ON MACROECONOMIC POLICY
AND MACROECONOMETRIC MODELS

Kenneth F. Wallis

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G.P.O. Box 4, Canberra 2601, Australia
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Kenneth F. Wallis
University of Warwick
and
Australian National University

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1. Introduction

All economic forecasters and policy analysts use economic models. That is, they have a framework for the interpretation and analysis of quantitative data that allows them to proceed from assumptions about economic policy and the external environment to a prediction of the likely state of the economy. Some people, interested in only a few aspects of the economy, do this in their heads, using various rules of thumb. But as the range of questions expands, this gets more difficult. In any case these informal and intuitive methods are hard to explain and transmit to other people, who are likely to get different answers, without knowing why. Increasingly, macroeconomic forecasting and policy analysis is based on a formal, explicit macroeconometric model that, quantified with reference to historical data, provides a consistent and comprehensive account of the relevant interactions and interdependencies within the economy. Such models represent 'a formal and quantified framework [that] is an irreplaceable adjunct to the processes of policy thought' (Higgins, 1988).

Models are simplifications, however, and economic modelling is an inexact science—more art than science, some would say. So in forecasting, judgement is needed, to take account of extraneous information about economic developments and to overcome perceived shortcomings of the model, which may become more evident when the economy moves outside the range of past experience, possibly as a consequence of institutional change. And the forecaster also exercises judgement in projecting the future values of variables that are treated as exogenous, that is, the inputs to the model. But the part played by judgement does not detract from the central role of the model, indeed a fully elaborated model ensures that all such inputs are accommodated in a precise and systematic way, to yield internally consistent estimates of the outcomes.

Different models are built for different purposes, and both of these evolve over time. New statistical evidence alters perceptions of existing relationships, and
social and political changes alter the focus of economic attention. Moreover models are built in accordance with an underlying view of the way the world works, and the available data cannot always provide a clear discrimination between competing views. Thus models are not only an essential part of the policy analyst's equipment but also a reflection of economic opinion and policy concerns. In this spirit the present paper analyses some recent changes in modelling and policy-making, and the interactions between them.

Attention is restricted to macroeconometric models, by which is meant aggregate, structural models based on time-series data. Thus input-output models and computable general equilibrium models such as ORANI, which provide great industry detail, are left on one side. Similarly attention is restricted to macroeconomic policy questions, leaving aside the microeconomic reform issues that feature prominently in some current policy proposals.

Recent developments of concern to both econometricians and policy analysts are discussed in two main areas, namely the 'supply-side' approach to wages and unemployment, and exchange rates and expectations; these form Sections 2 and 3 of the paper. In each case both economic and econometric aspects are considered, and some recent British and Australian research is compared and contrasted, this comparative perspective also drawing on the author's experience as Director, since 1983, of the ESRC Macroeconomic Modelling Bureau. This is a unique research project which brings together the different econometric models of a national economy, in this case the UK economy, in order to undertake comparative research and to help achieve greater openness and understanding of both independent and official models; Smith (1990) provides an independent appraisal of this programme. Some of the econometric work discussed below was undertaken within the framework of a complete macroeconometric model, while other work, particularly in the Australian context, was not, although it represents research on which a model-builder, seeking to improve the
specification of a particular sector of the model, might readily draw. Some issues surrounding the use of such models in the policy debate are then discussed in Section 4, and Section 5 contains concluding comments.

2. The supply side, wages and unemployment

2.1 Supply-side developments

The supply side was the catch-phrase of the 1980s. The previous macroeconomic paradigm over-emphasised effective demand, and had proved to be inadequate to deal with the supply-side shocks that had appeared to be more prevalent in the 1970s, such as the two oil-price rises and the world-wide productivity slowdown. This is not to say that supply theory had been neglected in the academic literature, rather that this work had had little impact on the macroeconomics used for policy. Greater emphasis on the supply side took a number of forms, including the improvement of incentives through a reappraisal of taxation, and the creation of more competitive conditions and the removal of distortions, predominantly in financial markets and the labour market. The resulting move to a more medium-term orientation of policy, with a reduced emphasis on the fine tuning of demand, was also encouraged by the increased amplitude of short-term forecast errors in the mid-1970s.

Macrooeconometric modellers also showed greater interest in the supply side, which again took a number of forms. Since the supply side of a model determines its long-run properties, one cannot be studied without the other. Increased attention to the long-run implications of dynamic econometric models is then required, with the objective of ensuring that a model has a long-run solution that is internally consistent and coherent, both empirically and theoretically. This implies that formal macroeconomic theory assumes a greater role, since this has relatively more to contribute on the nature of the steady state,
and rather less to say about the process of short-run adjustment. A leading example of a model constructed in this spirit is the AMPS model of the Australian economy (Murphy et al., 1986), where attention to its long-run properties began at the design stage.

Key elements in the supply-side approach concern the generation of inflation and the ways in which inflation feeds back on demand. Monetarist explanations of inflation have proved inadequate, and equations describing the behaviour of firms and the determination of wages have come to occupy centre stage. Particularly influential, at least in a British context, is the supply-side model of Layard and Nickell (1986), which treats the goods and labour markets as imperfectly competitive. Prices are set by imperfectly competitive firms, given the demand they face, and their demand for labour depends on both the real product wage and the level of real aggregate demand.

It is the behaviour of wage-setters, however, which is crucial to understanding unemployment in the medium term. Here 'the planned mark-up of wages over prices in wage settlements must be consistent with the mark-up of prices over wage costs in employers' pricing behaviour. For if wage-setters try to set real product wages higher than is consistent with employers' pricing behaviour, this generates ever increasing inflation. ... If events occur that push [wage-setters] towards too-high real wages, then unemployment has to rise to offset these influences. We shall call these influences "wage pressure variables" or "push factors", and they ... include the social security system, employment protection legislation, mismatch between unemployment and vacancies, union power, taxation, and real import prices' (Layard and Nickell, 1986, pp. S121-2). The most general form of wage equation of this kind is generated by a collective bargaining model, discussed fully in Layard and Nickell (1985), and this is the most commonly adopted approach to wage determination in current models of the UK economy. Firms and unions bargain over the wage, and the setting of
employment is part of the firm's 'right to manage'. Econometric implementation of the resulting wage equation is not straightforward, however, as Nickell (1988) notes. It is of interest to an Australian audience that he adds incomes policy to the list of wage-pressure effects that might be investigated in this framework, but he then observes (p.217) that 'appropriate data may not be available and the relationship between the available data and the "true" wage-pressure variables is likely to be weak. As a consequence, the wage equation lacks robustness because trends and dummies have to be used to cope with these problems.' We consider some empirical questions below, but first consider two further issues that may be addressed in this framework, namely the role of taxation and the determination of the natural rate of unemployment.

2.2 Wages and taxation

Whereas the real wage is the relevant variable in a labour demand function, wage negotiations typically focus on the nominal wage. This does not imply that employers and employees are insensitive to inflation, rather that different wage concepts are relevant to their objectives. For employers, what matters are their real wage costs, namely nominal wages plus employers' (payroll) taxes deflated by producer prices, whereas employees focus on the real consumption wage, namely nominal wages less direct taxes deflated by consumer prices. Thus taxes and the relative price of imports drive a wedge between the two wage concepts, and these variables are typically referred to as wedge variables, or collectively as the wedge. Formally, let \( w \) denote nominal earnings and \( p_c, p_p \) and \( p_m \) consumer, producer and import prices, all in logarithms, and \( t_d, t_i \) and \( t_e \) the average direct, indirect and employers' tax rates, expressed as proportions. Then employers' real wage costs (log) are \( w + t_e \cdot p_p \), the real consumption wage (log) is \( w - t_d \cdot p_c \) and the wedge is

\[
(w + t_e \cdot p_p) - (w - t_d \cdot p_c) = t_d + t_e + p_c \cdot p_p.
\]
Let $\theta$ be the weight of domestic goods in the (pre-tax) consumer price variable, so that

$$p_c = \theta p_p + (1-\theta)p_m + t_t$$

then the wedge is given as

$$\text{wedge} = t_d + t_i + t_e + t_m$$

where $t_m = (1-\theta) (p_m - p_p)$ is the 'tax' imposed by high import prices. Whatever incidence of taxation is determined in the bargaining process, each of the four variables should have the same effect on the final outcome, in principle. In practice, however, departures from this simple framework may arise, due to progressive rather than proportional income taxation and less-than-complete coverage of consumption taxes, and the incidence of a tax may differ in the short and long run. Nevertheless a clear implication is that all four terms should appear in the wage equation.

The form in which the wedge variables appear depends on the choice of dependent variable in the wage equation. To illustrate, we abstract from short-run dynamic adjustment and focus on the steady-state implications of the wage equation. The Australian wage equation formulated in this framework by Pissarides (1991) has employers' real wage costs (termed the real product wage) as dependent variable, and its steady-state form is

$$(w + t_e - p_p) = \alpha(t_d + t_i + t_e + t_m) + \text{other terms}.$$  

The parameter $\alpha$ is estimated as 0.63 thus, interpreting this as a measure of the incidence of taxation, firms bear 63 per cent of any taxes and workers the remaining 37 per cent. Pissarides found that he 'could not reject the proposition that all wedge variables have the same incidence. Thus, payroll taxes are shared between the firm and the worker very much as income and expenditure taxes are, even though the former are levied on firms and the latter on households'
(p.40). More commonly, the nominal wage and consumer price variables are used in wage equations, either to define a real wage dependent variable or by using $p_C$ as an explanatory variable in a nominal wage equation; in the latter case it is almost invariably found that static homogeneity holds, so that the equation is implicitly a real wage equation. Either way, the equivalent formulation to the above can then be written

$$w = p_C + \alpha t_d + (\alpha-1)t_I + (\alpha-1)t_e + (\alpha-1)t_M + \text{other terms}.$$  

The two formulations may have different implications for conventional specification search procedures, discussed below; they also indicate how, in the context of the basic bargaining model, the inclusion or exclusion of wedge variables has different incidence implications. Chapman et al. (1991) consider five Australian wage models in their analysis of the Prices and Incomes Accord, one of which is based on Pissarides' work. Of the remaining four, three contain no tax variables and so, interpreted in the present framework, imply that direct taxes bear fully on the real consumption wage whereas the remaining taxes are borne entirely by employers. The remaining wage equation, by Lewis (see Lewis and Kirby, 1987), includes direct taxes and import prices (relative to consumer prices) but no other wedge effects; the estimates over the longer sample period reported by Chapman et al., again interpreted in the basic bargaining model, imply that firms bear 22 per cent of direct taxes.

This framework is used by Fisher et al. (1990a) and Church et al. (1991) in their analysis of the overall properties of models of the UK economy. To understand the long-run effects of tax cuts on inflation and unemployment it is essential to identify their effects on wages, and it is seen that analysis of the wage equation provides a good guide to the results of simulation experiments on the complete models. The coefficients of the tax variables in the wage equation determine the extent to which tax changes operate, system wide, as demand shocks or supply
shocks, and the macroeconomic consequences of such changes are then comparable with those of other demand or supply shocks. In two of the five models considered by Church et al. (1991) the different taxes have the same effects, with the burden being shared by firms and workers approximately equally. Returning to an Australian context it is hard to see how, without a complete analysis of the tax wedge, the models can provide reliable guidance on the macroeconomic consequences of such policies as a wage-tax bargain or a switch from direct to indirect taxation.

This example raises questions about the methods of statistical inference that are conventionally used. In practice the average tax rates show relatively little variation over time, and in consequence their effects may be poorly determined in empirical estimation, that is, their point estimates may have relatively large standard errors. Classical statistical inference places great emphasis on the role of the null hypothesis, and the traditional null hypothesis used in model specification analysis is that an explanatory variable has no effect; thus the variable is only admitted to the model if there is overwhelming evidence against this null hypothesis. The alternative formulations of the wage equation presented above, however, indicate the polar extremes represented by the traditional null hypothesis. In one formulation the hypothesis is that the incidence of indirect taxation is entirely on workers, and in the other, entirely on firms. An uninformative sample may imply that neither hypothesis can be rejected when treated as the null. But neither view merits the weight that normally attaches to the null hypothesis, which if anything should be given to the view that all wedge variables have equal incidence. Then the emphasis is shifted away from testing extreme hypotheses about individual effects towards measurement of a common effect, to the benefit of the resulting economic analysis. This is not to say, however, that the uncertainty of the conclusions that derives from imprecise measurement should be overlooked. Nevertheless, as Nickell (1988) argues, 'it is essential to include the elements of the wedge in a
wage equation'; he presents examples which show that 'not doing so is tantamount to imposing some arbitrary degree of real wage resistance (or lack of it) on the model'.

2.3 The natural rate of unemployment

Almost twenty years ago Parkin (1973) posed the question 'does Australia have a long run trade-off between inflation and unemployment?' His answer was 'probably no', and this has been the broad consensus in the subsequent literature. That is, alternatively, there exists a 'natural' rate of unemployment, independent of the inflation rate, at which any steady-state rate of inflation is possible but below which inflation will persistently accelerate. Although the discussion has largely taken place in the context of the wage equation alone, in the present framework, where unemployment appears among the 'other terms' in the wage-bargaining model, which then delivers a long-run relationship between real wages and unemployment, the natural rate can only be pinned down when this relation is solved jointly with the remaining supply-side equations. In the simplest context, this means the price equation, which merely resurrects the advice in Sargent's classic Colston paper (1964), that 'in order to discuss the policy implications of the wage determination equation, it must be considered in relation to a price determination equation.'

Before proceeding, we note that discussion has sometimes focussed on the 'non-accelerating inflation rate of unemployment' (NAIRU), which may itself depend on the steady-state rate of inflation if the wage and price equations do not exhibit dynamic homogeneity or inflation neutrality. It is increasingly the case that this property does hold in the wage-price sectors of large-scale models, so that the NAIRU is indeed independent of the steady-state inflation rate and so is the natural rate of unemployment. This allows us to continue to restrict attention to the steady-state form of the relevant equations, written in terms of the levels of the relevant variables.
A typical assumption about pricing behaviour is that producer prices are determined as a mark-up on import and unit labour costs, \( w^* \), with the mark-up increasing with capacity utilization, thus

\[
P_p = \beta P_m + (1-\beta)w^* + \gamma u,
\]

where \( w^* = w + \tau_e - p_r \) and \( p_r \) is productivity. The two equations can then be solved for the natural rate of unemployment, which is a function of all the wage pressure variables or push factors, capacity utilization, and the real exchange rate, equal to \( p_p - P_m \). (Productivity is assumed to be among the 'other terms' in the wage equation, and so nets out.) For given values of these variables, the natural rate is that level of unemployment which leads wage bargainers to agree on a real wage which is consistent with that which firms are willing to accept in their pricing behaviour, in a steady state of constant inflation. Changes in these variables generate more or less inflationary pressure, requiring an adjustment in the natural rate to restore equilibrium. As far as capacity utilization is concerned, it is sometimes argued that this should be combined with unemployment into a single utilization index, alternatively that the natural rate should relate to a 'normal' level of the capacity utilization variable.

In the context of a large-scale model of an open economy, attention to the determination of the exchange rate is required. Once this is done, Joyce and Wren-Lewis (1991) show how this framework allows an analytic derivation of the NAIRU in the NIESR model of the UK economy, as a function of the long-run properties of the model's wage and price equations in conjunction with the response of the exchange rate. Turner (1991) uses the same framework as a benchmark against which to assess the Treasury model and interpret its long-run simulation properties. Joyce and Wren-Lewis find that changes in taxes have had an important influence on the NAIRU in the UK over the last twenty years, however 'their impact is significantly diminished by feedback from the real
exchange rate. A cut in taxes which reduces the NAIRU also raises imports, so a real depreciation is required to maintain current account equilibrium, which diminishes the fall in the NAIRU.

In the Australian empirical literature there is very little discussion of factors that affect the natural rate. The dominant approach to wage behaviour has been an expectations-augmented Phillips curve from which a constant natural rate of unemployment can be read off, without reference to any other equation. This formulation was used by Parkin (1973), and it remains in use in such large-scale models as the Murphy model (Murphy, 1988) and the Treasury's NIF88 model (Simes, 1988a), although in each case a modification should be noted. Murphy (1988) estimates his expectations-augmented Phillips curve with a dummy variable which allows the estimated NAIRU to assume a higher value in the later part of his sample period, while Simes acknowledges the role of the price equation, although this has no levels terms and it is the change in relative import prices that affects the NAIRU. The NAIRU depends on the natural rate, which is typically assumed to be a constant' (Simes, 1988a, p.4).

Commentators have occasionally questioned the adoption of the expectations-augmented Phillips curve approach and alternatives have started to appear. Hughes (1985), for example, in reviewing 'Brookings on the Australian economy' observes that 'perhaps this formulation of wage theory has been imported rather too readily into Australia'. Likewise Lewis and Kirby (1987) note that it has simply been applied 'rather than considering its suitability or alternative approaches'. The alternative they develop is a model of a competitive labour market with labour demand and supply functions and a real wage adjustment mechanism describing sluggish adjustment towards the market-clearing wage. The reduced form equation for wages that results has some similarity to the wage bargaining model, which might be a preferred interpretation, given the existence of monopolistic elements in labour markets.
(Pissarides, 1987). Watts and Mitchell (1990) employ a general wage equation that nests a number of different hypotheses, and conclude against the 'conventional Phillips curve relating inflation to unemployment.' Their preferred 'pressure variable' is capacity utilization, and since this enters their preferred model in differenced form it is concluded that 'there is not a steady state or natural rate of unemployment'. Much attention is paid to 'institutional arrangements', by which is meant the different incomes policies that have been applied. Dummy variables are employed that allow the intercept term to take nine different values during the 20-year sample period, and their explanatory power leads the authors to conclude that 'aggregate money wage outcomes are not determined by conventional market forces'. They claim that the econometric methods employed are 'superior to all the previous Australian studies.' This seems to rest on the use of a general-to-specific approach to specification searching and of tests for integration and cointegration, although when the preferred model (that does not derive from use of the latter procedures) is described as an ECM (error correction model) representation, it should be noted that it has no steady-state implications of the kind discussed above.

2.4 Exploring the Australian wage equation

An obvious next question is whether recent Australian experience offers any evidence for a wage equation reflecting features discussed above, and we present some initial explorations in the hope of encouraging further research along these lines. We use the historical database of the current version of the Murphy model, which is based on the quarterly national accounts and balance of payments statistics, but in particular constructs ideal price indexes consistent with the model's sectoral treatment and theoretical framework, as alternatives to the national accounts implicit deflators.

The after-tax real wage variables that are relevant to employers and employees are plotted in Figure 1. Of immediate interest are the different movements in
Figure 1. Real wage variables

Upper plot (right scale): employers' real wage costs (log) - nominal wages plus payroll tax deflated by ideal price index for domestic factors.

Lower plot (left scale): real consumption wage (log) - nominal wages less taxes on labour income deflated by constant-utility price index for private consumption.

Figure 2. The wedge (the difference between the two real wage variables)
these series during the 1980s, which can be seen by comparing the two trajectories in Figure 1, or by turning to Figure 2, which plots the wedge, namely the difference between the two variables that appear in Figure 1. Similar plots of the two real wage variables appeared in the Australian literature in the late 1970s (Stammer, 1978; Gregory and Duncan, 1979), but attention almost immediately turned to the relationship between employers' real wage costs and labour productivity - the 'real wage overhang'.

The wage equation in the Murphy model as of February 1992, estimated over 1976Q1-1991Q3, has the following form:

$$\Delta (w_t - p_{c,t-1}) = c_0 + c_1 \Delta_1 \Delta_2 p_{c,t-1} + c_2 \Delta_1 u_{t-1} + c_3 u_{t-4}^{-1} + c_4 I \Delta_2 u_{t-2}$$

where $\Delta_1 x_t = x_t - x_{t-1}$ and $p_c$ are logarithms, $u$ is an unemployment rate, and $I$ is an indicator variable taking the value 1 until 1983Q2 and zero thereafter. In the context of an expectations-augmented Phillips curve, the lagged and differenced price inflation terms represent expectational effects, and the indicator variable represents the move to a less market-determined, more centralized wage outcome with the introduction of the Prices and Incomes Accord. The appearance of the reciprocal of the unemployment rate echoes the original Phillips curve specification, and the natural rate of unemployment is given as $-c_1/c_0$; there is no term in the level of the real wage. Details are given in the Appendix.

Our alternative specification considers the real wage variables shown in Figure 1. Whichever variable is used, the homogeneity restriction is accepted, without any lagged price adjustment, and two lagged values of the dependent variable are required. Provided that the current value and two lagged values of the wedge variable are also entered in the equation, it is immaterial which real wage variable is chosen, and we report the results obtained with employers' real wage costs (rwc). The form of the equation is as follows, with details again being given in the Appendix:
where \( pr \) is productivity and \( wdg \) the wedge. The inflation acceleration term in the Murphy model drops out, but the unemployment terms are retained, indeed the coefficient \( b_3 \) exceeds twice its standard error, which is not the case for \( c_3 \). The equation implies a steady-state relation between real wages and unemployment, hence the natural rate of unemployment can only be obtained by solving jointly with a price equation, as in the models discussed above; it is dependent on the wedge variables.

With respect to the effects of incomes policies, we first note that the multiplicative dummy variable term in the Murphy model no longer makes a significant contribution. Next, on testing additive dummy variables of the form used by Watts and Mitchell (1990), we find that none of them, neither singly nor jointly, are significant when entered into the equation. Finally if the sample period is divided into two sub-samples, the first ending in 1983Q2 and the second beginning in 1983Q3, and the complete equation is allowed to vary over the two sub-samples, then the equation passes the resulting Chow test. These results support the view that incomes policies over this period have been a veil behind which economic forces, as represented in the equation, have continued to operate. This is not to say that institutional arrangements have no impact on wage determination over this period, rather that changes during the period have no differential impact, once allowance is made for other influences in the equation.

As for the wage determination process itself, neither the empirical results nor institutional knowledge support the basic bargaining model discussed above. The steady-state wedge coefficient does not lie between 0 and 1, which it would have to do to sustain a tax incidence interpretation, on the other hand this
interpretation is only relevant if firms and unions bargain only about the wage. Once bargaining also takes place over other variables, such as employment, there is no requirement that the agreed wage should lie within the interval represented by the zero-one incidence assumption. Australian negotiations have clearly gone beyond the wage, to include such matters as taxation and investment incentives during the life of the Prices and Incomes Accord, and unions encroach on the firm's 'right to manage' whenever large-scale redundancies are planned. Equally clearly negotiations have involved another party, namely government, as a representative of wider interests. Theoretical bargaining models are not yet sufficiently developed that they can provide good guidance to empirical research in this context, and in the meantime the material presented here provides a research agenda rather than a definitive answer.

3. Exchange rates and expectations

3.1 Introduction

'Perhaps the most radical changes in thinking took place in the external sector,' says Grenville (1990, p.3) in his introduction to the Reserve Bank conference on the Australian economy in the 1980s. He continues

The central focus of earlier policy had been the dichotomy between internal and external balance, with the former to be achieved by a judicious mixture of monetary and fiscal policy, and the latter to be achieved through changing the real exchange rate. This framework was outmoded by the floating of the exchange rate in December 1983. ... What had been seen as an exogenous policy instrument became an endogenous variable, reflecting the stance of other policy variables and market sentiment. ... The importance of interest- and exchange-rate-sensitive capital flows in the balance of payments now meant that the exchange rate and the current account were 'uncoupled', with exchange rate movements which were often perverse when viewed from the old perspective of current account imbalance.
Equally, econometric modellers now had to treat the exchange rate as an endogenous variable, and the search was on for a satisfactory explanation of its behaviour. This began, however, against a pessimistic background: Isard's (1988) conclusion from his international survey that 'empirical modelling of exchange rates over the past decade has been largely a failure' is a typically gloomy summary. More recently, however, as more data on floating exchange rate regimes in a world without constraints on the movement of capital have become available, some success has been achieved.

3.2 Uncovered interest parity

With respect to the treatment of the exchange rate in models of the UK economy, 'it is clear that convergence is occurring towards an uncovered interest parity condition with some adjustment for risk premia' (Ball and Holly, 1991). A contribution to this process is provided by Fisher et al. (1990b), who show that it is possible to develop an exchange rate equation which is both theoretically and statistically acceptable. Their equation is indeed of the uncovered interest parity (UIP) form, relating future expected exchange rate changes to interest rate differentials and a risk premium term.

There is concurrent interest, in parallel with the attention paid to the natural rate or NAIRU, in calculating the 'fundamental equilibrium exchange rate' (FEER) introduced by Williamson (1983). This is the exchange rate that is consistent with macroeconomic balance, both internal and external, in the medium run. Although the interpretation of what should be meant by external balance leaves considerable room for debate, the basic calculation is again a model-based exercise. Attention now focuses on the trade sector of the model, to determine the medium-term dependence of output and the balance of payments on demand and competitiveness. We leave this on one side, however, and in our present discussion concentrate on short term movements in the exchange rate.
Formally, denote the log of the exchange rate, defined as the foreign currency price of domestic currency, by $e_t$, its one-period-ahead expectation by $\hat{e}_{t+1}$, and (log) domestic and foreign interest rates by $r_t$ and $r^*_t$. (If $R_t$ denotes the interest rate in per cent per period, then $r_t = \log (1 + R_t/100)$, and $r_t = R_t / 100$.) Then the basic UIP condition derives from the assumption that domestic and foreign bonds are perfect risk-free substitutes. With perfect capital mobility domestic and foreign rates of return are equalised, thus

$$r_t - r^*_t = e_t - \hat{e}_{t+1},$$

and the interest differential equals the expected appreciation/depreciation of the currency. With appropriate definitions the relation can be expressed equivalently in real or nominal terms. For regression purposes it is usually written as

$$e_t = \hat{e}_{t+1} + \beta (r_t - r^*_t) + \text{other terms},$$

and then the questions concern (i) the treatment of expectations, (ii) whether $\beta = 1$, once interest rates have been appropriately scaled so that the holding period and the data interval coincide, and (iii) the choice of risk premium measures, should these prove necessary. The exchange risk premium can be derived from a portfolio balance model as a function of relative asset holdings and the cumulative balance of payments.

An inadequate treatment of expectations and a neglect of the simultaneity between exchange rates and interest rates are noted by Isard (1988) as contributory factors to previous empirical failures. In contrast to traditional ‘backward-looking’ approaches to the modelling of expectations, in which these are assumed to be extrapolations from past data, Fisher et al. (1990b) adopt an explicit ‘forward-looking’ approach, as first suggested by McCallum (1976). The future expectation is replaced by the actual future outcome and instrumental variable methods are used to overcome the resulting errors-in-variables problem. This
approach ties in with the model-consistent or rational expectations approach to future expectations variables that is adopted in forecasting and policy analysis exercises by several of the macroeconometric models of the UK economy. In estimation, the instrumental variable methods also accommodate the endogeneity of the interest rate term. When this is done, Fisher et al. find that the unit coefficients on both the forward expectation and the interest differential can be accepted.

Recent time series techniques, including tests for integration and cointegration, have been widely applied in exchange rate modelling, and it is important to be clear about the implications of the UIP relation in this context. A very common finding is that the exchange rate is an integrated or 'unit root' series, that is, a series that requires differencing to reduce it to stationarity. On the other hand some ambiguity surrounds the interest differential (see Gruen and Wilkinson, 1991, for a recent Australian example). Sometimes the data seem unable to reject the null hypothesis of integration, particularly when relatively short samples are employed. Typically the low power of the tests is noted, but considerable weight continues to be placed on the unit root null hypothesis. But in the absence of capital controls it is not credible that domestic and foreign interest rates will drift apart without bound, and this weight is misplaced. In some of the UK models examined by Fisher et al. (1990b) the use of short samples had led the model proprietor to a perverse unit root result, whereas over a longer period they find that the differential, real or nominal, is stationary. Regressions such as those described by Isard (1988) as 'the currently fashionable regression of a real exchange rate on a corresponding long-term real interest differential' are then completely inappropriate, as the two sides of the regression have vastly different temporal properties. It was the basic requirement that the time series characteristics of the two sides of a realistic regression equation must match up that led Granger (1981) to introduce the concept of cointegrated series: an integrated variable cannot be satisfactorily explained by a stationary variable, nor
vice versa. In the UIP context it is the (future expected) change in the exchange rate that is related to the interest differential, both stationary variables; likewise any risk premium proxy should also be stationary.

3.3 Australian models

There is no equivalent convergence in Australian empirical work. On the one hand, the Murphy and MSG2 (McKibbin, 1988) models impose a UIP condition, without any modification. The NIF88 model does not follow this route, however, as 'imposition of UIP has significant consequences for the properties of the macroeconomy' (Simes, 1988b, p.8). Instead, an interest differential effect is estimated in the exchange rate equation, with due attention paid to the joint determination of exchange rates and interest rates. The interest differential coefficient is significantly different from zero, but Simes does not comment on its magnitude: my interpretation of the information presented is that the hypothesis that $\beta = 1$ can be accepted, once allowance is made for the definition of interest rates that is used. There is also statistically significant risk premium proxy (the ratio of net foreign holdings of Australian assets to the value of exports). The treatment of expectations is backward-looking, however, (as is the case throughout the NIF88 model), with the future expected exchange rate depending on an 'equilibrium' exchange rate and the lagged actual rate. The equilibrium rate is modelled by various proxy variables, including commodity prices; in a rational expectations interpretation the risk premium proxies should also be included, implying a possible loss of identification, unless the equilibrium position is interpreted as one in which the risk premium is zero.

A prominent position in recent empirical research is occupied by the Economic Research Department of the Reserve Bank of Australia, with several discussion papers and survey articles to its credit. The general consensus seems rather negative, however, as reflected in the title of Gruen and Menzies (1991), 'The failure of uncovered interest parity...,' although all of this work is subject to the
same two shortcomings identified by Isard (1988), namely an inadequate
treatment of expectations and a neglect of the simultaneity between exchange
rates and interest rates.

Nor are these issues, nor the time series issues discussed above, paid any
attention when research by other authors is appraised. Thus Gruen and Menzies
(1991) state that 'the standard test of uncovered interest rate parity is to run the
regression' (in our notation)

\[(e_t \cdot e_{t+1}) = \alpha + \beta(r_t - r^*) + \text{error term}\]

and note that 'the overwhelming empirical finding is that \(\beta < 1\), and often that \(\beta < 0\), without making any comment on the invalidity of this 'test'. Regressions
of this kind by Goodhart (1988) are cited as 'a representative example', although
other exercises in Goodhart's paper are overlooked. In particular, he constructed
a dataset covering all fifty occasions of changes in UK base rates between March
1981 and April 1986, comprising the change over the day in the US/UK spot-
forward premium, in order to study exchange rate reactions to unanticipated
interest rate changes. Various tests demonstrate 'the absence of any systematic
relationship between changes in exchange rate levels and interest rate changes,
but a clear relationship between changes in spot-forward premia and in interest
rates (and in interest differentials)'. In the test which most closely corresponds to
the above model (Goodhart, 1988, Table 2, equation 3B), the intercept term is
insignificant and the coefficient estimate of 0.11 is close to the theoretical value
under UIP which, given the use of annualized one-month rates, is 0.083 (a sign
change is also needed to match the above equation).

Macfarlane and Tease (1989) run 'the standard test' and find that UIP is
'resoundingly rejected in most cases. ... The nominal interest differential is
found to have no explanatory power in predicting future movements in the
nominal exchange rate... These results are consistent with earlier Australian
evidence examining the behaviour of the USS/AUD exchange rate reported in Tease (1988) and Smith and Gruen (1989). It should be noted, however, that Tease (1988) presents no test involving interest rates or interest rate differentials. Macfarlane and Tease (1989) also consider regressions of $\Delta e_t$ on $(r_t - r_t^*)$, augmented by four lags of the dependent and explanatory variables, presumably to proxy the future expectation. Their results (Appendix, Table 5) show that, for four bilateral rates, the interest differential terms enter significantly in three cases with weekly data, though not with monthly data. Further calculations from the detailed regression results kindly supplied to me by the authors indicate that the long-run coefficients in these cases are of the correct sign but of smaller magnitude than required by UIP. In their conclusion, however, the negative results are allowed to carry the day, although it is noted that one explanation might lie in the two-way relationship between interest rates and the exchange rate, particularly over 1985-87, and that 'everyday observation demonstrates that capital is mobile and that it responds to higher interest rates'.

That the 'failure' of UIP might not be represented as a rejection of $\beta = 1$ in a proper test but as the need to modify the basic relationship as in the UK case or to adapt the treatment of expectations is one interpretation of the results of Smith and Gruen (1989). Following an analysis of market survey data on exchange rate expectations, they suggest that investors require an excess return for holding Australian dollar assets that is greater than the conventional risk premium, defined as the difference between the future expected spot rate and the forward rate, because they expect at some point a major depreciation as part of the adjustment towards a sustainable debt position. In a further explanation, Gruen (1991) argues that relatively high real interest rates are a consequence of relatively high inflation and a tax system that is not inflation-neutral. Foreign lenders find Australian nominal assets attractive, and their demand appreciates the real exchange rate. But this demand is not so great as to drive the domestic pre-tax real interest rate down to the world level because they remain wary of the
possibility that the persistent real exchange rate over-valuation will unwind.

It will be interesting to see whether these hypothesos can be incorporated into a satisfactory empirical model. The objective is to explain the variable shown in Figure 3, which is the residual in the Murphy model's UIP condition. Thus it comprises any systematic or random departures from the basic UIP condition, together with the 'rational expectations error' that is introduced when \( \delta_{t+1} \) is replaced by \( e_{t+1} \). The most striking feature is the increase in volatility following the floating of the Australian dollar.

![Figure 3. The UIP residual](image)

4. Policy analysis with macroeconometric models

4.1 'What-if' exercises

The standard form of model-based policy analysis is a what-if exercise. This addresses the question, what would be the macroeconomic consequences if policy settings were altered. The answer is obtained by comparing the results of two solutions or simulations of the model, one a baseline simulation, which could refer either to a historical period or to a future, forecast period, and the second a perturbed simulation, in which the model is re-run over the same period, but
with the policy variables being given their new values. The difference between
the two solutions for the output or endogenous variables of interest—inflation,
employment, growth, and so forth—provides an assessment of the policy's
effects.

A historical period is sometimes chosen for such exercises because the main
focus of attention is precisely a historical question—what were the
macroeconomic consequences of Mrs Thatcher, for example. Then the baseline
simulation uses the actual policy settings, and the perturbed simulation requires
a counterfactual policy to answer the supplementary question, compared with
what. The evaluation of policy options facing a government is typically carried
out over a forecast period. As long a horizon as is relevant to the policy question
can then be specified, whereas a suitably long historical period may not be
available, due to data limitations, for example; difficulties caused by particular
historical incidents are also avoided. Then the baseline scenario is typically a
forecast with a 'no-change' or 'neutral' policy stance, and the 'new policy'
scenario is the alternative forecast that is obtained with the alternative policy.
Note that presentation of the 'new policy' scenario by itself, without reference to
a baseline, is unlikely to be informative, since the impact of the new policies
cannot be separated from the other economic forces that are present in the
forecast: what is being compared with what is not made clear.

4.2 Policy innovations

Standard what-if exercises are limited to studying the effects of variations in the
settings of policy instruments that are included in the specification of the model,
and the evaluation of new policy proposals sometimes goes beyond this. The
proposed policies may be new with respect to a given model, in that the policy
instruments to be used do not appear in the model's specification, for one reason
or another. More fundamentally, the proposals may be genuine innovations,
such as the introduction of new policy instruments or new institutional
arrangements. Examples of the latter kind, implemented or under discussion in several economies, include microeconomic policies directed towards individual incentives, and structural reforms of economic institutions, including labour market reforms, financial liberalization, and privatization. Macroeconometric models continue to play a part in the discussion of such issues, by providing a fully elaborated, internally consistent, quantitative assessment of the macroeconomic consequences, but to do this they need to be augmented in ways which lie outside the normal model development process.

A simple example is that of the introduction of a new tax. If this serves to increase a price variable that is already part of the model’s specification, then it is a straightforward matter to incorporate the tax in the ‘new policy’ simulation. However, if the relevant price variable does not appear in the model, because it is but one component of an aggregate, for example, or because it has been constant for a considerable period, then evidence from statistical or accounting sources, or from microeconometric or survey research, must be drawn on to calculate the relevant adjustment to the model. More general examples which nevertheless permit a formal, quantified intervention to the model arise when microeconomic policies can be evaluated using highly disaggregated models such as ORANI. Their results on the aggregate efficiency gains of microeconomic reform can be fed into the macroeconomic model, with the two models being run in tandem, in effect. Less formal approaches are required when a new policy cannot be appraised in a systematic, quantified framework. In the extreme case converting the policy proposals into model inputs or interventions simply comes down to a matter of expert judgement, with the macroeconometric model providing a consistency check.
4.3 'If-only' exercises

If it is difficult to translate the new policy into model inputs or interventions, or if, for this or other reasons, the impact of the policy on certain endogenous variables is simply assumed, then the model can be used to appraise scenarios in which the 'new policy' settings relate to outputs, not inputs. It might be asked, for example, what would be the consequences if the exchange rate or real wages were lower, and a simulation could be performed in which these variables were held at a new, lower level to answer this question. Such exercises have an important part to play in research into the models themselves, for a comparison of the results from simulations in which a particular transmission mechanism is alternatively closed off or left in place provides a quantitative assessment of its importance. But they make no contribution to the discussion of policy, unless a mechanism whereby a direct reduction in an endogenous variable can be achieved is put forward. Such exercises typically assume that a policy is in place that will deliver the desired outcome, without specifying the policy in a form which can be implemented on the model. A number of different possibilities may exist—fiscal policy, monetary policy, market intervention, administrative fiat, structural reform—each likely to produce different responses elsewhere in the system. Estimates of the macroeconomic consequences will then be biased unless the implicit policy instrument has no influence on model variables other than through the variable being targeted, but this is unlikely. A simulation in which the exchange rate is held at some predetermined value gives different results from one in which interest rates, say, are manipulated to ensure that the exchange rate target is achieved, because the former neglects the impact of the required changes in interest rates on other variables in the model, such as investment.

Some years ago the UK Treasury model was used to assess the effect of wage restraint by comparing a baseline simulation with one in which real wages were held at a lower level, the wage equation being suppressed—real wages were
'exogenized', some would say. No circumstances that would produce this result were set out, hence Andrews et al. (1985) termed this 'if-only' as distinct from 'what-if' analysis—but wishful thinking is scarcely analysis. In its recent 'One Nation' scenario, the Australian Government has used a model in which prices and wages are treated as inputs, not outputs, to show the economic consequences that would follow if only price inflation were 3.5% p.a. and wage inflation 4% p.a. No policy that would produce this outcome is made explicit, hence neither its credibility nor its impact on other areas of the economy can be assessed.

4.4 Rational expectations

Expectations of future values of endogenous variables, such as inflation or exchange rates, are often an important determinant of current behaviour: the UIP relation discussed above is a simple example. A traditional way of handling such unobserved expectations is to assume that they are functions of the current and lagged values of a few observed variables and so substitute them out, giving a conventional backward-looking dynamic model. Such a model is unlikely to remain invariant across policy regimes, and hence likely to provide misleading estimates of the macroeconomic consequences of a change in policy regime, as noted by Lucas (1976). One response, at the level of standard what-if policy analysis, is to observe that such exercises are examples of 'normal policymaking', not 'permanent shifts in policy regime', in Sims' (1982) terms, and as such they can be sensibly analyzed in existing models without respecification.

Increasingly common is an explicit treatment of expectations variables that incorporates the hypothesis of rational expectations, namely that expectations coincide with the conditional expectations of the variables based on the model itself and on information up to the current period. Treating expectations variables explicitly, rather than substituting them out in distributed lag form, provides a practical response to the Lucas critique, as noted by Wallis (1980). Then, in solving the model for the endogenous variable values over a forecast
period, an internally consistent forward-looking solution is calculated, in which each period's future expectations variables coincide with the model's forecasts for the future period. Thus if economic agents react to forecasts and thereby alter the course of events, this reaction is taken into account to yield a self-fulfilling forecast. This approach is more appropriately and perhaps less controversially termed 'model-consistent' expectations. Although it was initially advocated by proponents of 'New Classical' equilibrium business-cycle models, there is no necessary connection between this theory of expectations and the type of model in which it is embodied, and since the mid-1980s it has been adopted by leading 'mainstream' models of the UK economy.

In policy analysis the adoption of rational expectations breaks the analogy between engineering and economic systems on which the application of control theory has traditionally rested. Economic systems are intelligent in a way that engineering systems are not, and they anticipate policy-makers' actions and react accordingly. The use of consistent expectations then allows policies to be tested under conditions in which their effects are understood. As Currie (1985) argues, good performance in these circumstances is a necessary condition for the acceptance of a policy proposal—'a policy that performs badly when its effects are understood must be unsatisfactory'.

4.5 Uncertainty

The user of model-based policy analysis needs to know how much confidence can be placed in the results. If the specification of the model is treated as a known fact, then econometrics textbooks provide the answer. They show how the effects of future random shocks, coefficient estimation errors and uncertainty in exogenous variable projections can be calculated and combined into an estimate of the uncertainty that surrounds a forecast. Although this may not be trivial, and the margin of error around a forecast increases with the forecast horizon, the margin of error that surrounds an estimated policy response,
calculated as the deviation between two model solutions or forecasts, is a good deal narrower. In practice, however, the specification of a model is itself uncertain, and cannot be treated as a known fact. In many areas of economics competing explanations of the same empirical phenomena coexist, and the data may not be able to provide a clear discrimination. Then, as noted above, the model-builder proceeds in accordance with an underlying view of the way the world works, but no measure of the uncertainty that surrounds the choice of this view is available. Data-based specification searches are also used to settle the detailed structure of the model, as in our preliminary exploration above, but formal study of the properties of such procedures is in its infancy.

Given these difficulties in assessing uncertainty ex ante, an alternative is to assess uncertainty ex post, by studying the track record of model-based forecasts. Some measure of past forecast performance can then be used as an indicator of likely future performance, although this is equally a forecasting problem, subject to the same caveats. For example, the British Government's budget forecasts of key macroeconomic indicators are accompanied by statements of the mean absolute error of the past ten years' forecasts. In the 1980 budget these were supplemented by a warning that the forecasts may have a greater margin of uncertainty due to the new Conservative government's adoption of a different approach to policy. This can be seen as an acknowledgement of the relevance of the Lucas critique, although at the simplest level it is little more than a reassertion of the fact that statistical models are less reliable the further they are driven outside sample experience.

Model-based forecasts are a joint product of model and forecaster, however, and in using a forecast track record to assess the quality of a model it is necessary to disentangle their respective contributions. The information on which a systematic comparative analysis of these contributions to errors in forecasts of the UK economy can be based has only recently become available (Wallis and
Whitley, 1991), and in most other countries there is no equivalent information. The common view that the credibility of a model should be established through forecast tests before it is used in policy analysis is then only a necessary condition: although a skilled forecaster may compensate for a poor model through judgemental adjustments and so produce an acceptable track record, if the forecast track record with judgement playing its part is poor, then the model is unlikely to be reliable in policy analysis.

5. Conclusion

This paper considers the use of macroeconometric models in macroeconomic policy analysis, and describes some areas of research which have contributed to the recent, and ongoing, process of model development. That models are constantly changing is sometimes presented as an objection to their use, but it can alternatively be seen as an argument in their favour. The external forces that impinge on an open economy and condition its response do not remain constant, and new forces lead to new responses, which requires the model-builder to elaborate those parts of the system that are relevant to the problem at hand. Of course recognition lags may be important, as with the impact of financial liberalization on private-sector behaviour, but this does not deny the need to incorporate new responses into our understanding of the system and its formal representation in a model.

An important requirement in modelling work, both model-building and model-using, is that it should be fully documented and completely open. This is seldom considered to be a controversial objective in principle, and many academic journals are working to improve reporting standards. Macroeconometric models might be thought to present particular difficulties in practice, however, by virtue of their size and their continuous evolution. Nevertheless reporting and communication standards are improving, as evidenced by the role of the
journal *Economic Modelling*, by model comparison work in several countries, and by the increased dissemination of models in a form suitable for implementation on microcomputers. There might be thought to be particular difficulties of a more political kind in publishing 'official' models of central banks and treasuries, but such difficulties have not been realised in the case of the models of the UK Treasury and the Bank of England. On the contrary, it can be argued that their presence in the public domain makes them less likely to be used as political footballs, and the case for glasnost should be pressed on the Australian Treasurer.

The need for openness and transparency equally arises in practical policy analysis, where additional assumptions and adjustments are often necessary, as discussed above. Now it is important that not only the model but also the off-model calculations should be exposed to view, so that results can be replicated and the relative importance of the different elements of the calculation can be assessed. When economists disagree, it is usually because they are making different assumptions or placing different relative emphases on parts of the system. If the assumptions are not made explicit, and full information is not made public, sensible discussion cannot proceed and the economics profession will retain its unfortunate public reputation for disagreement.
Appendix

1. The wage equation in the Murphy model (version of 24 February 1992)

\[ \Delta_1 (w_t - p_{C,t-1}) = c_0 + c_1 \Delta_1 p_{C,t-1} + c_2 \Delta_1 u_{t-1} + c_3 u_{t-4} + c_4 I \Delta_2 u_{t-2}/2 \]

Variable definitions: \( w = \log(W), \) \( p_c = \) LPCON, \( u = 1-\text{NT/NTS}, I=1 \) until 1983Q(2), 0 thereafter.


<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Estimate</th>
<th>Std error</th>
</tr>
</thead>
<tbody>
<tr>
<td>( c_0 )</td>
<td>-0.0114</td>
<td>0.0077</td>
</tr>
<tr>
<td>( c_1 )</td>
<td>-0.579</td>
<td>0.207</td>
</tr>
<tr>
<td>( c_2 )</td>
<td>-0.929</td>
<td>0.396</td>
</tr>
<tr>
<td>( c_3 )</td>
<td>0.000797</td>
<td>0.000502</td>
</tr>
<tr>
<td>( c_4 )</td>
<td>-2.082</td>
<td>0.864</td>
</tr>
</tbody>
</table>

Diagnostics

SE = 0.0117

- Autocorrelation: \( \chi^2(5) = 5.81 \)
- Heteroscedasticity: \( \text{asy.t} = 1.27 \)
- Non-normality: \( \chi^2(2) = 0.97 \)
- Functional form (RESET): \( \text{asy.t} = 3.52 \)

2. An equation for employers’ real wage costs

\[ \text{rwc}_t = b_0 + b_1 \text{pr} + b_2 \Delta_1 u_{t-1} + b_3 u_{t-4}^{-1} + b_4 \text{wdg}_t + b_5 \text{wdg}_t-1 + b_6 \text{wdg}_t-2 + b_7 \text{rwc}_{t-1} + b_8 \text{rwc}_{t-2} \]

Variable definitions: \( \text{rwc} = \log(W) + \log(1+\text{POL6}) - \log(\text{PYLR}), \) \( \text{pr} = \log(\text{A1A})_{t-1}, \) \( u = \text{URT (per cent)} , \) \( \text{wdg} = \log(1+\text{POL6}) - \log(1-\text{POL1}) + \) LPCON - \log(\text{PYLR})

Estimation period: 1976Q1 - 1991Q3
<table>
<thead>
<tr>
<th>Coefficient</th>
<th>Estimate</th>
<th>Std error</th>
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<tbody>
<tr>
<td>$b_0$</td>
<td>-3.366</td>
<td>1.787</td>
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<td>$b_1$</td>
<td>1.370</td>
<td>0.384</td>
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<td>$b_2$</td>
<td>-0.0141</td>
<td>0.0053</td>
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<td>$b_3$</td>
<td>0.195</td>
<td>0.092</td>
</tr>
<tr>
<td>$b_4$</td>
<td>0.641</td>
<td>0.155</td>
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<td>$b_5$</td>
<td>-0.462</td>
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<tr>
<td>$b_6$</td>
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<td>$b_7$</td>
<td>0.614</td>
<td>0.127</td>
</tr>
<tr>
<td>$b_8$</td>
<td>0.308</td>
<td>0.132</td>
</tr>
</tbody>
</table>

Diagnostics

\[ \text{SE} = 0.0123 \]

- Autocorrelation: $\chi^2 (5) = 5.51$
- Heteroscedasticity: $\chi^2 (8) = 7.01$
- Non-normality: $\chi^2 (2) = 0.67$
- Functional form (RESET): $\text{asy.t} = 0.77$
- Chow test (at 1983Q2/Q3): $F(9,45) = 1.066$

3. The UIP residual

\[ \text{residual} = \text{ER}_t - \text{ER}_{t+1} - 100 \log \left( \frac{(1+\text{RCS}/400)}{(1+\text{RCSF}/400)} \right) \]

4. Murphy model variable listing

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1A</td>
<td>labour efficiency in business sector</td>
<td>Scale parameter 1984-85=&quot;1&quot;</td>
</tr>
<tr>
<td>E</td>
<td>exchange rate index</td>
<td></td>
</tr>
<tr>
<td>ER</td>
<td>logarithm of E times 100</td>
<td></td>
</tr>
<tr>
<td>LPCON</td>
<td>logarithm of constant-utility price index for private consumption</td>
<td>1984-85=&quot;0&quot;</td>
</tr>
<tr>
<td>NT</td>
<td>total employment</td>
<td>persons '000</td>
</tr>
<tr>
<td>NTS</td>
<td>labour supply</td>
<td>persons '000</td>
</tr>
<tr>
<td>POL 1</td>
<td>rate of tax on labour income</td>
<td>proportion</td>
</tr>
<tr>
<td>POL 6</td>
<td>rate of payroll tax</td>
<td>proportion</td>
</tr>
<tr>
<td>PYLR</td>
<td>ideal price index for domestic factors</td>
<td>1984-85=&quot;1&quot;</td>
</tr>
<tr>
<td>RCS</td>
<td>90 day bank commercial bill rate</td>
<td>% p.a.</td>
</tr>
<tr>
<td>RCSF</td>
<td>three month foreign interest rate</td>
<td>% p.a.</td>
</tr>
<tr>
<td>URT</td>
<td>unemployment rate</td>
<td>per cent</td>
</tr>
<tr>
<td>W</td>
<td>wage rate</td>
<td>$000 p.q.</td>
</tr>
</tbody>
</table>
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