THE NATURAL-RATE HYPOTHESIS, THE RATIONAL-
EXPECTATIONS HYPOTHESIS, AND THE REMARKABLE
SURVIVAL OF NON-MARKET-CLEARING ASSUMPTIONS

Herschel I. Grossman

The Natural-Rate Hypothesis,
the Rational-Expectations Hypothesis,
and the Remarkable Survival of
Non-Market-Clearing Assumptions

ABSTRACT

Non-market-clearing models continue to dominate analysis of
macroeconomic fluctuations and discussions of macroeconomic
policy. This situation is remarkable because non-market-clearing
assumptions seem to be inconsistent with the essential
presumption of neoclassical economic analysis that market
outcomes exhaust opportunities for mutually advantageous
exchange. Non-market-clearing models apparently have survived
because they have evolved to incorporate both the natural-rate
hypothesis and the rational-expectations hypothesis and because
the alternative "equilibrium" approach has failed empirically.
This paper expands on these ideas and briefly discusses some of
the problems that we face in attempting to evaluate empirically
the recent vintage of non-market-clearing models. The main
difficulties seem to involve accounting for shifts in the natural
levels of real aggregates and specifying the timing of the past
anticipations that determine the effects of current monetary
policy.

Herschel Grossman
Department of Economics
Brown University
Providence, Rhode Island   02912

(401) 863-2606

A primary puzzle that macroeconomic analysis addresses--in fact, the problem that makes macroeconomics a distinct field of inquiry--is the empirical relation between nominal and real aggregate variables. Specifically, a successful theoretical and empirical analysis of macroeconomic fluctuations must provide satisfactory explanations for the observed relation between monetary aggregates and measures of real aggregate economic activity, as well as for the observed relation between monetary aggregates and the average price level. Since the Keynesian revolution in macroeconomics, most models of these relations have used non-market-clearing assumptions. Non-market-clearing is a shorthand description of the more precise idea that macroeconomic fluctuations and the relations between nominal and real aggregate variables reflect widespread failure of economic agents to realize expected gains from trade.

In current textbooks, professional journals, and nontechnical writings, non-market-clearing models continue to dominate analysis of macroeconomic fluctuations and discussions of macroeconomic policy. This persistent popularity of non-market-clearing assumptions requires explaining because non-market-clearing models raise basic and widely recognized logical problems for economic theorists. As critics of non-market-clearing assumptions periodically point out, widespread failure to realize expected gains from trade is apparently inconsistent with essential presumptions that underlie conventional neoclassical economic analysis of phenomena other than macroeconomic fluctuations.

In explaining and predicting changes in resource allocation and income distribution, the distinguishing feature of neoclassical economic analysis is that it assumes that market outcomes exhaust opportunities for mutually advantageous exchange. Neoclassical theory of resource allocation and income distribution does not presume that continual market clearing is literally true, but it supposes that deviations from market

clearing are not sufficiently large and persistent to account for significant economic phenonema. This presumption, of course, is nothing more than an aspect or natural extension of the basic neoclassical postulate of maximization. Maximization is so compelling to economic theorists that it even plays an important role in filling out models that incorporate non-market-clearing assumptions.

Over the years, the tension between neoclassical analysis and received macroeconomic models that use non-market-clearing assumptions has generated a series of innovations that have posed potent challenges to these models. The natural-rate hypothesis and the rational-expectations hypothesis probably have been the most important individual developments in this regard. The most comprehensive challenge, however, has come from the development of an "equilibrium" approach to the study of macroeconomic fluctuations. Equilibrium models assume that all expected gains from trade are realized and that expectations are rational, and they rely on assumptions about incomplete information to generate a relation between monetary aggregates and real aggregates. Because equilibrium models avoid non-market-clearing assumptions, their proponents claim that they are fully consistent with maximizing behavior.

Non-market-clearing assumptions apparently have survived this challenge for two main reasons: First, the equilibrium approach has failed empirically. Specifically, although contractual formulations of market-clearing assumptions are consistent with many observed features of macroeconomic fluctuations, equilibrium models that include consistent and realistic assumptions about available information seem unable to explain the facts of the relation between monetary aggregates and real aggregates. Second, models that use non-market-clearing assumptions have evolved to incorporate the main innovations in macroeconomic analysis--specifically, the natural-rate hypothesis and the rational-expectations hypothesis--that seem to be relevant for understanding macroeconomic developments and for

discussing the formulation of macroeconomic policy.

The discussion that follows expands on these ideas and then looks briefly at the main problems that we face in attempting to evaluate empirically the recent vintage of non-market-clearing models. We begin, however, by considering the presumptions that underlie current mainstream research about macroeconomic fluctuations.

1.   Monetary Nonneutrality and the Natural-Rate Hypothesis

Most current mainstream research in macroeconomics is based on two apparently plausible beliefs about the structure and history of market economics: First, because the economic structure is non-Walrasian, monetary disturbances are not neutral. Specifically, through non-Walrasian causal linkages, changes in the behavior of monetary aggregates produce both temporary changes in real aggregates and temporary deviations from the behavior of wages and prices implied by Walrasian assumptions. Second, the temporary non-Walrasian effects of monetary disturbances on real aggregates and the price level have been quantitatively significant. Specifically, the observed historical relations among these variables reflect these non-Walrasian linkages to an extent and in a way that enables us to isolate and to study them by analyzing data.

These presumptions imply both that monetary policy can affect real aggregates as well as the price level and that empirical analysis using appropriate econometric techniques offers the possibility of being able to quantify and to predict these policy effects. In actual modelling, a non-Walrasian structure has meant that exchange takes place either under non-market-clearing conditions or with agents in possession of incomplete information about potential gains from trade. The mainstream research program does not rule out the existence of additional interactions between monetary aggregate and real aggregates, some of which can be consistent with Walrasian assumptions. Moreover, it presumes that the long-run relations

between monetary aggregates, real aggregates, and the price level are Walrasian. The natural-rate hypothesis embodies this long-run convergence to a Walrasian outcome. The mainstream research horizon presumes, however, that the historical data contain recognizable intervals over which, either because of the failure of markets to clear or because of incomplete information, monetary disturbances have been the dominant factor affecting real aggregates.

Briefly consider the main alternatives to this presumption. In general, money is not superneutral in a Walrasian context. Specifically, even under general market-clearing and with complete information, values of real variables can depend on the rates of change of monetary aggregates. Failure of superneutrality has received considerable theoretical attention. See Fischer (1980) for a useful overview. There seems, however, to be no good theoretical or empirical reason to believe that lack of superneutrality is relevant to the cyclical behavior of real aggregates and the price level.

Another possible way to explain relations between monetary and real variables would be through causation running either from real aggregates or from factors responsible for fluctuations in real aggregates to monetary aggregates. Specifically, it is possible to formulate macroeconomic models that have the following three implications: First, fluctuations in real aggregates result either from disturbances to real factors-- tastes, technology, or resources--or from disturbances to monetary velocity. Second, a relation between monetary aggregates and real aggregates that has realistic characteristics reflects so-called reverse causation. Third, monetary dis-turbances, possibly induced by other disturbances, affect only the price level. See, for example, King and Plosser (1982).

Such "real" business-cycle models, however, seem unlikely to account for the facts for at least two reasons: First, nobody has identified a set of impulses that does not contain disturbances to monetary aggregates and that has appropriate

structural characteristics, sufficient magnitude, and requisite regularity to be responsible for the bulk of observed fluctuations in real aggregates. Second, specific historical episodes seem to exist in which policymakers have attempted deliberately to use monetary policy either to stimulate real economic activity or to reduce inflation, and in which real aggregates have responded directly to these policy initiatives as mainstream macroeconomics supposes.

2. Market Clearing: Spot and Contractual

As mentioned above, models used to implement the research program of mainstream macroeconomic analysis either employ non-market-clearing assumptions or combine incomplete-information assumptions with the assumption that all expected gains from trade are realized. Most incomplete-information models formalize the idea that all expected gains from trade are realized by specifying that prices and quantities equate spot demands and supplies. As critics have frequently pointed out, this specification of market clearing seems inconsistent with prominent observed features of macroeconomic fluctuations-- especially, lack of correlation between aggregate employment and real wage rates and apparent symptoms of the failure of labor markets to clear, such as the use of layoffs to effect employment separations and the positive correlation between quit rates and aggregate employment.

Another problem with standard incomplete-information models is that a framework of cleared spot markets requires strong restrictions on utility functions in order to produce realistic correlations among monetary aggregates and various real aggregates. For example, for aggregate production to respond positively to monetary disturbances, the representative supplier of factors of production must respond positively when it believes, perhaps incorrectly, that the relative value of its current marginal product has changed. One difficulty with this specification is that a change in the value of current marginal

product relative to consumption prices and/or future marginal products involves both substitution effects and income effects, and the correct positive response occurs only if substitution effects are dominant. Another difficulty is that assuming strong intertemporal substitution effects can preclude a positive correlation between aggregate production and aggregate consumption. See Seater (1977, 1978) and Barro and King (1982) for further analysis of these modelling problems.

More imaginative versions of incomplete-information models-- see, for example, Azariadis (1978)--extend the concept of market clearing to cover efficient contractual setting of quantities and certain prices in an explicitly stochastic setting. In models of efficient contracts, employment and the remuneration of productive factors satisfy both perceived productive-efficiency conditions, which imply realization of expected gains from trade, and risk-sharing-efficiency conditions.

A key implication of risk-sharing efficiency is that equality between the remuneration received by a factor of production and its marginal product obtains in some average sense, but does not necessarily hold at all points in time. This theoretical implication means that it is not appropriate to use observed time series of factor remunerations to measure variations in marginal products. For example, failure of an incomplete-information model to fit data on real wages under the maintained assumption of equality between observed factor remunerations and marginal products can mean merely that the efficient-contracts version of incomplete-information modelling is more realistic than the spot-market version.

Formalizations of the concept of market clearing within a framework of efficient contracts also suggest ways to get around various empirical objections to the assumption that expected gains from trade are realized. For example, contractual models explain layoffs as a consequence of the fact that wages do not signal changes in value of marginal product. Given efficient risk-shifting arrangements, layoffs do not imply a failure to

realize expected gains from trade. Also, in these models, perverse income effects are less of a problem because variations in worker income are mitigated and are not directly related to variations in value of marginal product. See Grossman (1979, 1981) for an extensive discussion of these issues.

The assumption of efficient contracts, of course, is radically different from stories about nominal labor contracts that sometimes are used in non-market-clearing models. Some proponents of non-market-clearing assumptions have argued, by reference to observed collective bargaining agreements, that, at least in the labor market, efficient contracting is not realistic. They point out, for example, that actual labor contracts lack explicit provisions for indexing wages completely to observed nominal disturbances and allow employers to determine the employment status of workers.

The literature on efficient contracts, however, has recognized that key arrangements that make contracts efficient are likely to be implicit. If we accept the implicit-contracts story, neither the absence of explicit indexation or the practices of layoff and recall preclude the attainment of productive efficiency and risk-sharing efficiency.

The main point of this section is that the usual objections raised to doing macroeconomic analysis within a market-clearing framework do not seem compelling. Models that embody incomplete information within a context of efficient contracts suggest that many observed features of macroeconomic fluctuations are consistent with realization of all expected gains from trade. Thus, the survival of non-market-clearing assumptions is not attributable to direct evidence that market clearing is unrealistic.

3. Rational Expectations and Equilibrium Models

In addition to the distinction between market-clearing and non-market-clearing assumptions, models used to implement the research program of mainstream macroeconomic analysis are also

distinguishable according to whether or not they assume that expectations are rational. In this context, rational expectations means the hypothesis that private agents believe as if they understand the economy's relevant stochastic relations, including the process governing monetary policy. This hypothesis gives operational content to the maximization postulate that private agents gather and use information efficiently.

On a priori grounds, it would seem most natural and congenial for neoclassical economists to assume both that transactions realize all expected gains from trade (MC) and that agents form rational expectations (RE). Such MC-RE models are often called "equilibrium" models, a name that connotes the logical security that is part of neoclassical economics.

The basic obstacle to evaluating the reality, either in an absolute or relative sense, of the four possible combinations of assumptions about market clearing and rational expectations is that they can exhibit essential isomorphisms. Most importantly, all four combinations are consistent both with nonneutrality of monetary disturbances and with the natural-rate hypothesis, which limits non-Walrasian effects to the short run. Empirical evaluation, consequently, must rely on other, more subtle, aspects of the relation between monetary aggregates, real aggregates, and the price level.

A particular problem in interpreting empirical results is to distinguish between the implications of MC-RE models and the implications of models that assume rational expectations, but incorporate non-market-clearing (NMC) assumptions. Econometric analysis relating to the macroeconomic relevance of rational expectations often has blurred this distinction. As explained below, the most widely discussed proposition associated with the introduction of rational expectations into macroeconomic models—namely, the proposition that the observed relation between real aggregates and the money stock reflects unanticipated money policy—is a direct implication of NMC-RE models, rather than MC-RE models.

A more restrictive proposition about monetary inferences that follows peculiarly from MC-RE models and provides a basis for an econometric test of the reality of MC-RE modelling is the following: For a disturbance to the money stock to affect the short-run behavior of real aggregates, this disturbance has to be both imperfectly anticipated and imperfectly perceived. To define terms more precisely, in this context, anticipation refers to inferences about current events based on observations about past events, and perception refers to inferences about current events based on observations about other current events.

The important paper by King (1981) makes clear how given the market-clearing assumption, the inferences of an agent operating according to the rational-expectations hypothesis are based on observations about both past events and current events. In other words, the relevant rational expectations in MC-RE models is an optimal combination of anticipation and perception. Thus, another way to state the above proposition is that disturbances to monetary aggregates affect real aggregates only to the extent that observations about past events and current events taken together do not permit agents to infer current monetary aggregates accurately.

In the limit, if the value of current monetary aggregates were part of the information set of private agents--as, for example, in Brunner, Cukierman, and Meltzer (1980) or Grossman and Weiss (1982)--monetary disturbances would have no effect on real aggregates. Under this assumption, all fluctuations in real aggregates reflect disturbances to real factors and/or to monetary velocity. In general, correct theoretical development of MC-RE modelling as well as correct empirical implementation along the usual lines involving estimation of an implied reduced form would have to relate real aggregates to measures of both unanticipated and unperceived monetary disturbances.

A potentially testable implication of the analysis of monetary inferences, also derived in King (1981), is the following: Any currently available observation or combination of

currently available observations that provides unbiased
information about current monetary aggregates--more generally,
the known part of any disturbance that would be neutral under
complete information--cannot cause short-run movements in real
aggregates. This implication has practical importance for
empirical analysis of MC-RE modelling because preliminary U.S.
monetary data that is contemporaneously available, although
subject to subsequent correction and revision, provides such an
unbiased observation of current monetary aggregates.

Recognition of contemporaneous monetary data leads to
additional important implications for empirical analysis and for
the relation between theory and policy evaluation. In an
MC-RE context, if, in addition to being random, the deviation
between contemporaneous preliminary monetary data and finally
reported monetary data is small--that is, if currently available
monetary data actually provides a highly accurate perception of
current monetary aggregates--monetary disturbances, even if
unanticipated, have little or no effect on the short-run behavior
of real aggregates. In this case, finding a significant
empirical relation between unanticipated monetary disturbances
and real aggregates would be, if anything, evidence against the
reality of MC-RE modelling. As explained below, such evidence,
in contrast, would be supportive of NMC-RE modelling.

In addition, if MC-RE modelling were realistic, the
availability of accurate contemporaneous monetary data would make
the effects of monetary policy independent of its predict-
ability. In this case, a contemporaneous observed reduction in
the growth rate of monetary aggregates would produce an immediate
and permanent decrease in the inflation rate, without the
frequently emphasized cost of a temporary decrease in real
aggregates. Thus, discussions of monetary policy that focus on
the credibility of announced policy intentions presume, at least
implicitly, either that contemporaneous monetary data is not
accurate or that MC-RE modelling is not realistic. In
contrast, even with accurate contemporaneous monetary data,

emphasis on credibility is natural and highly relevant within an NMC-RE context.

The classic MC-RE models--for example, Lucas (1972, 1973) and Barro (1976)--obscured these issues because they ignored the existence of contemporaneously available monetary data. As a modelling strategy, this abstraction seems to be an especially bad choice. Contemporaneous preliminary monetary data are readily available, are an unbiased measure, and are highly correlated with finally reported monetary data. Abstracting from contemporaneous monetary data, thus, seems contrary to the postulates and modelling strategy underlying the idea of rational expectations. Rational, maximizing agents do not ignore readily available and relevant information. In addition, this abstraction seems inconsistent with evidence from financial markets that contemporaneous monetary data have significant effects on asset prices. See, for example, Urich (1982).

In order to implement direct tests of MC-RE models based on the neutrality of monetary information, Boschen and Grossman (1982) extend King's model in two ways: First, we take account both of the availability of preliminary data on current monetary aggregates and of the process of accumulation of revised monetary data. Because of positive correlation in the revisions of estimates of current and past monetary aggregates, inferences about current monetary policy and, hence, current real aggregates, depend on information about past monetary policy and on past random disturbances to monetary aggregates. Second, we allow monetary policy to respond systematically to past levels of real aggregates, and we allow present levels of real aggregates to depend on past levels of real aggregates through the production technology. These extensions enable us to control for the possibility of spurious correlation between current real aggregates and contemporaneous monetary data that could arise because both are related to past real aggregates.

In this extended MC-RE framework, the main testable hypothesis is that the current innovation in real aggregates is

uncorrelated with contemporaneous measures of current and past changes in monetary aggregates. Analysis of data for the United States from 1953 through 1978, not surprisingly, implies unambiguous rejection of this hypothesis. Given the presumption that causation actually runs from monetary disturbances to fluctuations in real aggregates, an appropriate inference from this empirical result is that the combined assumptions of market clearing and rational expectations do not fit the facts. Although market clearing and rational expectations are individually attractive assumptions, in combination with a realistic specification of the information structure, they seem unable to account for the observed relation between monetary aggregates and real aggregates.

A second hypothesis implied by the extended MC-RE framework is that the innovation in real aggregates is positively correlated with revisions in preliminary measures of changes in monetary aggregates, these revisions being measures of the unperceived part of monetary policy. The empirical analysis in our paper, which is consistent with earlier work of Barro and Hercowitz (1980), fails to reject the contrary of this second hypothesis. This finding both reinforces the conclusion that MC-RE modelling is unrealistic and indicates that failure to perceive current monetary policy accurately is not a significant source of monetary nonneutrality.

Rejection of models that combine the assumptions of market clearing and rational expectations suggests that either one or both of these assumptions are not satisfactory as-if representations of the true structure of the economy. One possibility is that the rational-expectations hypothesis is false, but that the hypothesis that incomplete information within a market-clearing context is responsible for the relation between monetary aggregates and real aggregates is true. Such models involving market clearing and nonrational expectations (MC-NRE) were theoretical forerunners of equilibrium models. Prominent examples include Friedman (1968), Lucas and Rapping (1970), and

Mortensen (1970).

Recent research, however, has focused our NMC-RE models rather than on MC-NRE models. There seem to be at least two good reasons for the neglect of MC-NRE models. First, now that we understand the idea of rational expectations, an assumption that expectations are not rational seems incongruous in a model that assumes that expected gains from trade are realized. Second, no specific hypothesis about expectations, other than rational expectations, seems sufficiently compelling to warrant the effort and resources required for econometric implementation. Tests of rational expectations are much more interesting than tests of ad hoc expectations mechanisms.

4.   Rational Expectations Without Market Clearing

The preceding discussion implies that the continued popularity of non-market-clearing assumptions is a consequence of the combination of the empirical failure of equilibrium models and, somewhat ironically, the popularization of the idea of rational expectations. The survival of non-market-clearing assumptions, however, also has involved the incorporation of the natural-rate hypothesis and the rational-expectations hypothesis into non-market-clearing modelling. These two positive developments have produced NMC-RE models that are an attractive alternative to both MC-RE and MC-NRE models.

Those neoclassical economists who attempt to rationalize non-market-clearing assumptions naturally reason as follows: The objective of agents who set (say) wages is to satisfy market-clearing conditions--that is, to set wages such that all expected gains from trade are realized. However, technical or other factors, which are not well understood, prevent perpetual achievement of this goal. This reasoning leads directly to the wage-setting hypothesis that wages adjust over time to close the gap between current wages and the future path of wages that agents anticipate would be consistent with market clearing.

This wage-setting hypothesis implies that the actual rate of

wage inflation is larger (smaller) than the anticipated growth rate of market-clearing wages if and only if actual wages are below (above) their current market-clearing level. Moreover, the larger is the current gap between market-clearing wages and actual wages and/or the higher is the anticipated growth rate of market-clearing wages, the higher is the current inflation rate. For further development of this analysis, see, for example, Barro and Grossman (1976, ch. 5) and Mussa (1981). This hypothesis also implies that past anticipations of present market-clearing wages predetermine, or help to predetermine, actual present wages. Fischer (1977) and Phelps and Taylor (1977) stress this latter phenomenon.

Derivation of the natural-rate hypothesis in a non-market-clearing context requires combining this specification of wage adjustment with a suitable specification of the determination of real aggregates. To be concrete, suppose, as in Keynes (1936) and in some recent models of nominal wage contracting, such as Fischer (1977), that non-market-clearing conditions occur only in labor markets. Specifically, nominal wages are wholly or partly predetermined and can be inconsistent with the clearing of labor markets, but prices always adjust to clear product markets. Moreover, employment is positively related to demands for labor services, which, in turn, are negatively related to real wage rates.

These assumptions imply that actual real aggregates are larger (smaller) than their natural levels--that is, the levels that would obtain under market-clearing conditions--if and only if wages are below (above) their current market-clearing levels. Combining these relations between inflation and current wages and between real aggregates and current wages yields the following formulation of the natural-rate hypothesis: Actual levels of real aggregates are larger (smaller) than their natural levels if and only if the actual inflation rate is larger (smaller) than what private agents anticipate that the inflation rate would be under market-clearing conditions.

This analysis readily extends to a situation in which
product prices are also wholly or partly predetermined and can be
inconsistent with clearing of product markets. In this case of
general disequilibrium, the distinction between wages and prices
is not crucial. For further analysis of this case, see, for
example, Barro and Grossman (1976, ch. 2).

In any event, in a complete model that relates aggregate
demand and market-clearing wages and prices to monetary
aggregates, given predetermined wages and/or prices, larger
monetary aggregates generate both a larger difference between
actual real aggregates and their natural levels and a larger
difference between the actual inflation rate and what private
agents anticipate the inflation rate would be under market-
clearing conditions. Moreover, whether or not non-market-
clearing conditions are limited to labor markets, the theoretical
relations determining real aggregates and wage and price levels,
taken together, imply that, if past anticipations of the present
market-clearing wage and price levels were accurate, then present
real aggregates would equal their natural levels, and the present
inflation rate would equal the inflation rate that private agents
anticipate would be consistent with future market clearing.

The second major development in non-market-clearing
modelling, attributable to Fischer (1977) and Phelps and Taylor
(1977), is the additional incorporation of the rational-
expectations hypothesis. This extension means that anticipations
of the market-clearing wage and price levels, which serve to
predetermine actual wages and/or prices, reflect anticipations of
monetary aggregates and, specifically, are based on understanding
of the true relation between monetary aggregates and the market-
clearing wage and price levels. Consequently, for a monetary
disturbance to cause the actual market-clearing wage and price
levels to differ from the anticipated market-clearing wage and
price levels, and, thus, to affect the short-run behavior of real
aggregates, this disturbance has to be imperfectly anticipated.

The rational-expectations hypothesis also means that

anticipations of monetary aggregates are based on the true
process governing monetary policy. Thus, in NMC-RE models,
present disturbances to monetary aggregates are unanticipated or
imperfectly anticipated only to the extent that rational agents
cannot predict such disturbances accurately using all information
available when they form these anticipations. Note also that
NMC-RE models accommodate the Lucas (1976) critique of
econometric policy evaluation.

The critical difference between the corresponding
implications of NMC-RE and MC-RE models involves the
relevance of perceptions. In NMC-RE models, with the actual
wage level or wage and price levels predetermined by past
anticipations and real aggregates dependent on the accuracy of
these anticipations, perceptions--that is, inferences about
current monetary disturbances based on observations about current
events--are not consequential. Specifically, contemporaneously
available data on monetary aggregates do not make monetary
disturbances neutral in NMC-RE models because, by assumption,
the process determining real aggregates cannot respond to such
information. Thus, the finding, discussed above, that real
aggregates are significantly related to contemporaneous monetary
data is <u>not</u> evidence against the reality of NMC-RE modelling.
Moreover, the additional finding that real aggregates are not
significantly related to measures of unperceived monetary
disturbances is supportive of NMC-RE modelling.

An important attraction of NMC-RE models is that they have
provided an interesting and apparently relevant framework for
policy analysis. The natural-rate hypothesis and the rational-
expectations hypothesis imply important limitations on the
effects of monetary policy, but, within a non-market-clearing
context, they do not imply that monetary policy is irrelevant for
the short-run behavior of real aggregates. Specifically, in the
NMC-RE models just described, if monetary policy responds to
information that became available after private agents have pre-
determined present nominal wages--for example, observations about

more recent events--then, rational expectations notwithstanding, the feedback rule governing monetary policy can influence the extent to which the present behavior of the nominal money stock is unanticipated and, hence, can influence the stochastic properties of real aggregates. Thus, in these NMC-RE models, policy analysis focuses on differences in information sets and, in particular, on differences in the timing that are involved in the wage-price setting decisions of private agents and in the responses of monetary policy.

The NMC-RE models that we have been discussing violate the neoclassical presumption that all expected gains from trade are realized. Nevertheless, they have a neoclassical motivation in that they assume that the objective of wage and price setting agents is to satisfy market-clearing conditions. These models, therefore, seem to be at least potentially reconcilable with neoclassical economic analysis through the possible development within a maximization framework of a convincing model of the factors responsible for failure to achieve market clearing. In this sense, from a neoclassical perspective, these models are relatively clean.

In contrast to these clean NMC-RE models, Taylor (1979, 1980) has developed much dirtier NMC-RE models that incorporate explicit backward-looking elements into the wage-setting process. Taylor rationalizes this formulation by presuming that wage-setting agents have relative wages as an explicit objective. In fact, although expectations about future wages and prices also enter into Taylor's wage-setting processes, this role for expectations also derives from relative wage consciousness, and not from a goal of realizing expected gains from trade. Taylor shows that his models can generate realistic looking patterns of persistence in the behavior of wages and real aggregates, but his suggestion that clean NMC-RE models cannot fit these facts as well seems unwarranted. See, for example, Gertler (1981, 1982). Thus, Taylor's models, although they incorporate the natural-rate hypothesis and rational

expectations, seem hopelessly ad hoc from a neoclassical
perspective, and also have no obvious empirical advantage.

5.   Empirical Analysis of NMC-RE Models

The main conceptual problem involved in empirically
implementing NMC-RE models concerns the dating of the formation
of the expectations that are relevant to the determination of
current real aggregates. One theoretical possibility is that the
true interval involved in the pre-determination of nominal wages
is sufficiently short that NMC-RE models are not empirically
distinguishable from MC-RE models. The empirical failure of
MC-RE modelling, however, suggests that we cannot dismiss non-
market-clearing assumptions so easily.

A more serious practical problem is that, at least in the
American context, the fact that explicit labor contracts are not
synchronized suggests that the predetermination of present
nominal wages involves a set of overlapping time intervals.
Specifically, if the NMC-RE story that nominal wages are
predetermined is true, it seems likely that anticipations formed
at a number of past dates, and, hence, based on different
information sets, are responsible for determining the present
nominal wage level. Parkin (1980) and Fethke and Policano (1982)
have analyzed the staggering of contracts theoretically, but,
unfortunately, such questions of timing are difficult to resolve
econometrically. For example, Fisher (1980, p. 220) concludes
"that the data cannot tell us whether only one-year ahead or only
two-year ahead errors in predicting money, or both, contribute to
explaining the behavior of output."

As noted above, much of the empirical work relating to the
macroeconomic relevance of rational expectations has focused on
the relation between real aggregates and unanticipated monetary
disturbances and, thus, would seem to represent implementation
of NMC-RE modelling. The seminal contribution along these
lines is the work of Barro, which is summarized and updated in
Barro (1981, ch. 5). Barro's work and various related studies,

however, do not address the issue of the dating of relevant
expectations. Consequently, their findings are not unambiguously
interpretable as estimates of the reduced-form relations implied
by NMC-RE models. Nevertheless, this research is instructive
about the problems involved in drawing inferences from the data
about the true relation between monetary aggregates and real
aggregates.

Most of Barro's work focuses on the effects of disturbances
to the average value of monetary aggregates during a calendar
year that rational agents could not have anticipated using
information available at the beginning of the year. His results
in the main seem consistent with the hypothesis that such
disturbances, and only such disturbances, affect the value of
real aggregates in the current and succeeding calendar years.
Strictly speaking, this conclusion accords with an NMC-RE model
that includes two auxiliary assumptions. First, nominal wages
are predetermined at the beginning of each calendar year.
Second, technological factors produce the observed pattern of
persistence in the effects on real aggregates.

Other studies have produced similar results using quarterly
data--see, for example, Barro and Rush (1980) for the U.S. and
Attfield, Demery, and Duck (1981) for the U.K.--and, accordingly,
are directly supportive of the assumption that nominal wages are
predetermined at the beginning of each quarter. In all of these
studies, however, inconsistency, most apparent in the lag
patterns, between estimated equations for real aggregates and
estimated equations for the price level is a serious problem.

Other problems involve apparent sensitivity of the empirical
results to changes in supplementary assumptions. For example,
Pesaran (1982) finds that Barro's conclusions depend on the
assumption that private agents are able to predict real federal
expenditures. Pesaran also finds that different testing
procedures suggest different conclusions.

Mishkin (1983, ch. 6) expands Barro's analysis by
distinguishing the hypothesis that only unanticipated monetary

disturbances affect real aggregates from the hypothesis that the relevant anticipations are rational expectations, and he attempts to test these hypotheses both jointly and separately. Mishkin is able to replicate the results of Barro and Rush, but he finds that, without their truncation of the lagged effects of unanticipated monetary disturbances, the data strongly reject the irrelevance of anticipated monetary disturbances and give an ambiguous verdict on rational expectations.

The problems and ambiguities involving dynamic aspects in this line of research possibly result from inadequate specification of the dating of relevant expectations. Another possibility is that these problems reflect inadequate modelling of the natural levels of real aggregates. Barro's formulation of the process generating the natural levels is admittedly simplistic, and Mishkin assumes that the natural levels merely follow time trends. It may be, however, that the extended lagged effects of monetary variables that play an important role in Mishkin's study are serving as a proxy for a significant disturbance to the natural levels of real aggregates. This suggestion is plausible because it seems clear that recent American data cannot satisfy the restrictions implied by the natural-rate hypotheses without allowing for such a disturbance.

The behavior of the unemployment rate illustrates this point dramatically. An assumption that the natural unemployment rate was constant over the postwar period would imply that the actual unemployment rate was below the natural rate until about 1970 and above the natural rate since then. Given the actual behavior of the price level and any plausible specification of inflationary expectations, this implication is clearly inconsistent with the natural-rate hypothesis. Moreover, assuming that the natural unemployment rate increased steadily over the postwar period, or even just for Mishkin's 1954 to 1976 sample, does not do much to alleviate thus inconsistency. What seems to be necessary to reconcile the data with the natural-rate hypothesis is to model the natural unemployment rate such that it increases sharply

between 1970 and 1974, but otherwise exhibits no noticeable trend.

A model of the natural unemployment rate that could generate this behavior might emphasize the effects of military manpower policy and/or of expanded income maintenance programs. In any event, it is clear that understanding the behavior of the natural unemployment rate persents an essential problem in reconciling the data with the natural-rate hypothesis. Moreover, the apparent empirical importance of correct modelling of the natural levels of real aggregates also suggests why as Mishkin finds, the data do not seem able to provide clear evidence on the reality of the rational-expectations hypothesis.

The general point is that convincing econometric implementation of NMC-RE models requires, among other things, identifiable specifications of the distinct processes that generate monetary policy and the natural levels of real aggregates. Given the actual response of monetary policy to the behavior of real aggregates and the available data, such specifications may not be empirically feasible.

6. Concluding Comment

The reaction of economic theorists to the survival of non-market-clearing assumptions often is to swallow hard and to look the other way. This response is hardly adequate. The position that strict application of neoclassical maximization postulates is relevant to macroeconomic developments only in the "long run" may seem reasonable from an empirical standpoint, but it puts neoclassical economics in a defensive position. It suggests the possibility of a general inability of neoclassical economics to account for short-run economic phenomena.

REFERENCES

C.L.F. Attfield, D. Demery, and N.W. Duck, "A Quarterly Model of Unanticipated Monetary Growth, Output, and the Price Level in the U.K. 1963-1978," Journal of Monetary Economics, 8, November 1981, 331-350.

C. Azariadis, "Escalator Clauses and the Allocation of Cyclical Risks," Journal of Economic Theory, 18, June 1978, 119-155.

R.J. Barro, "Rational Expectations and the Role of Monetary Policy," Journal of Monetary Economics, 2, January 1976, 1-32; reprinted in R.J. Barro, Money, Expectations, and Business Cycles (New York: Academic Press, 1981).

R.J. Barro, Money, Expectations and Business Cycles (New York: Academic Press, 1981).

R.J. Barro and H.I. Grossman, Money, Employment, and Inflation (New York: Cambridge University Press, 1976).

R.J. Barro and Z. Hercowitz, "Money Stock Revisions and Unanticipated Money Growth," Journal of Monetary Economics, 6, April 1980, 257-267.

R.J. Barro and R.G. King, "Time-Separable Preferences and Inter-temporal-Substitution Models of Business Cycles," NBER Working Paper No. 888, May 1982.

R.J. Barro and M. Rush, "Unanticipated Money and Economic Activity," in S. Fischer, ed., Rational Expectations and Economic Policy (Chicago: University of Chicago Press, 1980).

J. Boschen and H.I. Grossman, "Tests of Equilibrium Macroeconomics Using Contemporaneous Monetary Data," Journal of Monetary Economics, 8, November 1982.

K. Brunner, A. Cukierman, and A.H. Meltzer, "Stagflation, Persistent Unemployment, and the Permanence of Economic Shocks," Journal of Monetary Economics, 6, October 1980, 467-492.

G.C. Fethke and A.J. Policano, "Determinants and Implications of Staggered Wage Contracts," LSE Centre for Labour Economics Working Paper No. 112, February 1982.

S. Fischer, "Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule," Journal of Political Economy, 85, February 1977, 191-205.

S. Fischer, "On Activist Monetary Policy with Rational Expectations," in S. Fischer, ed., Rational Expectations and Economic Policy (Chicago: University of Chicago Press, 1980).

M. Friedman, "The Role of Monetary Policy," American Economic Review, 58, March 1968, 1-17.

M.L. Gertler, "Long-Term Contracts, Imperfect Information, and Monetary Policy," Journal of Economic Dynamics and Control, 3, August 1981, 197-216.

M.L. Gertler, "Imperfect Information and Wage Inertia in the Business Cycle," Journal of Political Economy, 90, October 1982, 967-987.

H.I. Grossman, "Why Does Aggregate Employment Fluctuate?" American Economic Review, 69, May 1979, 64-69.

H.I. Grossman, "Incomplete Information, Risk Shifting, and Employment Fluctuations," Review of Economic Studies, 48, April 1981, 189-197.

S.J. Grossman and L. Weiss, "Heterogeneous Information and the Theory of the Business Cycle," Journal of Political Economy, 90, August 1982, 699-727.

J.M. Keynes, The General Theory of Employment, Interest, and Money (London: Macmillan, 1936).

R.G. King, "Monetary Information and Monetary Neutrality," Journal of Monetary Economics, 7, March 1981, 195-206.

R.G. King and C.I. Plosser, "The Behavior of Money, Credit, and Prices in a Real Business Cycle," NBER Working Paper No. 853, February 1982.

R.E. Lucas, Jr., "Expectations and the Neutrality of Money," Journal of Economic Theory, 4, April 1972, 103-124; reprinted in R.E. Lucas, Jr., Studies in Business Cycle Theory (Cambridge: MIT Press, 1981).

R.E. Lucas, Jr., "Some International Evidence on Output-Inflation Trade-Offs," American Economic Review, 63, June 1973, 326-

334; reprinted in R.E. Lucas, Jr., Studies in Business Cycle Theory (Cambridge: MIT Press, 1981).

R.E. Lucas, Jr., "Econometric Policy Evaluation: A Critique," in K. Brunner and A. Meltzer, eds., Carnegie-Rochester Conference Series on Public Policy, Volume 1 (New York: North-Holland, 1976); reprinted in R.E. Lucas, Jr., Studies in Business Cycle Theory (Cambridge: MIT Press, 1981).

R.E. Lucas, Jr. and L.A. Rapping, "Real Wages, Employment, and Inflation," in E.S. Phelps, et. al., Microeconomic Foundations of Employment and Inflation Theory (New York: Norton, 1970); reprinted in R.E. Lucas, Jr., Studies in Business Cycle Theory (Cambridge: MIT Press, 1981).

F.S. Mishkin, A Rational Expectations Approach to Macro-economics: Testing Policy Ineffectiveness and Efficient Markets Models (Chicago: University of Chicago Press, 1983).

D.T. Mortensen, "A Theory of Wage and Employment Dynamics," in E.S. Phelps, et. al., Microeconomic Foundations of Employment and Inflation Theory (New York: Norton, 1970).

M. Mussa, "Sticky Prices and Disequilibrium Adjustment in a Rational Model of the Inflationary Process," American Economic Review, 71, December 1981, 1020-1027.

M. Parkin, "The Output-Inflation Tradeoff When Prices are Costly to Change," unpublished manuscript, October 1980.

M.H. Pesaran, "A Critique of the Proposed Tests of the Natural Rate-Rational Expectations Hypothesis," The Economic Journal, 92, September 1982, 5229-554.

E.S. Phelps and J.B. Taylor, "Stabilizing Powers of Monetary Policy Under Rational Expectations," Journal of Political Economy, 85, February 1977, 163-190.

J.L. Seater, "A Unified Model of Consumption, Labor Supply, and Job Search," Journal of Economic Theory, 14, April 1977, 349-372.

J.L. Seater, "Utility Maximization, Aggregate Labor Force Behavior, and the Phillips Curve," Journal of Monetary Economics, 4, November 1978, 687-713.

J.B. Taylor, "Staggered Wage Setting in a Macro Model," American Economic Review, 69, May 1979, 108-113.

J.B. Taylor, "Aggregate Dynamics and Staggered Contracts," Journal of Political Economy, 88, February 1980, 1-23.

T.J. Urich, "The Information Content of Weekly Money Supply Announcements," Journal of Monetary Economics, 10, July 1982, 73-88.