MACROECONOMETRIC MODELLING FOR POLICY EVALUATION AND DESIGN

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ABSTRACT

The paper reviews recent developments in macroeconomic theory and their implications for econometric modelling and for policy design. The following issues are addressed. 1) The theoretical and practical problems of modelling sequence economies. 2) Problems of evaluating the role of money given the absence of reasonable microfoundations for monetary theory. 3) The implications of the view that macroeconomic models should be viewed as non-cooperative differential games. 4) Identification and estimation of the policy-invariant structure of rational expectations models. 5) Time inconsistency of optimal plans and 6) The welfare economics of stabilization policy and the need to pay much greater attention to market structure if a market failure-based justification for stabilization policy is to be developed.

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1. Introduction

The seventies have been a difficult time for macroeconometric model builders as conventional practice was shaken by three severe jolts. One of these was the embarrassment of the failure to predict the stagflation and stagnation of the past decade: the concurrence in most industrialized countries of high and rising inflation rates with high and rising measured unemployment rates, the apparent slowdown in the underlying rate of growth of productivity and the painful adjustment to the OPEC oil price rise. More generally, the response of both nominal and real variables to monetary and fiscal policy instrument changes and to changes in exogenous variables no longer appeared to follow the patterns that prevailed in the sixties.

The blow from outside the economics profession was complemented by steadily mounting internal pressure for more adequate microfoundations of *ad hoc* aggregate relationships. The desire to root macroeconomics in optimizing behaviour was of course not something new. Bits and pieces of the major macroeconometric models here and in the U.S.A. had gradually been respecified to be consistent with modern consumer theory (e.g. the lifecycle model of Ando and Modigliani [1963] and the permanent income model of Friedman [1957]), investment theory (e.g. Jorgenson [1967]), the term structure of interest rates (Shiller [1980]) and financial markets theory (e.g. Tobin [1965). With the publication of the Microeconomic Foundations of Employment and Inflation Theory (Phelps *et al.* [1970]), the pace accelerated and *ad hoc* macroeconometric models were increasingly on the defensive. One danger on this quest for the Holy Grail of microfoundations is that the mere fact of having been derived from optimizing behaviour sometimes appears to be sufficient to give a modicum of respectability to a model. Optimizing an arbitrary objective function subject to a set of implausible contraints does not yield good economics. E.g., money as an argument in the direct utility function and households capable of borrowing on the same terms as the government -- two specifications found frequently in the literature (including my own work) -- will yield fully optimizing but nevertheless quite inadequate models.

The rational expectations revolution can be viewed as part of this general movement to base macroeconometric models on optimizing behaviour. Because of its importance, however, separate mention is in order. Muth's [1961] postulate that anticipations of future values of variables should be formed in a way that is consistent with the stochastic processes gnerating these variables, given the information available to the forecasting agent, is revolutionizing the specification and estimation of macroeconometric models. It has also altered and deepened our understanding of the roles of both stabilization and structural or allocative policies. The contribution of the "Lucas critique" ([Lucas [1976]) to sanitizing a large number of spurious econometric relationships and to the explanation of certain kinds of parameter instability has been of major importance. Interesting applications include the inflation-unemployment trade-off (Lucas [1973]) consumption behaviour (Dolde [1976]), the demand for money ("Goodhart's Law"), the term structure of interest rates (Shiller [1980]) and exchange rate behaviour (Minford [1978]).

An unfortunate and largely accidental by-product of the rational expectations revolution has been a resurgence of the view that there is no role for active stabilization policy. Rationally anticipated stabilization policies, such as monetary policy based on deterministic feedback rules, were argued not to affect the joint density functions of real variables. To minimize destabilizing uncertainty about the conduct of policy, monetary, fiscal and financial policies should therefore be governed by fixed, open-loop rules, i.e. rules that do not permit instrument responses to new information about the state of the world. I have demonstrated elsewhere that rational expectations are neither necessary nor sufficient for such a conclusion: the standard argument that contingent or conditional rules dominate unconditional rules survives and is in some ways reinforced by [1/] the introduction of rational expectations.

2. New developments in time-series modelling

In this paper I propose to discuss both a number of properties that the macroeconometric models of the future ought to have and some of the problems that stand in the way of constructing and estimating the right kinds of models. I shall take it as read that economic policy evaluation and design require quantitative, that is econometric models and that these models should have structures that are invariant, or at least reasonably stable, under the changes in policy behaviour contemplated by the modeller. As the technical aspects of specification, estimation, inference and prediction are not my area of comparative advantage, I shall say little about them. It is apparent even to an outsider, however, that recent advances in time series analysis are in the process of altering fundamentally our approach to macroeconometric modelling. I am thinking especially of the work of Granger [1969] and Sims [1972] on causality in econometric models, of the multivariate simultaneous-equations versions of the Granger and Sims exogeneity or causality tests (Geweke [1978], Cuddington [1980]), of Sims's multivariate innovation accounting (Sims [1980 a, b]) and of the work of Hendry *et al.* on the specification, estimation and testing of time series models (e.g. Hendry [1980], Hendry and Anderson [1977]). Many of these new developments are discussed in Sims [1980a], Sargent [1979] and Hansen and Sargent [1980].

If, as I believe, the purpose of econometric modelling is to uncover structural relationships, i.e. relationships that are invariant under certain classes of changes in the stochastic process governing the evolution of exogenous variables and policy instruments, then Granger-causality tests, block exogeneity tests and innovation accounting are to be used for preliminary date description and for diagnostic tests of model specification. Any policy-oriented model must of course be data-coherent. Historical data description, such as the fitting of unconstrained or minimally constrained vector-autogressive models, is only the first necessary step towards the real objective of econometric analysis. That goal can only be the specification, estimation and identification of policy-invariant, structural models. This statement is in no way meant to belittle the contribution to our understanding of economic processes represented by the new time series methods. Nor does it imply any great optimism about the degree of difficulty (or even the feasibility) of the task.

3. The shape of things to come and some of the obstacles in their path

Equations (1) - (3) contain a formal representation of the general structure of the kind of econometric model that I believe to be required for the analysis of macroeconomic polic issues and, indeed, of economic policy issues in general.

$$(1)\quad y_t = A_t\, y_{t-1} + \sum_{p=1}^{P} \sum_{i=o}^{T_1} \sum_{j=o}^{T_2} \sum_{\tau=t-T_3}^{t} \left[B^p_{t,ij\tau}\ \hat{y}^p_{\tau+i|\tau-j} + C^p_{t,ij\tau}\ \hat{V}^p(y_{\tau+i|\tau-j}) \right]$$

$$+ \sum_{p=1}^{P} D^p_t\, x_{pt} + e_t + u_t$$

$$(2)\quad \min_{\{x_{pt}\}} W_p = \min_{\{x_{pt}\}} E\left[\tfrac{1}{2} \sum_{t=o}^{T_4} (y_t - a_{pt})'\, K_{pt}\, (y_t - a_{pt}) \,\Big|\, I^p_o \right]$$

$p = 1, \ldots, P$

$T_1,\ T_2\ ,\ T_3,\ T_4 \geq o$

$$(3a)\quad \hat{y}^p_{\tau+i|\tau-j} \equiv E(y_{\tau+i} \mid I^p_{\tau-j})$$

$$(3b)\quad \hat{V}^p(y_{\tau+i|\tau-j}) \equiv E\left[(y_{\tau+i} - E(y_{\tau+i} \mid I^p_{\tau-j}))^2 \mid I^p_{\tau-j} \right]$$

The choice of a Linear-Quadratic-Gaussian (LQG) specification is for expositional convenience only. y_t is a vector of state variables. x_{pt} is the vector of instruments of agent p in period t. e_t is a vector of strictly deterministic exogenous variables and u_t a white noise disturbance vector. Systems involving finite higher order distributed lag functions for the state vector, the instrument vector and the vector of exogenous variables can be transformed into the format of (1). The same applies if the vector of exogenous variables follows a finite order ARIMAX process or if the disturbance vector can be characterized by a finite order ARIMA process. $\hat{y}^{p}_{\tau+i|\tau-j}$ denotes the rational expectation of $y_{\tau+i}$ formed by agent p on the basis of the information available to him in period $\tau-j$. $\hat{V}^{p}(y_{\tau+i|\tau-j})$ denotes the rational variance of agent p. E is the expectation operator and I^{p}_{t} is the information set of agent p at time t. 2/ Each agent chooses (a rule for) his instruments so as to minimize his objective functional given in (2).

For reasons of space I an unable to discuss a number of potentially very important technical issues. These include the following.
a) The structure of the model [the A_t, $B^{p}_{t,ij\tau}$, $C^{p}_{t,ij\tau}$ etc.] will not be known exactly to the agents in the economy and has to be viewed as stochastic. In general the process of estimating the model and optimizing the estimated model cannot be separated. b) The linear approximation of the model and the quadratic approximation of the objective functions may be inappropriate; specifically, higher moments than the second may be required to represent adequately agents' attitudes towards risk. Even after excluding these technical issues from consideration, enough remains on the agenda to give ample support to the view that satisfactory macroeconometric modelling will remain a daunting but not, I believe, a hopeless task.

a) Sequence economies

The model in (1) - (3) is dynamic. Macroeconometrics concerns modelling sequence economies, that is economic systems in which decisions are made and anticipations are formed at different points in time. In such economies, whose essential characteristic is the incompleteness of the set of contingent forward markets, anticipations of the future, held with different degrees of confidence, replace the non-existent contingent forward markets. Intertemporal speculation is therefore bound to play a major role.

Even at a purely theoretical level it is extremely difficult to model a sequence of incomplete spot and forward markets reopening with different frequencies, yet this is the essence of the economic systems we are trying to understand. One aspect of modelling dynamic economic systems on which considerable progress has been made is the integration of the income-expenditure accounts, the flow of funds accounts and the balance sheet. Private saving adds to financial wealth, government budget deficits must be financed, current account imbalances change external net worth etc.

Applied microeconomic research has so far been of very little help to those attempting to model dynamic aggregative behaviour. Even best-practice work is almost invariably static in nature (e.g. Deaton and Muellbauer [1980]). It is not surprising that when asset endowments and anticipations of future prices are ignored, the data reject even the homogeneity property of microeconomic consumer demand systems! Recent work on intemporal aspects of the labour supply decision (e.g. Hall [1980], Altonji and Ashenfelter [1980]) is generating results that may become useful inputs into future macroeconometric models. The availability of panel data appears to be almost a prerequisite for further empirical progress on household behaviour over time (Ghez and Becker [1975], Heckman [1978], Lillard and Willis [1978]).

b) Why money?

While it does not relate to the model of equations (1) - (3), the absence of microfoundations not merely for the demand for money and the supply of money but for the very existence of money deserves special mention. The monetary sector is an essential ingredient in every serious macroeconomic model,[3/] yet we do not have a convincing, let alone an empirically implementable theory of money. The less said about the two standard intellectual shortcuts in this area -- those of including money as an argument in the direct utility function (yielding unspecified convenience and liquidity services) and of including money as an argument in the production function (saving real resources in an unspecified way) -- the better. It is indeed possible to derive a demand for money as a store of value using optimizing behaviour and thus to have money as an argument in the indirect utility function, but only by unacceptable restrictions on the available asset menu (e.g. Lucas [1972]). In actual economies every reasonable concept of money is dominated as a store of value by fixed price nominal assets earning an interest rate in excess of that earned on the money assets. If transactions costs and the use of money as a resource-saving device in exchange constitute the missing microfoundations, it is necessary to show how this generates the kind of demand-for-money functions commonly found in macroeconometric work. It would also be desirable to open the lid of the transactions costs black box to make certain that it isn't empty. All existing macroeconometric models, even those putting the most emphasis on microeconomic foundations such as Minford [1980], contain money demand functions that are entirely *ad hoc*. This implies that they are potentially vulnerable to the "Lucas Critique". The well-documented instability of money demand functions both in the U.K. and the U.S.A. (see e.g. Goldfeld [1976]) suggests that this concern may not be purely academic. The statement that inflation is a monetary phenomenon is not very helpful unless there exists a well-defined and policy-invariant monetary aggregate that bears a stable, policy-invariant relationship to the price level. It matters greatly in the U.K. whether inflation is a monetary base phenomenon, an M1 phenomenon, an M3 or a PSL2 phenomenon. We do not currently possess the theoretical apparatus to answer this fairly basic question.

Mutatis mutandis the same can be said about the treatment of privately held interest-bearing public sector debt. Under the strict conditions of the "Ricardian equivalence theorem", the present value of the future taxes "required" to service the public debt exactly offsets the value of this debt in private portfolios (Barro [1974]). There are good reasons for believing that the conditions for debt neutrality do not hold in practice (Buiter and Tobin [1979], Tobin and Buiter [1980], Buiter [1980c]). The extent of debt neutrality, that is the degree to which public sector bonds are perceived as private net worth, will not however be invariant under changes in the stochastic processes describing the external environment and government behaviour. The *ad hoc* bond demand functions characteristic of all existing macroeconometric models are therefore vulnerable to the Lucas Critique.

In the fields of money and public sector debt there is no applied microeconometric work to aid the beleaguered macroeconomist. The study of static barter economies cannot be expected to contribute much to the understanding of sequential monetary economies.

c) The name of the game

The model of equations (1) - (3) represents a dynamic or differential game. Its solution requires the selection of the appropriate game-theoretic equilibrium concept. The agents, $p = 1, \ldots, P$, can represent households, firms, unions and branches of government. The modelling of public sector-private sector interaction as a dynamic game is still in its infancy. Among those authors who have tackled this problem, the (non-cooperative) Stackelberg leader-follower equilibrium has been popular (see e.g. Fischer [1980]). "Small" private agents take government actions as parametric when selecting their optimal strategies while a "large" government allows for the dependence of private behaviour on its choice of behavioural rule.

Such an "asymmetric" equilibrium specification may be inappropriate when the interaction of the government and large corporations or large unions is studied. At times some of the agents may play co-operative rather than non-cooperative games. The "social compact" under the Callaghan administration is an example of an attempt to play a co-operative union-government game. The correct specification of the game-theoretic equilibrium is crucial for econometric estimation and model identification. The behavioural rules or strategies adopted by the players will differ significantly according to the game that is being played. It is impossible to interpret the data correctly and to extract from them the "invariant structure" required for policy analysis without knowledge of the rules of the games that have been played over the sample period. E.g. a change in the wage-employment relationship may have been the consequence of a switch from a cooperative to a non-cooperative union-government game . I hope and expect that this issue will get a lot more attention in the future.

d) Anticipations and the identification of a policy-invariant structure

The model of equations (1) - (3) incorporates the assumption of rational forecasting by all agents (rational expectations and rational variances in the LQG model[4/]). In spite of all its well-known shortcomings, the most important of which is probably that neither the information collection process nor the forecasting rule itself are generated as the outcome of optimizing behaviour, the rational expectations assumption is certain to be an essential ingredient of all serious future macroeconometric research. Its greatest strength is the palpable absence of any reasonable operational alternative. Some of the more implausible implications of the current crop of macroeconomic models incorporating the rational expectations assumption can be avoided by recognizing that the information sets conditioning forecasts may be fairly empty and that they are likely to differ between agents.

The invariant structure of the model consists of the following elements:

$$\left\{\begin{array}{l} A_t \,,\; B^p_{t,ij\tau} \,,\; C^p_{t,ij\tau} \,,\; D^p_t \,,\; a_{pt} \,,\; K_{pt} \,,\; E(u_t u_t') \\ \\ I^p_{\tau-j} \\ \\ \text{The nature of the game} \\ \\ t=o, \ldots, T_4; \quad i=o, \ldots, T_1; \quad j=o, \ldots, T_2; \quad \tau=t-T_3, \ldots, t; \quad p=1, \ldots, P. \end{array}\right.$$

In principle the policy maker, agent 1 say, needs all this information in order to derive an optimal decision rule. If private agents (2, ..., P) are Stackelberg followers, the behaviour of the economic system given in (1) - (3) will, under a given rule for x_{1t} and after solving out the rational expectations and rational variances, be described by a stochastic difference equation system relating y_t to its own past values, current and past values of the exogenous variables and the disturbances and current and past values of the policy maker's instrument vector x_{1t}. The coefficients of this observable, reduced form system will in general be functions of the parameters of the stochastic process generating x_{1t}. Changes in these parameters imply changes in the coefficient of the reduced form system. Econometric estimates of the "effect of" x_{1t} on y_t obtained from the time series behaviour of such a reduced form system during a period for which a particular rule for x_{1t} is in effect cannot, in general, be expected to remain valid when the rule for x_{1t} is altered. This is the Lucas Critique. While the point is obviously correct in principle, its practical importance, as measured by the extent of parameter instability under a particular set of changes in the policy rule, can only be established empirically on a case-by-case basis.

The identification of policy-invariant relationships between the state variables and the policy instruments is often problematic as a reading of Wallis [1980] makes clear. A simple example, taken from Buiter [1981d], provides an illustration of the kind of "observational equivalence" or identification problems one is likely to encounter.

Equation (4) is an output equation of the kind used by Barro [1978]. Output, q, depends on the current and past period's unobserved monetary growth, m. It is clear that the deterministic part of any monetary feedback rule such as (5), will have no effect on the density function of q_t. Equation (4') makes current output a function of the differences between current monetary growth and its values anticipated currently and in the previous period. Here q_t will be a function of the deterministic part of the monetary feedback rule (5). An equation such as (4') can be derived from a model with multi-period non-contingent nominal contracts as in Fischer [1977] and Phelps and Taylor [1977]. u_t^q and u_t^m are white noise disturbance terms.

(4) $$q_t = \alpha_1\left[m_t - E(m_t|I_t)\right] + \alpha_2\left(m_{t-1} - E(m_{t-1}|I_{t-1})\right) + u_t^q$$

(4') $$q_t = \alpha_1'\left[m_t - E(m_t|I_t)\right] + \alpha_2'\left(m_t - E(m_t|I_{t-1})\right) + u_t^q$$

(5) $$m_t = \beta m_{t-1} + u_t^m$$

The reduced form of (4) is (6).

(6) $$q_t = \alpha_1 u_t^m + \alpha_2 u_{t-1}^m + u_t^q$$

The reduced from of (4') is (6').

$$(6') \quad q_t = (\alpha_1' + \alpha_2') \, u_t^m + \alpha_2' \beta u_{t-1}^m + u_t^q$$

In (6) known monetary feedback rules do not influence q_t while in (6') they do. Yet, as long as β is constant over the sample period, (6) and (6') are observationally equivalent. Only if a change in the monetary policy process, that is, in β, is known to have occurred during the sample period, can we hope to discriminate between (6) and (6') and so to test (4) against (4').

e) Time-inconsistency

In non-cooperative games in which the current state depends on anticipations of future states, the optimal plan may be time-inconsistent (Kydland and Prescott [1977]). Forward-looking expectations and variances are present in equation (1) if $i > o$. A time-consistent plan is a sequence of rules, one for each period, which specifies policy actions as functions of the state of the world in that period. Each rule is optimal given the subsequent elements in the sequence. Rules derived using stochastic dynamic programming are time-consistent. They can be suboptimal because they fail to allow for the effect of future actions by other players on the current state, through changes in current and past behaviour induced by the anticipation of such future actions. This scenario is clearly relevant to a public sector-private sector Stackelberg game when private behaviour depends on anticipated future government actions. It creates two kinds of problems in the use of macroeconometric models for optimal policy design -- one technical and one political. The technical problem is that a particular mathematical method for optimization in stochastic dynamic models is no longer appropriate. Progress is now being made on the development of new optimization techniques that allow for the effect of anticipated future policy on current and past behaviour (see e.g. Chow [1980] and Buiter [1981 c]). The political or constitutional problem is more serious. Almost by definition, rational non-cooperative behaviour will be time-consistent and therefore in general suboptimal. How then can the policy maker be convinced or constrained to pursue time-inconsistent optimal policies and how can the private sector be convinced that this is what will happen? A resolution of these issues involves the design and reform of economic institutions and is beyond the scope of this paper.

Note that time-inconsistency does not affect the superiority in stochastic models of conditional (contingent, flexible, feedback or closed-loop) rules over fixed (open-loop) rules. In models with forward-looking expectations, an open-loop rule will be both time-inconsistent and suboptimal. The optimal (time-inconsistent) rule will express policy actions in a given period as a function of all the information on the state of the world available to the policy maker in that period. The (time-inconsistent) optimal constitution will be a closed-loop, flexible one.

For correct specification and inference in macroeconometric models one needs to know whether, over the sample period, time-consistent or optimal time-inconsistent policies were pursued. So far, very little attention has been paid to this issue.

f) Aggregation

Macroeconomists are frequently given a hard time about the heroic (and untested) aggregation assumptions implicit in their models. To the extent that the issue is addressed at all, the aggregative relations are justified as representing the behaviour of the "representative" household, firm, worker or portfolio holder. From careful microeconometric studies of consumer behaviour (e.g. Deaton and Muellbauer [1980]) we know that even more flexible aggregation procedures such as the AIDS model 5/ which does not require parallel linear Engel curves, are decisively rejected by the data. Until such time as we can base operational sequential general equilibrium models entirely on microdata, however, heroic or desperate aggregation and the intellectual handwaving it entails will be with us. This does not mean that certain kinds of "second-best" disaggregation cannot be attempted right away. The following partitions of the agents come to mind as potentially useful.

- Disaggregation of households into liquidity-constrained and net worth-constrained categories.
- Disaggregation of households into employment-constrained and unconstrained categories.
- Disaggregation of firms into cashflow-constrained and -unconstrained categories.

These partitions are of interest because they condition the real effects of cyclical stabilization policies. Of equal interest is the explanation of changes in the relative weights of the various categories both over the cycle and in the long-run.

g) Market structure

In most macroeconometric models scant attention is paid to the actual *modus operandi* of the various markets they contain. Minford [1980] is the exception by modelling explicitly the interaction of a monopolistic unionized labour market and a competitive "residual" labour market. No existing model, however, attempts to make those distinctions between various kinds of markets that are essential for an evaluation of the existence of a role for stabilization policy based on sound microeconomic foundations.

I take it to be common ground that the rationale for stabilization policy, as indeed for all forms of government intervention other than redistribution of wealth or income, must be market failure plus a belief that the proposed remedial action will indeed improve economic performance. (Beenstock [1980]). The following discussion motivates the decision to permit agents' information sets to differ in (1) - (3).

Using the classification scheme of Table 1, a role for stabilization policy can emerge provided the B1, B2, E1 and E2 boxes are not all empty. The two main partitions, that between row A and row B on the one hand and that between rows C or D and row E on the other hand are not necessarily independent. Indeed, the reason for the existence of long-term, incompletely contingent contracts may well be the presence of incomplete and asymmetric information as between buyers and sellers.

Efficient competitive "auction markets", that is competitive markets for homogeneous commodities with symmetrically known characteristics, cleared instantaneously and continuously through complete price flexibility are represented by A1, C1 and D1. The markets for government debt, the foreign exchange market and perhaps certain other domestic and international financial markets belong to these categories. Minford's residual or secondary non-unionized labour market belongs to A1 and C1. (Minford [1980]). The unionized labour market of that same model belongs to A2 and C2. As none of the financial markets and goods markets in the "Liverpool" model fall in the B1, B2, E1 or E2 categories, a role for stabilization policy is ruled out.

It is well-known that asymmetric information gives rise to adverse selection and moral hazard, two information-based sources of market failure. Initial applications of the asymmetric information paradigm to insurance markets and credit markets have been followed by applications to the labour

TABLE 1

		1 Competitive	2 Non-Competitive
A	Markets in which buyers and sellers have identical (but not necessarily complete) information about the characteristics of the commodity that is exchanged.	Certain primary commodity markets, markets for government debt, foreign exchange markets and (possibly) the stock market and the corporate bond market.	As A1
B	Markets in which buyers and sellers have asymmetric information about the characteristics of the commodity that is exchanged.	Labour markets, insurance markets, markets for personal and business loans, markets for health, education and professional services and for most "sophisticated" goods and services.	As B1
C	Sequential spot markets, that is markets that reopen frequently or even continuously and in which only spot transactions are made.	Domestic and international financial markets, markets for certain primary commodities, "secondary" labour markets.	As C1
D	Sequential spot and forward markets, that is markets that reopen frequently or even continuously and in which both spot transactions and a limited number of forward transactions are made.	As C1, except for secondary labour markets.	As D1
E	Markets in which long-term, incompletely contingent forward contracts are made and which reopen infrequently	"Primary" labour markets, markets for sophisitcated goods and services, including capital goods.	As E1

market. In a recent paper Weiss [1980] has shown how adverse selection in the labour market can give rise to socially inefficient, quantity-constrained equilibria. In response to a fall in demand for its product a firm may lay off workers rather than lower the wage it offers. If the firm pays a uniform wage to all workers because it is unable to differentiate between high quality and low quality workers, and if a worker's reservation wage is an increasing function of his quality, lowering the wage in response to a fall in product demand would cause the higher quality workers to leave first. A random laying off of workers can therefore be a superior strategy for the firm. It may be possible to design output - or employment - contingent payroll taxes or wage subsidies, or other anti-cyclical fiscal policies that minimize the loss of social welfare resulting from this market inefficiency.

In markets with long-term contracts that are not contingent on all new information that may accrue over the duration of the contract, the positive economics of intervention are clear. If monetary or fiscal instruments can respond to information that private agents covered by long-term contract cannot respond to (or cannot respond to in the same way), the government has a handle on the real economy. The welfare economics of such intervention are more complicated, as a case must be made that it is desirable for the authorities to respond to new information when it is not in the perceived best interests of private agents to do so themselves. Such a case can certainly be made in principle, as the opportunity set of the public sector differs from that of the private sector. The ability to tax and to declare some of its liabilities legal tender is unique to the government. This renders government interest-bearing debt an imperfect (superior) substitute for private sector debt. There may therefore be a natural and socially optimal division of labour between the private sector and the public sector as regards the nature of their responses to different kinds of shocks.

Governments can then be viewed as one of the social institutions through which citizens mediate their responses to random or systematic changes in the external environment. A fully convincing optimal policy rule cannot be derived until the microeconomics of long-term contracts are better understood. The Lucas Critique also puts us on guard that long-term contracts cannot be expected to be invariant under changes in policy rules.

h) Nominal inertia

While we have the beginnings of a theory of sticky wages and prices and of socially inefficient, quantity constrained equilibria based on private optimizing behaviour, these equilibria involve real not nominal stickiness. There are no informational asymmetry arguments against making the money wage contingent on a broad price index like the C.P.I. It is equally observable by workers and employers and cannot be manipulated by either group. It is therefore fair to say that we do not have a satisfactory theory of nominal stickiness (Barro [1977]).

The comparative rarity of explicit price level-contingent money wage contracts even in periodsof variable and uncertain inflation is indeed surprising. A possible explanation of this paradox is that money wages are in fact price level-contingent, but that the timing of the payments due under the implicit indexing rule obscures this relationship. The money wage negotiated for a given period, 1, could e.g. be based on the best estimate, at the beginning of period 1, of the rate of inflation during period 1. In addition the understanding could exist (implicitly or as part of the contract), that when the next contract negotiation comes up, the money wage negotiated for period 2 will reflect any departure of the actual rate of inflation in period 1 from the estimate reflected in the money wage negotiated for period 1. The money wage negotiated for period 2 would of course also reflect the best estimate of inflation during period 2. If capital markets work efficiently and workers have security of tenure, the timing of the payments due under an indexing clause is of no concern; it is only their present value that matters. The frequent talk of "catching up during wage negotiations need therefore not reflect mechanical backward-looking behaviour and may be consistent with wage negotiations being conducted entirely in forward-looking real terms. The empirical problem is that wage payments in any given period need bear no close relation to the wage income earned in and attributable to that period, as the latter include the present value of the inflation surprise adjustment payable in the next period.

The presence or absence of nominal inertia in wages and prices is crucial for a correct appreciation of the stabilization role that can be played by monetary policy. If there is significant nominal inertia in labour and product markets, but if domestic and international financial markets are efficient auction markets, deceleration in the rate of growth of the money stock can result in a large appreciation of the nominal and real exchange rates (Dornbusch [1976], Buiter and Miller [1980]). If nominal wages and prices are as flexible as the exchange rate, no change in the real exchange rate will result. It is to be hoped that future theoretical and empirical work will resolve this issue, as the design of sensible monetary policy rules hinges on it.

4) Conclusion

From the discussion of the properties that a macroeconometric model suitable for policy evaluation and (optimal) policy design ought to possess, it is apparent that all existing macroeconometric models are seriously flawed. To the extent that they are data-coherent they may provide us with useful information about the relationships between policy instruments and target variables during the periods over which they were estimated. It is almost trite to end a paper with a call for further research, but in view of the importance of the issues that are at stake no other ending seems appropriate.

FOOTNOTES

1/ Reinforced because rational expectations of future policy actions can be exploited, through known contingent policy rules, to improve the accuracy of private sector forecasts of endogenous variables and thus to reduce unwanted instability in economic performance [Buiter 1980b, 1981a, c, d].

2/ Note that $t - T_3$ is the earliest date with regard to which expectations are formed that influence y_t and that $t - T_3 - T_2$ is the earliest date at which forecasts are made that influence y_t.

3/ At the University of Chicago the term "macroeconomics" is discarded in favour of that of "monetary theory".

4/ Of all the U.K. econometric models that I know, only Minford's makes any attempt to incorporate second moments of the density functions of future endogenous variables.

5/ The Almost Ideal Demand System due to Deaton and Muellbauer [1980].

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