0.36	0.34	0.27	0.00	-0.12	-0.20
Services	11.72	-0.03	-0.05	0.12	0.16	0.11	0.12	0.23	0.11	-0.04	-0.02	-0.16
Share of Expenditure on Real GDP												
Changes in Business Inventories (Mean 1.13%)	2.99	-0.09	-0.24	0.05	0.12	0.21	0.61	0.31	0.27	0.10	-0.13	-0.32
Net Exports (Mean -4.93%)	3.31	-0.02	-0.06	-0.11	-0.23	-0.29	-0.05	-0.28	-0.36	-0.04	0.01	0.17
Labor Input												
Hours												
Aggregate	2.59	-0.11	-0.07	-0.05	-0.10	0.12	0.14	0.11	0.23	-0.01	-0.03	0.12
Private	3.43	0.03	0.02	0.06	-0.06	0.03	0.13	0.18	0.19	0.07	0.07	0.05
Employment												
Aggregate	1.11	-0.10	0.02	0.14	0.12	0.26	0.32	0.37	0.31	0.24	0.22	0.08
Private	1.44	-0.05	0.05	0.15	0.14	0.28	0.36	0.38	0.29	0.25	0.18	0.01
Productivity												
Aggregate	4.29	0.04	-0.01	0.17	0.16	0.18	0.80	0.18	-0.05	0.15	-0.04	-0.09
Private	4.79	-0.04	-0.07	0.09	0.13	0.20	0.70	0.09	-0.05	0.08	-0.10	-0.06
Capital Input												
Nonresidential Stock	0.81	-0.01	-0.01	0.04	0.13	0.21	0.33	0.40	0.47	0.53	0.45	0.37
Capacity Utilization												
	1.86	0.06	0.11	0.19	0.29	0.34	0.29	0.23	0.09	-0.11	-0.24	-0.19

Table 11
Cyclical Behaviour of Key Price Level and Monetary Variables
Quarterly Deviations from Trend: 1966(4) - 1990(1), $\lambda = 1600$
SPlus Seasonal Adjustment

Variable x	Volatility: % Std. Dev.	Cross Correlation of Real GDP with										
		x(t-5)	x(t-4)	x(t-3)	x(t-2)	x(t-1)	x(t)	x(t+1)	x(t+2)	x(t+3)	x(t+4)	x(t+5)
Domestic Price Level Variables												
GDP Deflator												
(Market Price)	5.43	-0.01	0.01	0.00	-0.13	-0.16	-0.25	-0.17	-0.23	-0.15	-0.06	-0.14
Private Consumption Deflator	2.64	-0.10	-0.15	-0.26	-0.27	-0.30	-0.37	-0.18	-0.07	-0.09	-0.03	-0.01
Consumer Price Index	2.33	-0.11	-0.15	-0.18	-0.18	-0.20	-0.17	-0.03	0.04	0.01	0.07	0.06
Producer Price Index												
Outputs	4.15	0.18	0.22	0.19	0.12	0.07	-0.01	-0.14	-0.27	-0.32	-0.29	-0.26
Inputs	2.58	0.00	0.05	0.10	0.09	0.09	0.02	-0.02	-0.05	-0.16	-0.17	-0.15
Average Hourly Real Compensation												
Aggregate	2.54	0.08	0.07	0.06	0.06	0.12	0.16	0.05	0.03	-0.03	-0.06	-0.06
Private	2.16	-0.00	0.02	0.08	0.12	0.22	0.25	0.09	0.01	-0.01	-0.03	-0.05
Foreign Price Variables												
World Prices	1.76	-0.08	-0.07	-0.06	0.01	0.11	0.20	0.23	0.24	0.27	0.27	0.23
Domestic Price of Exports of Goods	5.95	0.18	0.19	0.23	0.25	0.23	0.12	0.05	-0.14	-0.33	-0.36	-0.34
Domestic Price of Exports of Services	3.32	0.05	-0.00	0.08	0.16	0.01	-0.01	0.05	0.05	0.00	-0.02	-0.03
Domestic Price of Imports of Goods	6.38	0.02	-0.07	-0.08	-0.00	0.05	0.10	0.21	0.27	0.20	0.25	0.29
Domestic Price of Imports of Services	7.62	-0.02	-0.03	-0.13	-0.07	-0.03	-0.02	0.02	0.08	0.08	0.08	0.21
Terms of Trade	8.55	0.12	0.18	0.23	0.17	0.12	0.01	-0.12	-0.29	-0.37	-0.43	-0.46
Nominal Trade Weighted Exchange Rate Index*	4.56	-0.03	0.08	0.05	-0.15	-0.24	-0.19	-0.17	-0.11	-0.06	-0.12	-0.24
Nominal Monetary Aggregates												
M1	5.44	0.16	0.21	0.27	0.21	0.15	0.07	-0.03	-0.10	-0.18	-0.17	-0.17
M3	3.93	0.03	0.10	0.15	0.13	0.09	0.02	0.01	-0.04	-0.20	-0.20	-0.15
M3 - M1	4.23	-0.02	0.04	0.08	0.08	0.05	-0.01	-0.00	-0.03	-0.19	-0.19	-0.14
Velocity												
M1	7.09	-0.15	-0.19	-0.12	-0.21	-0.08	0.29	0.04	-0.04	0.11	0.06	0.01
M3	6.19	-0.04	-0.09	0.01	-0.13	-0.02	0.38	0.02	-0.11	0.09	0.04	-0.04
Nominal Interest Rates**												
Medium Term Government Bond	10.92	-0.21	-0.23	-0.17	-0.08	-0.07	-0.02	0.03	0.08	0.03	-0.02	-0.07
90 - day Comm./ RB Bill	16.63	-0.16	-0.26	-0.26	-0.27	-0.23	-0.04	0.18	0.31	0.30	0.15	0.02

* 64 observations only, from 1974(2) to 1990(1).

** 65 and 61 observations only, to 1990(1).

CHART 1: NZ REAL GDP: ACTUAL AND TREND
1966(4) - 1991(2)

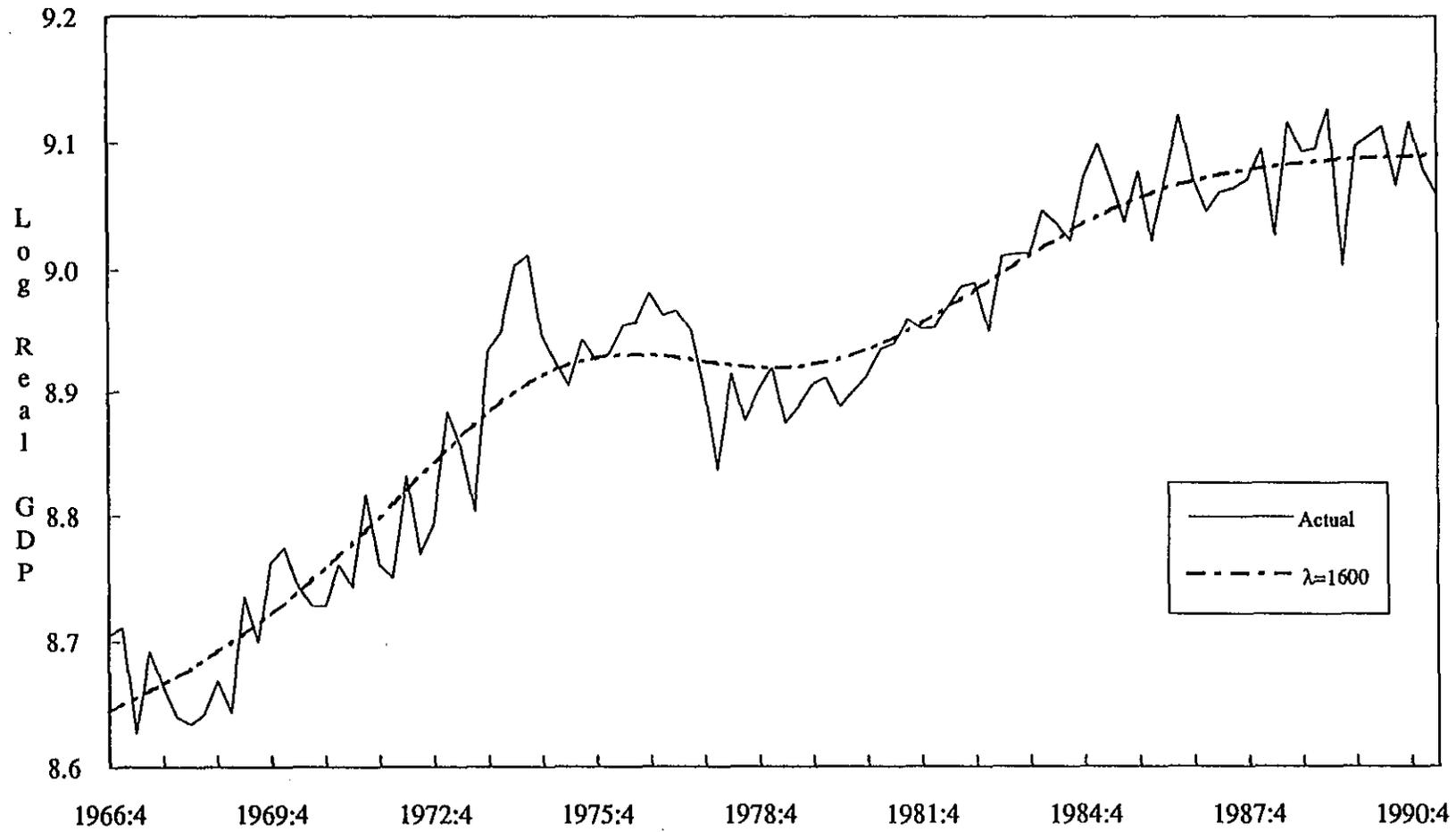


CHART 2: NZ REAL GDP: ACTUAL AND ALTERNATIVE TRENDS
1966(4) - 1991(2)

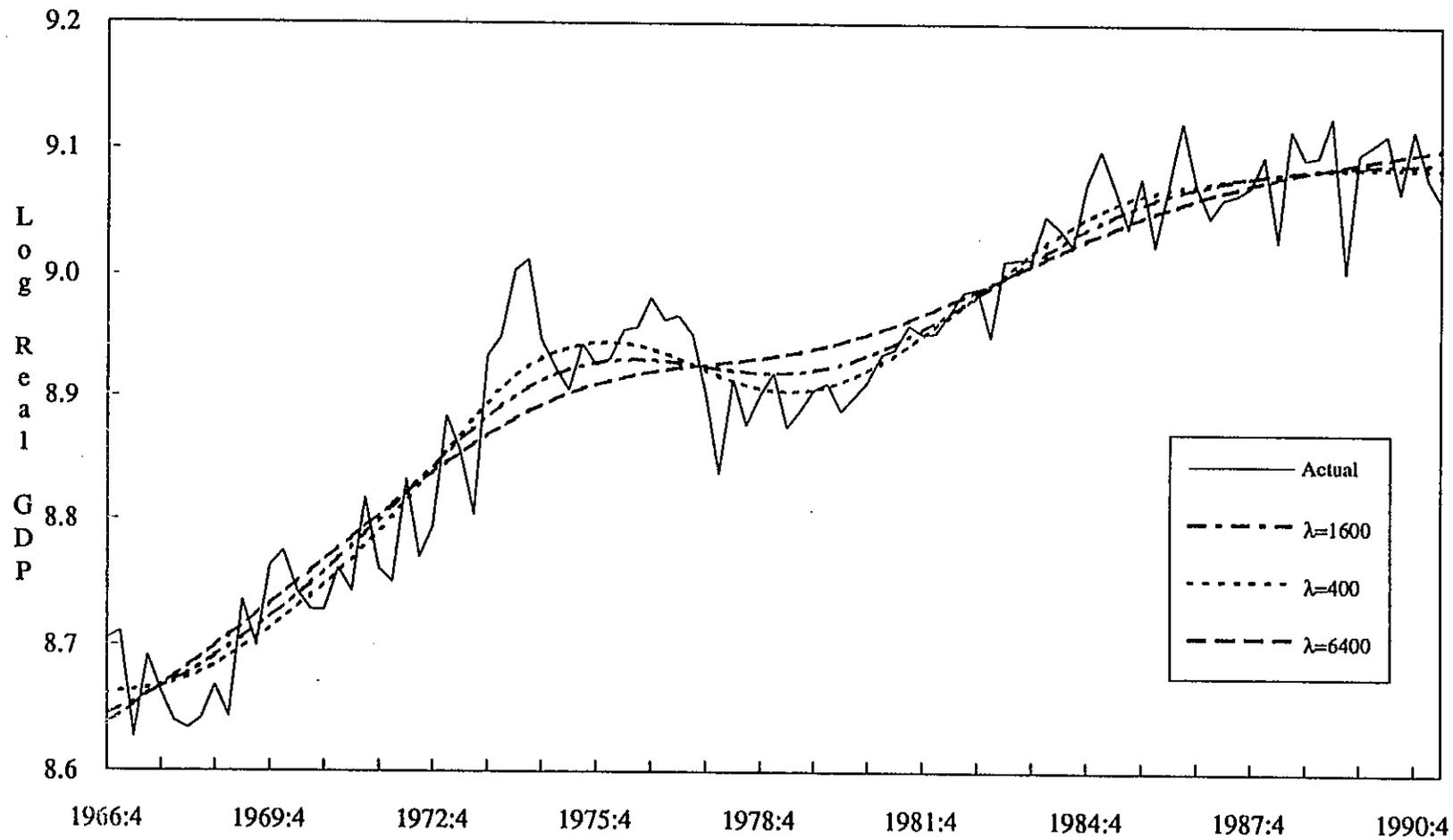
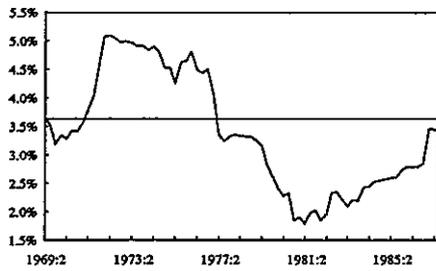
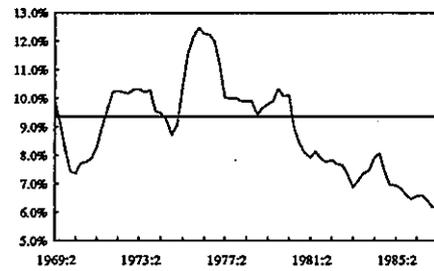


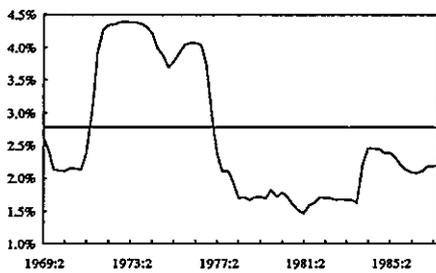
CHART 3: MOVING PERCENTAGE STANDARD DEVIATIONS FROM TREND



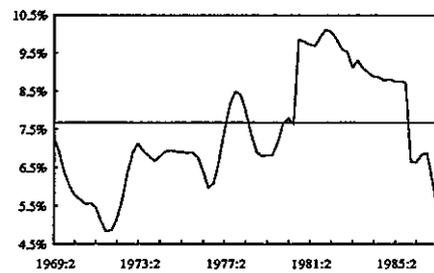
Real GDP



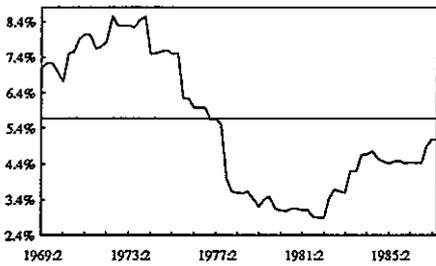
Real Private Fixed Investment



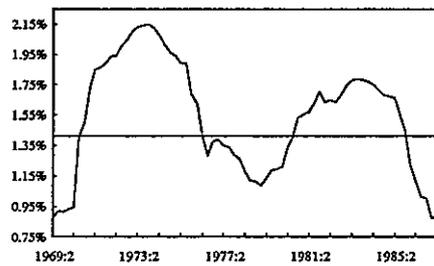
Real Private Consumption



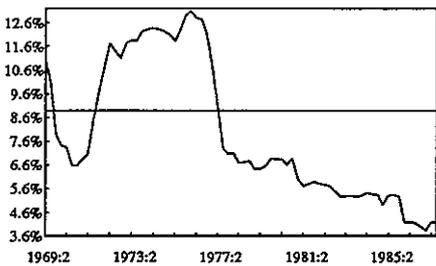
Real Government Purchases



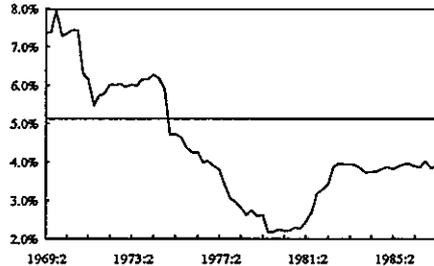
Real Exports



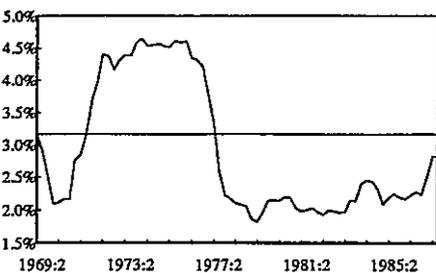
Real "World" GDP



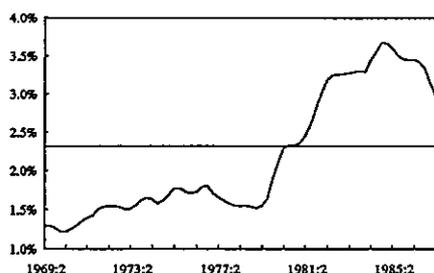
Real Imports



GDP Deflator

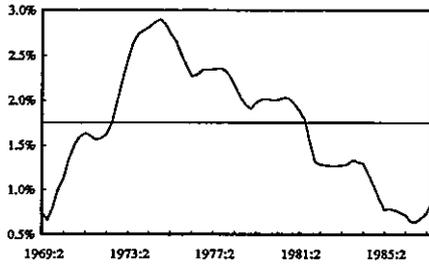


Real Net Exports Share

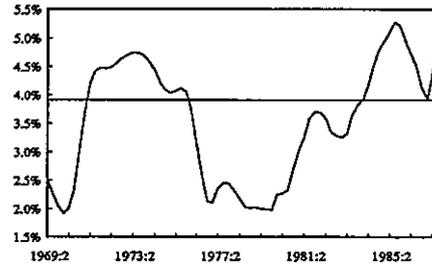


Consumer Price Index

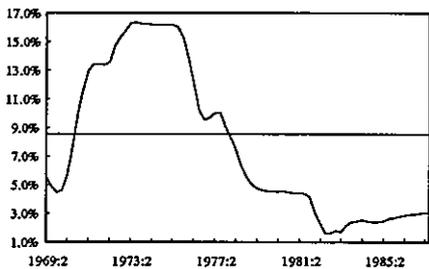
CHART 4: MOVING PERCENTAGE STANDARD DEVIATIONS FROM TREND



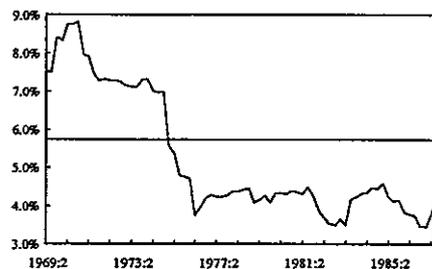
"World" Prices



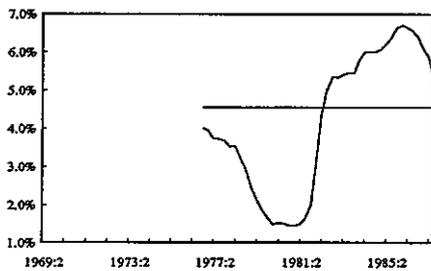
Nominal M3



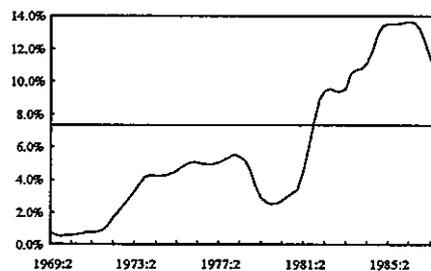
Terms of Trade



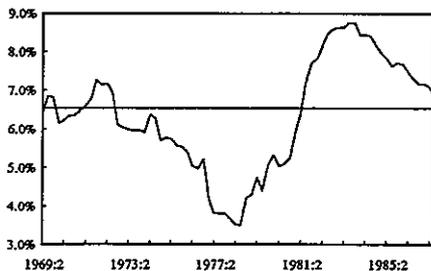
Nominal M3 Velocity



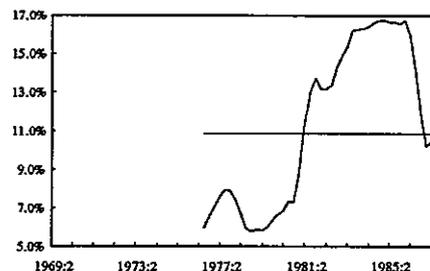
Nominal TWI



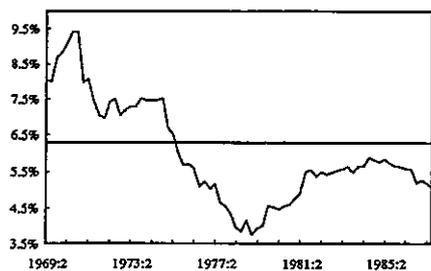
Nominal Trading Bank Lending Rate



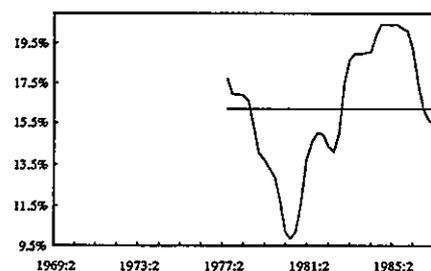
Private Sector Unit Labour Cost



Nominal Medium-Term Bond Rate

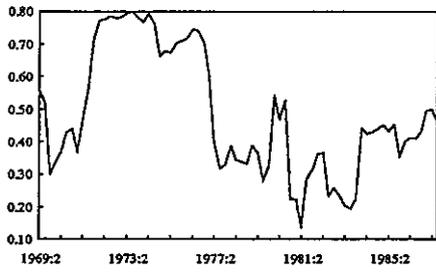


Private Real Unit Labour Cost

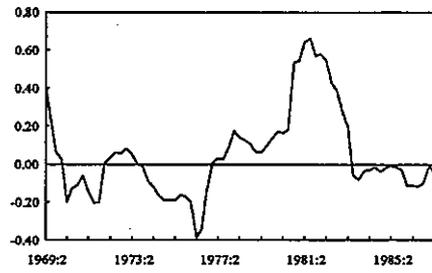


Nominal 90-Day Bill Rate

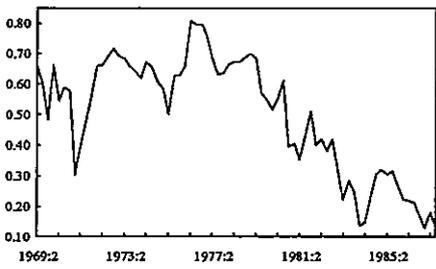
CHART 5: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP



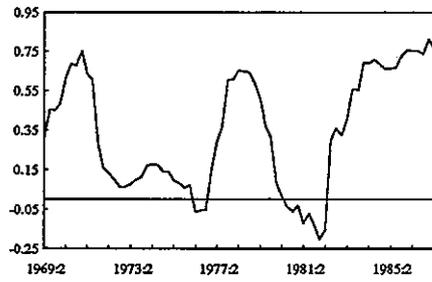
Real Private Consumption



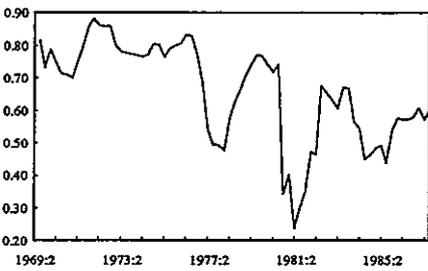
Real Government Purchases



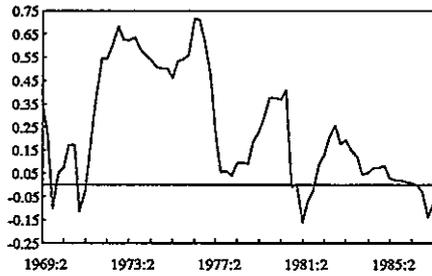
Real Private Fixed Investment



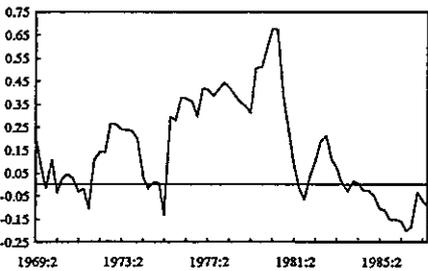
Real Exports



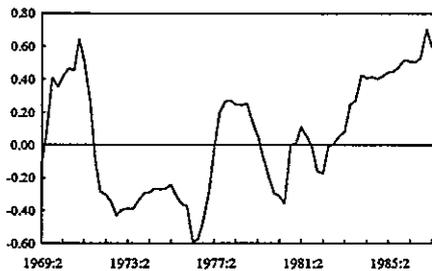
Real Business Inventories Share



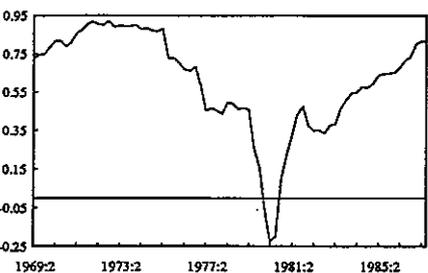
Real Imports



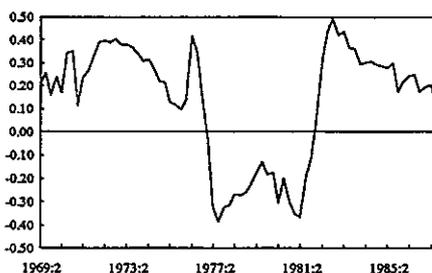
Labor Input (Hours)



Real Net Exports Share

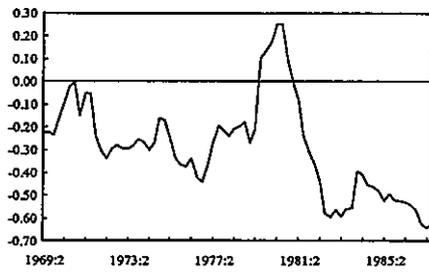


Average Labor Productivity (Hours)

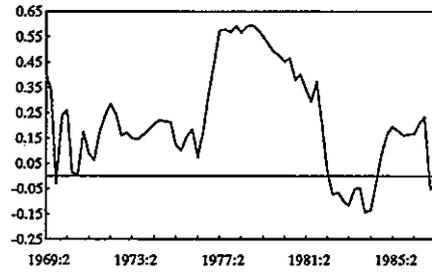


Real "World" GDP

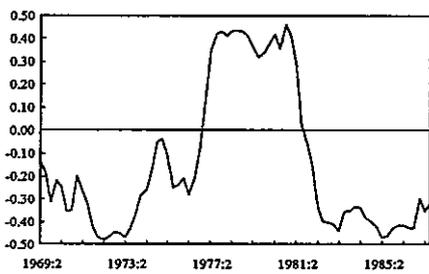
CHART 6: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP



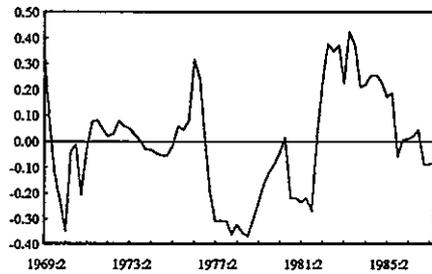
GDP Deflator



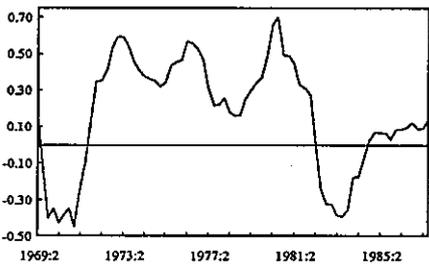
"World" Prices



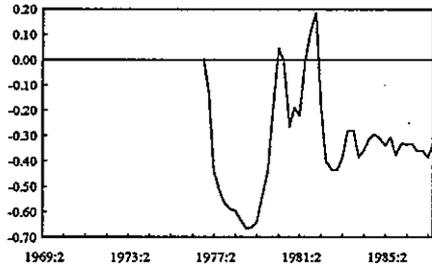
Consumer Price Index



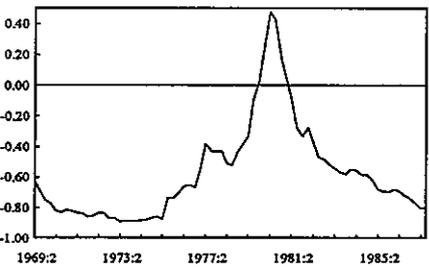
Terms of Trade



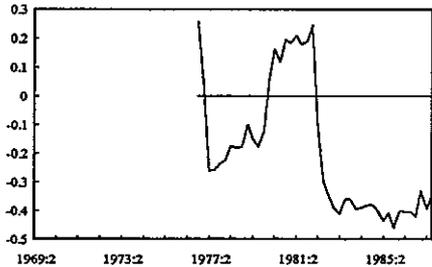
Average Hourly Private Sector Real Wage



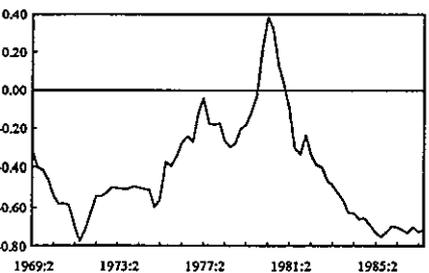
Nominal TWI



Private Sector Unit Labour Cost

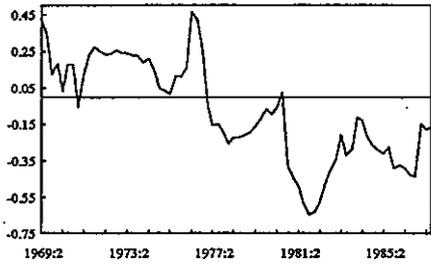


Real TWI

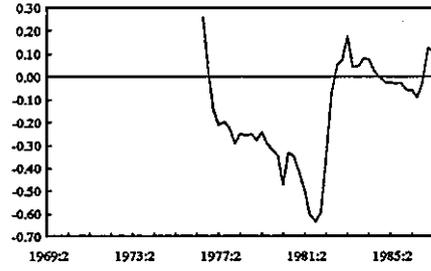


Private Real Unit Labour Cost

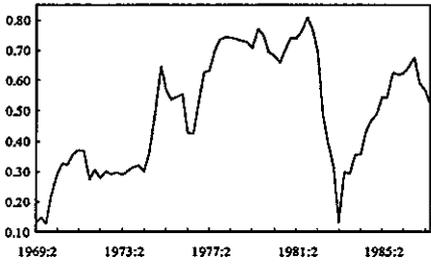
CHART 7: MOVING CONTEMPORANEOUS CROSS CORRELATIONS WITH REAL GDP



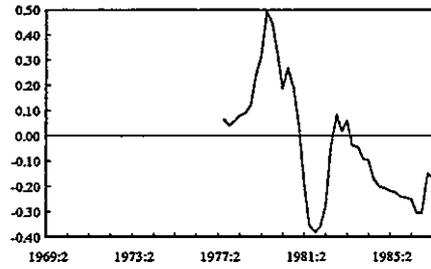
Nominal M3



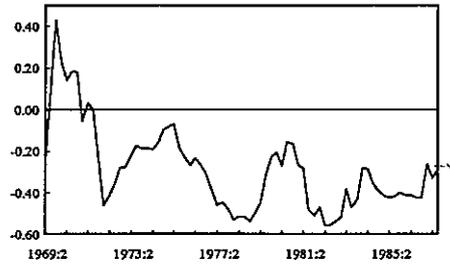
Nominal Medium-Term Bond Rate



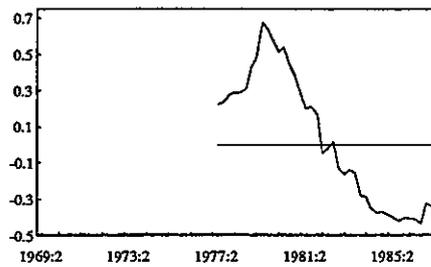
Nominal M3 Velocity



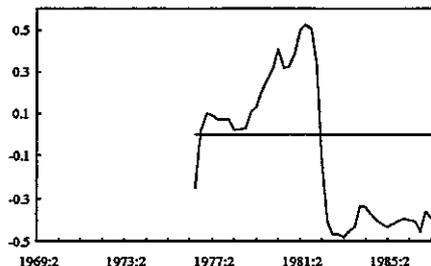
Nominal 90-Day Bill Rate



Nominal Trading Bank Lending Rate



Yield Gap: Bill - Bond Rate



Yield Gap: Tr. Bank Lend. - Bond Rate

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