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RECENT DEVELOPMENTS IN MACROECONOMICS

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ABSTRACT

This paper surveys much of modern macroeconomics. The focus is on the core macroeconomic issue, of the reasons for macroeconomic fluctuations and sometimes persistent unemployment. To provide continuity and perspective on how promising research leads of the past turned out, the paper starts by summarizing developments since the Barro-Fischer (1976) survey of monetary economics. Sections III and IV develop in some detail the current representations of the two basic approaches to macroeconomics: the equilibrium business cycle approach and new Keynesianism respectively. Brief sketches of developments in several areas of research in Section V broaden the coverage. Section VI contains concluding comments.

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RECENT DEVELOPMENTS IN MACROECONOMICS.

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Underlying the existence of macroeconomics as a separate field of study are the phenomena of economy-wide fluctuations of output and prices, and sometimes persistent high levels of unemployment. Two basic views of macroeconomic behavior have persisted even as conceptual innovations and the application of more powerful analytic and empirical techniques have brought significant changes in macroeconomics.

One view and school of thought, associated with Keynes, Keynesians and new Keynesians, is that the private economy is subject to coordination failures that can produce excessive levels of unemployment and excessive fluctuations in real activity. The other view, attributed to classical economists, and espoused by monetarists and equilibrium business cycle theorists, is that the private economy reaches as good an equilibrium as is possible given government policy.

Any two-fold division of a complex, large and developing field of study is inevitably a caricature, which cannot do justice to the subtleties of the views of different individuals at a moment of time, the intricacies of the

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[1]Department of Economics, MIT, and Research Associate, NBER. This survey will appear in the Economic Journal. I am grateful to Olivier Blanchard, Rudiger Dornbusch, Andrew Oswald, Danny Quah, Julio Rotemberg, and the referees for helpful comments and/or discussions, and the National Science Foundation for research support. I am especially indebted to Olivier Blanchard, for I draw freely in this survey on material contained in our forthcoming book (1988).

development of the field over time, and the remarkable range of research topics that fall under the heading of macroeconomics. For instance, although the protagonists in the sixties were Keynesians and monetarists, and in the eighties are new Keynesians and equilibrium business cycle theorists, there is a clear sense in which the views of Milton Friedman or Karl Brunner and Allan Meltzer are closer to those of Keynesians than those of equilibrium business cycle theorists.[2] Nonetheless, the caricature captures the essence of macroeconomic controversies and provides a useful organizing framework within which to attempt a survey of a field that is too large for such an enterprise.

It appears that macroeconomics as such has not been surveyed. The classic 1962 Harry Johnson survey is of monetary economics; Barro and Fischer (1976) also survey monetary economics, though their definition of the subject is sufficiently broad to encompass disequilibrium theory, which is more macroeconomics than monetary economics. Rotemberg (1987) and Blanchard (1988) each provide excellent surveys of part of the material discussed in this paper.[3]

The focus in this survey is on the core issue, of the reasons for macroeconomic fluctuations and sometimes persistent unemployment. To provide continuity, and perspective on how promising research leads of the past turned out, I start by summarizing in Sections I and II developments since the Barro-Fischer survey. The core of the survey is contained in Sections III and IV

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[2]Milton Friedman's theoretical framework (1970) is close to the standard IS-LM model; Brunner and Meltzer's (1976) basic analytic model is not dissimilar to Tobin's (1969) three asset model. Friedman's view of the macroeconomy as adjusting slowly and unpredictably to monetary policy is very far from the modern real business cycle view that monetary policy plays at most a minor role in macroeconomic fluctuations and that markets are continually in equilibrium.

[3]Fischer (1987) also contains survey-like material.

which describe the current representations of the two basic approaches to macroeconomics: the equilibrium business cycle approach and new Keynesianism respectively. Brief sketches of developments in several areas of research in Section V broaden the perspective on the field. Section VI contains concluding comments.

I. Update from 1975.

Barro-Fischer (1976, written in 1975) describe their survey as complementary with Harry Johnson's 1962 paper. This survey in turn can be regarded as complementary with Barro-Fischer, which classified research into seven topics.

The Theory of Money Demand.

Theoretical work on the demand for money was a declining industry in 1975, and there has been only a brief subsequent revival. Akerlof and Milbourne (1980) develop a target-threshhold model of the demand for money, related to s-S models (Miller-Orr, 1966), in which money balances adjust passively to inflows and outflows of cash until they hit a lower bound, at which point the balance is restored to a higher level. Akerlof and Milbourne show that the short-run income elasticity of money demand in this model is very small, so long as the target and threshhold stay fixed, and argue that their model accounts for the very small short run income elasticities of demand found in empirical studies.

The collapse of the empirical demand for money function in the U.S. (Goldfeld, 1976; Rasche, 1987) led to a largely empirical reexamination of the basics of money demand. Most attention has been commanded by the work of

Barnett and others (e.g. Barnett, Offenbacher and Spindt, 1984) creating Divisia aggregated money stock measures. The change in the Divisia quantity index is equal to a weighted sum of the changes of the components, with the weights corresponding to the share of spending on that component of the aggregate. In the case of monetary assets, the spending on a particular component is priced at user cost, equal to the difference between the maximum expected holding period yield available in the economy and the expected yield on the particular asset--it thus corresponds closely to the notion of non-pecuniary returns. The Divisia aggregates are contrasted with the simple sum aggregates such as M_1, which weight components of each measure equally. The empirical success of the new measures has been mixed. Monetary targetting in terms of Divisia aggregates is complicated by the fact that the aggregates themselves depend on interest rates, so that achieving a targetted Divisia aggregate implies achieving a specific level of a non-linear function of different asset stocks and interest rates. Poterba and Rotemberg (1987) develop and estimate a more explicit related approach in which money and other assets enter the utility function, with differing liquidity characteristics and risk premia accounting for interest differentials.

Technical and regulatory changes and induced changes in definitions of the money stock are responsible for many of the shifts in the demand for money function (Porter, Mauskopf and Simpson, 1979). Nonetheless, these shifts have significantly reduced belief in the efficacy of a constant growth rate monetary rule and in monetarism.

Even though interest rate controls have been lifted, there is more deregulation of the United States financial system to come, for instance in

interstate and international banking. Whether stability will return to the demand for money function, for any of the conventional monetary aggregates or some Divisia aggregate, as deregulation of the banking and financial systems slows, remains to be seen. Continued deregulation and technical progress in the payments mechanism--heading in the direction of, but not reaching, the cashless society--are likely to make for future unpredictable and significant changes in velocity.

Money, Inflation and Growth.

In the 1976 survey this topic was devoted largely to the question of the effect of an increase in money growth on capital intensity. Whereas Tobin (1965) showed in a non-maximizing model that a higher growth rate of money produced both more inflation and higher capital intensity--and thus a lower real interest rate, money in Sidrauski's optimizing model (1967) is superneutral in the sense that higher rates of inflation do not affect steady state capital intensity and thus the real interest rate.

The effect of higher inflation in reducing the real interest rate is known as the Mundell-Tobin effect. In fact, the mechanisms that produce this effect in Mundell (1964) and Tobin (1965) are not identical. In Mundell, a higher inflation rate reduces real balances and thereby, through a wealth effect, consumption; the interest rate falls to ensure goods market equilibrium. In Tobin new money is introduced into the economy through transfer payments, the net real value of which is $(g-\pi)m$, where g is the growth rate of nominal balances, π the inflation rate, and m is real balances. In the steady state $(g-\pi)$ is equal to the economy's growth rate (assuming unitary income elasticity of money demand) which is independent of the

inflation rate, whereas m falls with the inflation rate. The real value of monetary transfers thus falls with the inflation rate, reducing consumption demand and the real interest rate. Back-of-the-envelope calculations suggest that both these effects are empirically very small.

Subsequent analysis showed that dynamic adjustment towards the steady state capital stock is typically faster in the Sidrauski model the higher the growth rate of money, thus reinstating the Mundell-Tobin result in the Sidrauski model, at least for the adjustment path (Fischer, 1979). A variety of results on the relationship between capital intensity and inflation have been obtained in other models of money, including for instance Stockman's (1981) model with a Clower constraint in which investment goods have to be paid for with cash in advance. The cost of investing rises with the inflation rate, and inflation therefore reduces capital intensity. However this result is not robust to the precise details of the assumed Clower constraint (Abel, 1985). In overlapping generations models inflation generally reduces capital intensity (e.g. Weiss, 1980).

The most important development in this area is the incorporation of details of the tax system into the analysis of the effects of inflation on interest rates and capital accumulation (e.g. Feldstein and Summers, 1978). Mainly because inflation erodes the value of depreciation allowances, these generally indicate that it reduces capital intensity and capital accumulation. Tax effects also disturb the Fisher effect on nominal interest rates, implying that the nominal rate should rise more than one-for-one with inflation if the after-tax real rate is to remain constant (Feldstein, 1976).

The empirical evidence supports the view that inflation adversely affects capital accumulation; in a cross-section of countries, the predominant relationship between inflation and the share of investment in GNP is negative (Fischer, 1983).

Empirical evidence on the Fisher effect has had an unusually checkered history. After Fama's striking 1975 demonstration that, on the assumptions of a constant real interest rate and rational expectations, the Fisher effect held one-for-one in the U.S. for the period 1951-1973, it soon became clear that the result was period specific (Begg, 1977). Further, the tax effects should have produced a greater than one-for-one effect of inflation on nominal interest rates. Subsequently Summers (1982) showed that ex post decadal average real interest rates have a strong negative correlation with inflation, and argued that this implied that ex ante rates are also negatively related to anticipated inflation.[4]

Changes in the real interest rate in the United States in the first half of the 1980's were in the direction implied by Summers' regressions. Indeed, it was common to account for the high real rates as a regular feature of disinflations--which while true is hardly an explanation. The high real rates of the early 1980's made the assumption of a constant ex ante real rate implausible if the rational expectations hypothesis is maintained.[5]

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[4]However McCallum (1984) has pointed out problems with the Summers argument. See also the subsequent debate between Summers and McCallum in the July 1986 Journal of Monetary Economics.

[5]It is always possible and possibly plausible to account for high long rates as consistent with unchanged real rates at the start of a disinflation, but high short rates cannot be consistent with an unchanged ex ante real rate.

Welfare Costs of Inflation, the Optimum Quantity of Money, and Inflationary Finance.

By 1975 the Phelps (1973) analysis of the inflation tax in the context of optimal tax analysis was becoming well known. Subsequent work was directed to answering the question of whether there were conditions under which the inflation tax would not be used, so that the optimum quantity of money result--that the nominal interest rate should be driven to zero--would still hold. Drazen (1979) showed, using a representative family infinite horizon model that there was no general presumption that money should be taxed, the result depending on cross-elasticities of demand between real balances and other goods. Faig (1985) proved in the case where money is modelled as an intermediate good, that it would be optimal not to tax it. The question of how optimally to finance government spending among bonds, money issue and taxes received was analyzed by Helpman and Sadka (1979).

The topic of the welfare costs of inflation received empirical attention. The conclusion of attempts to enumerate and quantify the costs of inflation (Fischer and Modigliani, 1978; Fischer, 1981) was that the costs of even moderate inflation could in practice amount to one or two percent of GNP in developed economies, but that these costs were largely the result of institutional non-adaptation to inflation.

As inflations in several countries rose to three digit annual rates in the 1980's, monetary financing of budget deficits became central to the analysis of the inflationary process. Seigniorage revenue can amount to several percent of GNP for governments operating at high rates of inflation, and could thus be an important factor in the perpetuation of high inflation in countries with rudimentary tax systems.

As a result of the Laffer curve, there may be two inflation rates at which a given amount of seigniorage revenue can be collected. The stability properties of the two equilibria differ, the high inflation equilibrium typically being stable under rational expectations. (Bruno and Fischer, 1987; Sargent and Wallace, 1987). Governments could then find themselves operating at an unnecessarily high inflation rate.

Despite the fact that seigniorage per se can produce significant amounts of revenue for the government, the inflation tax analysis that focuses on seigniorage may be seriously misleading. The Keynes-Olivera-Tanzi (1980) effect whereby tax revenues decline at high inflation rates[6] reduces the net revenue effects of inflation on government revenues. Remarkably, in the Israeli case there is evidence that on net inflation reduced government revenues during parts of the inflationary period, because the government was a net creditor on nominal terms and debtor on real terms (Sokoler, 1987). These considerations strongly suggest that something other than rational revenue considerations is driving the money-creation process in high inflation economies; one possibility is that the government has put in place a set of operating rules that leaves money creation as the residual source of government finance.[7]

Disequilibrium Theory.

In 1975 disequilibrium theory was a live area of research that had already produced insights, particularly into the notion of effective demand,

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[6]The effect is more likely a function of the change than the level of the inflation rate, for once the inflation level stabilizes tax rates are usually adjusted.

[7]Mankiw (1987) examines the determination of the inflation rate in the United States from an optimal tax viewpoint.

into the fact that behavior in any one market depends on whether other markets clear, and into the effects of changes in the real wage on the macro equilibiurm. The distinction between classical unemployment, resulting from too high real wages, and Keynesian unemployment, resulting from a lack of aggregate demand, which can be clearly understood from standard disequilibrium models, also proved useful, for example in empirical analyses of the European unemployment problem (Bruno and Sachs, 1985).

Beyond those insights, and despite the elegant statement of the approach in Malinvaud (1976) and other contributions reviewed in Drazen (1980), interest in disequilibrium theory has waned. The difficulty, already evident in 1975, was that the careful maximizing analysis that underlay the derivation of demand and supply functions at given prices was not extended to price dynamics itself. If there is a successor to disequilibrium theory, it is the new Keynesian analysis to be reviewed in Section IV, where price and quantity determination are treated symmetrically.

General Equilibrium Approach to Monetary Theory.

The "general equilibrium" discussed under this heading in the 1976 survey was the equilibrium of the assets markets, with attention focussed on the Brainard-Tobin supply and demand framework for asset pricing and the analysis of monetary policy. That approach has been integrated with the capital asset pricing model, in an attempt to identify the effects of changes in asset supplies on risk premia (e.g. B. Friedman, 1985; Frankel, 1985).

The modern approach to asset pricing deploys various forms of the capital asset pricing model, mainly derived through representative consumer models (e.g. Lucas, 1978; Breeden, 1979; Cox, Ingersoll and Ross, 1985).

Asset supplies are exogenous in the Lucas model; it is difficult to obtain closed form solutions for asset prices in models in which supplies are endogenous. The Lucas model has been used for studying relative asset returns (Campbell, 1986) and the size of the equity premium (Mehra and Prescott, 1985); Mehra and Prescott's results raise the question of whether the historical size of the equity premium can be rationalized in such models.

The term structure has continued as an active area of research, with the development of rational expectations econometrics making formal testing of the joint hypothesis of the expectations theory of term structure and rational expectations possible. The recent literature is surveyed by Shiller (1987), who states that there has been much progress in understanding the term structure in the last twenty years, but that empirical work has produced very little consensus.

The New Microfoundations of Money.

Covered under this heading was fundamental work attempting to explain the need for and use of money (e.g. Brunner and Meltzer, 1971; Kurz, 1974; Starr, 1974). Lucas (1980) and Townsend (1980) have pursued models in which the lack of a double coincidence of wants necessitates the use of an asset for making exchanges, but by and large work on the reasons for the use of money has not gone much further than it had in 1975. Rather the modern trend has been to impose the use of money on the model, rather than to allow it to emerge from within the model.

There are two approaches: the Clower or cash-in-advance constraint; and money in the utility function. The Clower constraint imposes the requirement that money has to be used in making some or all transactions. The

usual cash-in-advance constraint in discrete time models is that current income is not available for making current purchases, so that money for this period's purchases has to be held from the end of the previous period. By imposing unitary velocity on money holding this rules out the important systematic effects of inflation and interest rates on money holding.

Lucas and Stokey (1987) restore interest elasticity to money holding in a cash-in-advance constraint model by introducing a distinction between credit and cash goods, the former of which can be purchased with an interest free one period loan, the latter requiring the use of cash. Shifts in demand between cash and credit goods as their relative prices change then make it possible for inflation to produce systematic effects on velocity. However the distinction between cash and credit goods is unlikely to be independent of the inflation rate and interest rates. Svensson (1985) relaxes the unitary velocity assumption by assuming that individuals face uncertainty about their spending and have to decide on money holdings before the uncertainty is resolved.

The Clower constraint has also been imposed in general equilibrium continuous time models (Jovanovic, 1982; Romer 1986) where lump sum transactions costs generate a demand for money, as in the original partial equilibrium Baumol-Tobin models. There is a Clower constraint in the innovative continuous time model of Diamond (1984), in which both multiple and inefficient equilibria arise from the increase in the efficiency with which sellers search for buyers when there are more buyers. The constraint has been used constructively to explain asset pricing anomalies (Svensson, 1985; Townsend, 1987) and price level determinacy with pegged nominal interest rates (Woodford, 1985).

The money in the utility or production function approach has the benefit of greater generality in producing a demand for money. Indeed, as the theory of revealed preference shows, specifying that a good enters the utility or production function is merely the assumption that there is a demand for that good. Restrictions on the demand function emerge from the functional form of the utility function and from the precise way in which money balances are put into the utility function (Feenstra, 1986).

Rational Expectations and the Phillips Curve.

The longest section of the 1976 survey discusses the rational expectations hypothesis and its applications in monetary models. A sample Phillips curve along Lucas (1973) lines, but more explicitly emphasizing intertemporal substitution on both the supply and demand sides, is presented and used both to illustrate the information assumptions needed to generate a Phillips curve in an equilibrium model and the monetary policy ineffectiveness theorem.

The 1976 survey draws a clear distinction between the rational expectations hypothesis as a theory of expectations, and the type of equilibrium model in which the hypothesis was typically embodied at the time. Rational expectations has indeed become the dominant expectations hypothesis in macroeconomics, despite the evidence by Kahneman and Tversky (1983) of systematic errors in expectations, and repeated failures of joint tests of rational expectations and subsidiary hypotheses. The rational expectations hypothesis is the dominant paradigm because it is the natural benchmark model of expectations[e] and because the technology now exists to do rational expectations econometrics.

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[e]Or, what is almost the same thing, because there is as yet no clear way of choosing among alternative assumptions.

However, the need to couple the weak form of the rational expectations assumption--that individuals make the optimal use of the information available to them--with an explicit learning model is well recognized. De Canio (1979) showed convergence to rational expectations for a plausible learning process; the topic has been the subject of considerable recent research, e.g. Bray and Savin (1986), Marcet and Sargent (1986), and will no doubt generate further results on conditions for convergence to a rational expectations equilibrium, and the nature of the alternative equilibria.

The further difficulty of dealing with the rational expectations assumption in a many-agent model in which each agent's expectations depend on his beliefs about the expectations of others has been wrestled with by Frydman and Phelps (1983). The problem of infinite regress can be cut through by assuming each agent's expectations of actual outcomes is correct. However in situations such as the inception of an inflation stabilization program, the process of learning about the new situation where there are other agents whose actions depend on their beliefs is neither conceptually nor in practice straightforward.

The subsequent history of the Phillips curve component of the Lucas model is discussed in the next section.

II. Money and Equilibrium Business Cycle Theory.

The Lucas (1973) Phillips curve model[9] was the dominant equilibrium model for almost a decade. The distinguishing features of the model are that

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[9]Lucas (1972) is a more fully specified general equilibrium model that generates a non-exploitable Phillips curve tradeoff. It is possible that this model contains multiple equilibria.

it builds the Phillips curve on imperfect information, and that the exposition though not necessarily the structure of the model emphasizes a monetary cause of economic fluctuations.

A third feature distinguishes the model as a prototype equilibrium model: prices move instantly to clear markets which are fully competitive. By contrast, Phillips (1958) rationalized his curve as an expression of the response of wages to labor market disequilibrium. If the expectations of individuals in the Lucas model were correct, the equilibrium would be a Pareto optimum. More even than the assumption of equilibrium, it is the assumption of competition that distinguishes the equilibrium business cycle approach from other analyses of economic fluctuations.[10]

Lucas derived several important results in his 1973 paper. The first is the Phillips curve-but result; there is a tradeoff between output and inflation, but the tradeoff is only with unanticipated inflation. This implies the policy ineffectiveness result, later developed by Sargent and Wallace (1975), that monetary policy has no real effects in models of this type. This was the main empirical implication of the model tested by later researchers.

The third result is that the slope of the Phillips curve in the Lucas model consists of a combination of a structural parameter, the elasticity of supply in each market, and a variance ratio that is affected by policy. Thus an apparently structural parameter, the slope of the Phillips curve, would change if policy changed in a particular way.[11] Such possibilities are at the

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[10]Equilibrium theorists frequently rely on the result that a Pareto optimum can be supported by a competitive equilibrium to analyse quantity movements in representative agent models without having to examine price behavior.

[11]In the 1973 article Lucas attempted to test this implication using international cross-sectional data.

heart of Lucas's famous econometric policy evaluation critique (1976), which asserts that because apparently structural parameters may change when policy changes, existing econometric models cannot be used to study alternative policy regimes.

The policy evaluation critique has had a devastating impact on both econometric policy evaluation and the seriousness with which large scale macroeconometric models are treated by researchers, at least in the United States. Into the mid-seventies, serious academic researchers were putting major efforts into large-scale models; state-of-the-art empirical versions of major behavioral functions were as likely to be found in the MPS (MIT-Penn-SSRC) model as anywhere.

Such models are now routinely dismissed as "subject to the Lucas critique"--though remarkably, that critique has not been shown to be of any empirical significance in accounting for the failures of the econometric models in the seventies. Lucas himself (e.g. 1976) has repeatedly referred to the massive empirical failure of these models in including a long-run inflation-unemployment tradeoff that was falsified in the seventies.[12] But that was a failure of theory, which was repaired in the late sixties, following work by Friedman and Phelps, by adding the expected inflation rate to the Phillips curve. The 1973 supply shock also led to an underprediction of inflation in the major models, but that has nothing to do with the Lucas critique--unless the Lucas critique is reduced to the statement that models are inevitably misspecified.

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[12]See also Lucas and Sargent (1978) who refer to "empirical failure on a grand scale" and the evaluation of that claim by Blanchard (1988).

From a theoretical viewpoint, the Lucas (1972 and 1973) model is of interest for its demonstration of the information-conveying role of prices. Lucas included two disturbances and one source of information about them--the price in the local market. Some of the subsequent theoretical developments elaborated on the information structure, for example by adding a capital market. The basic result in models in which money would be neutral with full information is that it will be neutral (non-superneutrality, such as the Mundell-Tobin effect aside) if there is sufficient information to identify the disturbances in the economy; so long as monetary disturbances (which may come from the demand as well as the supply of money) cannot be fully identified, unanticipated changes in money will have real effects.

Despite the elegance and intellectual power of the original model, subsequent intensive theoretical development, and some empirical successes, the imperfect information about current monetary variables approach to the monetary business cycle has met with severe difficulties. The basic problem is that it is difficult to believe that a lack of information about current nominal variables, particularly the price level, can be the source of monetary non-neutrality, when the lags in producing money stock and price level data are of the order of weeks. Further, if those lags were important, they could be reduced to seconds. It would be entirely possible to produce an on-line estimate of the current price level at low cost by providing terminals to businesses, which would enter price changes as they took place. The failure of the CPI futures market set up in the United States in 1985 also suggests that short term aggregate price level uncertainty is not a significant problem in the U.S. economy.

Beyond this problem, empirical support for the model was not robust. Despite early work by Barro (1978) indicating that only unanticipated changes in the money stock affected output, later research by Gordon (1982) and Mishkin (1983) suggested that both anticipated and unanticipated money mattered. Results by Boschen and Grossman (1982) showing that output appeared to be affected by the currently perceived money stock, and related conclusions reached by Barro and Hercowitz (1980), coming as they did from proponents of the equilibrium approach, had a significant impact on supporters of the approach.

The Lucas model was set up to model the Phillips curve, or the apparent association between inflation and output. The non-neutrality of money is a problem for monetary theory precisely because money is neutral in most clearly specified models in which markets clear quickly. If sticky prices are ruled out on methodological grounds, and the implausibility of the information assumptions rule out the information-confusion assumption of the 1973 Lucas model, then it becomes difficult (this is an empirical statement) to provide a convincing theoretical acccount of a causal Phillips curve relationship.

The most influential demonstration of the real effects of money on output is no doubt Friedman and Schwartz's (1963) account of the Great Depression; their more systematic attempt to address this issue (1963a) by working with cyclical average data and timing relationships was less persuasive because of the evident variability of the timing relationships and the question of causation.

Confidence in a causal role of money was increased by Sims' (1972) result in a two variable (nominal GNP and the money stock) system that money Granger-causes output, and by the previously noted results on the effects of unanticipated money on output. However, the disappearance of Granger causation for money in a vector autoregression to which the nominal interest rate was added (Sims, 1980) raised doubts about the role of money, even though no clear explanation for the latter finding emerged.[13] Combined with the theoretical difficulties, this 1980 result led to exploration of the implications of endogeneity of the money stock.

Money may be endogenous either because central banks pursue accommodating policies, or because most of the money stock is inside money, the real volume of which adjusts to the level of economic activity. Tobin (1970) showed in a model of endogenous money that particular money supply rules may generate the appearance that money Granger-causes (a concept that was not yet used in economics) output even in a context where it has no effects on real output (Tobin presented this result as an example of the post hoc, ergo propter hoc fallacy).

One approach to modelling the role of inside money is to include transactions services as a factor of production, and to assume that banks are involved in the production of such services, using labor, capital, and perhaps outside money as factors of production (King and Plosser, 1984).[14] In the absence of outside money, it is difficult to see why the price level or

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[13]Both Rotemberg (1987) and Blanchard (1988) examine and extend the evidence, concluding that it supports the view that monetary shocks affect output.

[14]However there is no inherent reason that outside money is needed in such a system.

inflation rate as opposed to real activity is procyclical in such models. Once outside money is introduced, the behavior of the price level follows from the interactions of the real demand for outside money and the nominal supply: this approach like that of Tobin (1970) relies on central bank behavior to determine the correlation between the price level, the money stock, and output.

With regard to money, the equilibrium approach appears to be squeezed between the theoretical difficulty of finding a route through which monetary policy can affect output and the fact that changes in aggregate demand do appear in practice to affect output. The real business cycle approach sidesteps the money issue and attempts to account for the major characteristics of the cycle in a purely non-monetary framework.

III. Business Cycles and Real Business Cycles.

Four sets of stylized facts are the central focus of business cycle analysis:

.There are fluctuations over time in both employment and unemployment, correlated across industries, associated with only small changes in the real wage, and apparently correlated with demand disturbances.

.These fluctuations, along with fluctuations in output, are serially correlated, which is the essence of the business cycle.

.Business cycle fluctuations appear to be correlated with monetary disturbances: there is a Phillips curve. The two approaches to building equilibrium models consistent with this fact have already been described.

.Consumption, income, and employment are positively correlated over the cycle.

The work of Nelson and Plosser (1982) and subsequent research by among others Rose (1986), Cochrane (1986), Campbell and Mankiw (1987), and Quah (1987) has cast doubt on the conventional characterization of the cycle as consisting of serially correlated divergences of output from a smooth trend. Rather it is argued there is a unit root in the stochastic process for output--and that there is little dynamics other than that. If there were no dynamics other than the unit root--that is if output followed a random walk, then it would not be possible to talk of a business cycle in output. However, Campbell and Mankiw cannot reject the characterization of output as a second order hump-shaped process around a deterministic trend. Further, Cochrane (1986) finds some evidence that the dominant root is less than one.

More fundamentally, even if there were a unit root in output, the business cycle could be defined as consisting of fluctuations of the unemployment rate about a slowly moving trend. There is little evidence of a unit root in unemployment, except perhaps for some European countries (Blanchard and Summers, 1986). Thus the existence of the business cycle does not seem threatened by the finding of a unit root in the stochastic process for output.

Business cycle theory was a major branch of economics until the Keynesian revolution. Early business cycle theorists saw the cycle as largely self-sustaining, with each boom containing the seeds of the subsequent recession and slump, the slump in turn containing the seeds of the recovery and boom.[15] The business cycle continued to be a subject of research

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[15]Haberler (1937) contains an authoritative account of the earlier approaches.

following the Keynesian revolution; Samuelson's (1939) multiplier-accelerator model, Kaldor's non-linear cycle (1940), and Hicks' non-linear models (1950) are all firmly in the Keynesian tradition. The Keynesian revolution did shift the focus of macroeconomics from the inevitability of the cycle to methods of improving macroeconomic performance.

During the long expansion of the sixties, it was even possible to think that the business cycle had been cured.[16] Poor economic performance during the seventies, reflected in the increased frequency and depth of recessions, together with the forceful advocacy of Robert Lucas (1977) renewed interest in the business cycle as a specific field of research. But modern approaches are not a continuation of the main line of earlier business cycle analysis.

Rather, modern theorists have followed the stochastic approach of Frisch (1933) and Slutsky (1937), which distinguishes between the shocks that impinge on the economy, causing variables to differ from their steady state values, and the propagation mechanisms that convert the shocks into longer lived divergences from steady state values.[17] The modern approach is especially convenient for econometric implementation. Further--and this was the basic point of Frisch and Slutsky--the time series behavior of economic variables produced when shocks disturb relatively simple linear difference equation systems is broadly consistent with business cycle characteristics. Adelman and Adelman in 1959 showed that the Klein-Goldberger econometric model

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[16]No doubt economic fluctuations will always be with us; the cycle would be cured if deviations from full employment output were small and serially uncorrelated.

[17]Zarnowitz (1985) compares earlier and later approaches, not always to the benefit of the latter, which he suggests has become excessively fragmented.

(the forerunner of the Wharton model) generated output movements similar to those observed in the U.S. business cycle when subjected to stochastic disturbances.

Shocks may hit the economy on the demand side, for instance a stochastic change in private sector or government demand for goods, perhaps resulting from a change in fiscal or monetary policy. Or they can come from the supply side, as productivity shocks, or shifts in the supply functions of factors of production. The shocks, for instance productivity shocks, may be serially correlated.

A variety of propagation mechanisms can carry the effects of the shocks forward through time:

.Because individuals prefer smooth consumption streams, temporarily high output today generates high saving, thus high investment, and a larger capital stock and higher output tomorrow.

.Lags in the investment process may mean that increased investment demand today increases investment demand and output in future periods as well.

.Firms carry inventories in part to meet unexpected changes in demand. A demand shock today will cause firms both to draw down inventories and increase production, and in future periods they will increase production to restore inventories. Thus production will be serially correlated.

.Individuals may work harder when wages are temporarily higher--the intertemporal substitution of leisure--and thus both magnify the effects of productivity shocks on current output and tend to produce negative serial correlation of labor input.

.Because it is costly for firms to adjust their labor forces, firms tend to adjust the labor force gradually in response to changes in wages and prices.
.Because individuals may take time to understand the nature of the shocks hitting them (in particular whether they are permanent or transitory) their responses to shocks may be distributed over time.
.Because it takes time for individuals to search for and find jobs, shocks to demand and supply lead to prolonged labor force adjustments.

Both the shocks and the propagation mechanisms identified in the preceding paragraphs can be embodied in either market clearing or non-market clearing cycle models.[18] Proponents of the equilibrium real business cycle approach[19] are distinguished by their view that virtually all business cycle phenomena are the result of productivity shocks hitting an economy in which markets are continuously in equilibrium.

In general, though, real business cycle theorists do not examine markets explicitly, rather drawing on the equivalence of market and planning solutions to deduce the behavior of quantities that would be seen if resources were allocated optimally. They typically also work with representative agent models. In the remainder of this section I concentrate on the real business cycle approach, best exemplified in the paper by Kydland and Prescott (1982).

Serial correlation of output in an equilibrium model can be generated most simply by assuming that productivity disturbances are serially correlated--as they undoubtedly are. A priori it seems reasonable to posit

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[18]Capital accumulation, inventory dynamics and slow adjustment of factors of production were all components of the MPS model.
[19]See for example the case made by Prescott (1986); Summers (1986a) attacks Prescott's claims for the approach. Fischer Black (1982) was an early proponent.

that productivity shocks are a mixture of permanent changes that come from improvements in knowledge[20] and transitory changes such as those that come from the weather. If factor inputs were constant, any pattern of output correlation could be derived purely by specifying the stochastic process for productivity. Kydland and Prescott do assume productivity is serially correlated, though there is no indication in the description of their results how much the different shocks and propagation mechanisms in their model each contribute to the overall variability of output. Whether their assumption about productivity is a satisfactory basis for explaining cyclical and trend behavior depends on whether independent evidence can be found for the assumed formulation (McCallum, 1986)). Research attempting to identify supply and demand disturbances (Shapiro (1987) and Blanchard and Quah (1987)) is currently under way.

I now briefly discuss propagation mechanisms; it will turn out that the key issue is that of the intertemporal substitution of leisure, without which shifts in aggregate demand have no impact on output and supply shocks have no impact on labor input.

The Role of Capital.

It is straightforward to obtain a stochastic first order difference equation for output from an overlapping generations model of two-period lived people who supply work inelastically in the first period of life and save by

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[20]By definition, the stock of genuine knowledge must always be increasing, apparently implying that technical knowledge as represented by the production function should have only positive increments. However, mistakes may be made in choosing technologies to use. In the field of economics, monetarists would argue there was technical regress when the Keynesian revoluation was adopted, Keynesians would argue there was technical regress when monetarism temporarily triumphed in the seventies.

buying capital that is used up in retirement. A positive productivity shock in the current period raises output and the income of the employed, therefore saving, and therefore future capital stocks. This produces positive serial correlation of output, through the supply side.

However the supply of capital route to serial correlation cannot be empirically significant. Suppose that a shock raises GNP this year by 1% and that saving increases by as much as 0.5% of GNP. With the real return on capital equal to about 10%, the extra saving would increase output by 0.05% in the following year, implying very little persistence of the effects of the productivity shock.

Long and Plosser (1983) develop a simple multi-sector capital model. With an n-sector input-output structure, and a one-period production lag between inputs and outputs, the system has n roots and is therefore capable of interesting dynamic behavior when disturbed by productivity shocks. This model too will not generate high serial correlation of output unless the share of capital in output is high.

Nonetheless, it has long been observed that booms in economic activity are typically accompanied by investment booms; the multiplier-accelerator mechanism has for long been part of most accounts of the cycle. Kydland and Prescott (1982) emphasize "time to build"--investment projects require inputs in several earlier periods before they come into operation. However it is not clear from their exposition how much of their dynamics results from the time to build assumption.

Inventories.

It is well known (see for example Dornbusch-Fischer (1987), Chapter 9) that inventory decumulation accounts for a significant proportion of the decline in real GNP in periods following cyclical peaks. In every post-1948 U.S. business cycle except one (1980-81), a large part of the decline in demand during the recession consisted of a decline in inventory accumulation.

The intuitive explanation for the role of inventories is that a decline in demand causes an inventory build-up, perhaps slowly if producers do not notice the demand shift immediately, and that production is then cut back to work off the excess inventories. In a model with a multiplier, this cutback in production itself reduces demand further, accentuating the decline in output.

Inventory accumulation is usually motivated in equilibrium models by production smoothing. Increasing marginal costs of production imply that it is cheaper to meet shifts in demand by changes in production that are distributed over several periods than by increasing production solely in the period of the demand shift.[21] A shock to demand causes an increase in consumption in the current period, which is met in part by increased production and in part by drawing down inventories. Then in subsequent periods production stays high as inventories are restored to their target level. In the case of cost shocks, a temporary cost reduction should lead to an increase in output and buildup of inventories, followed by lower output that allows inventories to return to their target level.

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[21]The insight goes back at least to Holt, Modigliani, Muth, and Simon (1957). Blinder and Fischer (1981) embed production-smoothing based inventory behavior in an equilibrium model.

In the real business cycle approach, which emphasizes productivity shocks, inventories tend to create negative serial correlation of output. A favorable temporary productivity shock results in higher output today, partly for consumption and also to build up inventories. Then in future periods output is lower than normal as the inventories are consumed, creating the possibility of negative serial correlation of output.

Although inventory dynamics is not helpful in explaining positive serial correlation in real business cycle theory, I briefly review recent work. The production smoothing model implies that if shocks are to demand, output is smoother than consumption; if shocks are to supply, output is more variable than consumption. Several researchers have found that the variability of production exceeds that of sales or consumption[22] implying either that the production smoothing model is inappropriate or that cost shocks play a larger role in explaining inventory behavior than most researchers are willing to allow.

At least two other models have been proposed to account for the cyclical behavior of inventories. One builds on production lags (Abel, 1985; Kahn, 1986).[23] Suppose that the sales process takes at least one period, and that goods have to be in place at the beginning of any period in which they are to be sold, and that demand is serially correlated. Then high sales this period imply that inventories have to be restored, and that production has also to increase to meet higher than average demand next period.

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[22]See for example Blinder (1984) and West (1985).

[23]Although the Kahn and Abel models are related, Abel examined conditions under which production smoothing still took place, whereas Kahn was looking for conditions that explain the "excess" volatility of inventories.

A second approach, initiated by Blinder (1981), and followed by Caplin (1985) and Mosser (1986), explores the implications of models in which inventory policy is s-S. The policy is to order inventories only when the inventory level hits a trigger point, s, and then to order an amount that restores the inventory level to S.

If the average order size (S-s) is large relative to sales, then this ordering policy, which is frequently used in practice, creates the possibility that production can vary more than sales. Whether it does, depends significantly on the cost function of ultimate suppliers. If the supplier has constant costs of production, the s-S policy may well lead to more variable output. Alternatively, suppose demand for the final good were relatively constant, and that the s-S orders come in quite regularly to the producing firm. With concave production costs the producing firm would produce smoothly to meet expected orders, and the s-S policy would determine only where inventories were held--by producer or by seller--rather than the production pattern (Caplin, 1985).

Intertemporal Labor Supply Substitution.

Both capital accumulation and inventory dynamics undoubtedly play a role in business cycle dynamics, and both illustrate that entirely neoclassical economies in which markets are always in equilibrium can be expected to produce serially correlated movements in output around trend. But none of the models we have developed so far accounts explicitly for the first stylized fact set out above, the pro-cyclical pattern of hours of labor.

If shocks are assumed not to come from the labor supply function itself, then the cyclical pattern of labor supply in an equilibrium model is

determined by the cyclical behavior of the real wage. The question of whether the real wage is pro- or countercyclical has been the subject of research for at least a half-century, since Keynes assumed in the General Theory that firms were always on their demand function for labor.[24]

Geary and Kennan (1982) test and are unable to reject the hypothesis that the real wage and employment are independent across a sample of twelve industrial countries. They show that results on the cyclical properties of the real wage depend on whether the CPI or WPI is used to define the real wage. However the weight of the evidence by now is that the real wage is slightly procyclical. Schor (1985) finds evidence of pro-cyclical wages in nine industrialized countries for the period 1955-70, with less procyclicality in the subsequent decade. Basing his argument on overtime premia, Bils (1986) also finds significantly procyclical real wages. We shall in the following discussion assume that the real wage is mildly procyclical, but that it would require large elasticities of labor supply for these real wage movements to be interpreted as movements over the cycle along a simple labor supply curve.

There have been three approaches to explaining the cyclical behavior of the real wage. One is to argue that the labor market is not in equilibrium, that, for instance, there is always excess supply of labor, and that the business cycle is driven by shifts in aggregate demand. The pattern of the real wage then depends on assumptions about pricing. In the General Theory and early Keynesian models, in which firms were assumed to be always on a stable demand function for labor, the real wage would be counter-cyclical if

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[24]It is well known that Dunlop (1938) showed the real wage was procyclical in fact. Tarshis (1939) is often credited with supporting Dunlop's results, though as noted by Blanchard (1987) in fact he showed a negative correlation between changes in manhours and changes in real wages.

aggregate demand disturbances are the predominant cause of the cycle.[25] In mark-up pricing models, in which the price is a mark-up on the wage, the real wage may be independent of the state of the cycle.

The second argues that observed real wages have very little to do with the allocation of labor[26]. The wage is set either to provide insurance to workers, or as part of a long-term bargain between the firm and the worker, and need not vary with employment. Nonetheless, because it is efficient to do so, work at all times is pushed to the point where the marginal product of labor is equal to the marginal utility of leisure.

Proponents of equilibrium business cycles have however largely pursued a third route, the intertemporal substitution (of leisure) approach. The approach, which can be traced to an influential 1969 paper by Lucas and Rapping, argues that labor supply responds extremely sensitively to transitory incipient changes in the real wage, and that this high elasticity reduces movements in the real wage. Whatever movements there might be in the real wage could easily be obscured by small disturbances to the supply of labor function.

Consider a person who consumes and works in two periods. The utility function is:

$$U(c_1,c_2,x_1,x_2) = \ln c_1 - \gamma(1+\beta)^{-1}x_1^{1+\beta} + (1+\theta)^{-1}(\ln c_2 - \gamma(1+\beta)^{-1}x_2^{1+\beta}) \qquad (1)$$

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[25]When in the 1970's supply disturbances made their entry into standard macroeconomic models, it became clear that the cyclical pattern of the real wage depends on the predominant source of disturbances.

[26]This is implied by Azariadis (1975) and developed in Hall and Lilien (1979).

where c_1 is consumption, and x_1 is labor; $\beta > 0$. The greater is β the greater is the curvature of the disutility of labor function and the less willing are individuals to substitute labor (and thus leisure) intertemporally. The individual maximizes (1) subject to the budget constraint

$$c_1 + c_2/R = w_1x_1 + w_2x_2/R \qquad (2)$$

where R is one plus the interest rate.

Solving the resultant first order conditions, the ratio of labor inputs in the two periods is:

$$x_1/x_2 = [w_1/(w_2(1+\theta)/R)]^{1/\beta} \qquad (3)$$

The ratio of labor inputs is determined by the relative wages in the two periods w_1 and w_2/R, with an elasticity $1/\beta$ that depends on the curvature of the disutility of labor function, and which for β small (in which case the marginal disutility of labor is virtually constant) may be extremely large. Thus, depending on the utility function, a small increase in the wage in one period relative to the wage in the other may cause the individual to work much more in that period relative to the amount of work done in the other period.

When w_1 and w_2 change in the same proportion, (3) shows that there is no change in the ratio of work done in the two periods. It can also be shown that a proportional increase in wages in the two periods leaves total hours of work in each period unchanged as the income and substitution effects of the change in the wage just balance each other. That is, individuals may respond sensitively to transitory changes in the real wage, while responding not at all to permanent changes.

This result is the essence of the intertemporal substitution explanation of the behavior of hours of work over the cycle: that individuals respond sensitively to the small pro-cyclical variations that can sometimes be detected in the real wage. Such variations could for instance be caused by productivity shocks. Hence if the cycle were driven largely by productivity or supply shocks, and if intertemporal substitution were to be established as a major force in determining hours of work, the basic puzzle of large movements in the quantity of labor could be solved in an equilibrium framework.[27]

The empirical evidence on the intertemporal substitution hypothesis is mixed, though mainly unfavorable. Work by Altonji (1982) and Ashenfelter (1984) finds little evidence to support strong intertemporal substitution effects in labor supply. Heckman and Macurdy (1987) suggest that the evidence is still in its infancy, and that it is not inconsistent with equilibrium models that admit considerable worker heterogeneity.

Consumption and Leisure over the Cycle: Even if the inter-temporal leisure substitution explanation of the cyclical behavior of real wages and employment is accepted, the final stylized fact--the negative covariance of consumption of goods and consumption of leisure--has to be accounted for. More work is done in booms than in recessions; there is also more consumption (or at least purchases of consumption goods) in booms.

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[27]Note that the real interest rate plays a role in determining the intertemporal allocation of labor: a procyclical pattern of the real interest rate could therefore account for cyclical changes in the quantity of labor that occur despite constant real wages.

The standard utility function used to study intertemporal allocation problems is additively separable (over time). Assuming both consumption and leisure are normal, Barro and King (1984) show that such functions have the very strong implication that both consumption and leisure should move in the same direction in response to all disturbances except those that change the terms of trade between consumption and leisure within a given period, that is the real wage. Without real wage movements the cyclical pattern of consumption and leisure cannot be explained by the standard form of utility function. But since real wage changes are, if at all, only mildly procylical, the additively separable formulation cannot be a good one--if one insists on an equilibrium interpretation of the business cycle.

Mankiw, Rotemberg and Summers (1985) examine the Euler equations derived from the standard intertemporal optimization problem based on a particular additively separable utility function. Using aggregate time series data they find no support for the intertemporal substitution model. The essential problem is the cyclical pattern of leisure and consumption, for they typically find that one or the other is inferior.

Equilibrium business cycle proponents have suggested two alternatives to the standard formulation. The first, due to Kydland and Prescott (1982), allows for habit formation or fatigue in the utility function, by replacing the leisure argument in the utility function by a distributed lag on leisure.

The second formulation builds on the fact that most variation in hours takes the form of changes in numbers employed rather than hours per employee. Staying within the representative agent framework, Hansen (1985) and Rogerson (1985) have built models in which individuals work either zero hours or full time (say forty hours).

Solving the central planning problem in such an economy, Hansen shows that "wage" or consumption variability over time does not depend on the properties of the underlying utility of leisure function. Rather, the cyclical pattern of the wage reflects the properties of the marginal utility of consumption function and not the marginal utility of leisure function--because hours of work are not set to equate the marginal utility of leisure[28] to the real wage.

What is the market setup corresponding to this central planning problem? It is that everyone owns a share of the firm or firms in the economy, and receives the same share of profits; in addition, every potential worker signs a contract with a firm, which guarantees a given utility level in exchange for the individual's willingness to work a specified number of hours if his or her number is drawn. If there is disutility to work, then each worker will receive a payment for signing, and an additional payment if he or she works.

It is not clear what should be regarded as the wage in this setting. If it is the marginal product of labor, then that may not change over the cycle--for instance if the utility function is separable, and there is the appearance of large changes in output with no change in the wage. Alternatively, if everyone who signs a contract with the firm receives a payment, and there is an additional payment for those who work, that marginal payment may be regarded as the wage--and it could be constant over the cycle. It is also possible though that the wage is measured as the per capita payment

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[28]If the utility function is separable between leisure and consumption, then the marginal utility of leisure at 40 hours of work per week is constant.

(averaged over employed and unemployed) received from the firm by each worker, which increases with the aggregate amount of work done in this model. Further, if the marginal utility of consumption were decreasing, the average payment per worker would be even more pro-cyclical. In this case the Hansen-Rogerson construction also implies a pro-cyclical real wage.

Two issues are relevant in judging the potential value of the Rogerson-Hansen amendment to the standard equilibrium model. First, it is necessary to detail the factors determining the length of the workweek, and the possibilities of part-time and overtime work. It is clear that there is some fixed cost of taking a job and thus that the approach starts from a useful fact; it is also clear that the workweek in fact varies over the cycle, and that part-time work has become increasingly common. Second, the implication of full private insurance against unemployment and the fact that the unemployed are in no way worse off than the employed are both unsatisfactory, the first because there is very little private unemployment insurance, the second because it violates everyday observation. Whether by invoking moral hazard and non-homogeneities of the labor force it becomes possible to explain the absence of such private insurance in an equilibrium model remains to be seen.

The more important lesson of a model of this type may be that the representative agent assumption is unsatisfactory, and that labor force heterogeneity may play an important role in determining the cyclical pattern of wages. Suppose that for technological reasons individuals can work either full time or not at all. Suppose also that workers differ. Then variations in employment take place at the extensive margin where new individuals enter

employment or leave it, rather than at the intensive margin of hours of work. Then the responsiveness of hours of work to changes in the real wage have nothing to do with individual utility functions, but rather with the distribution of reservation wages of those near the employment margin.[29]

Variation in numbers employed across the cycle is reflected also in the pattern of unemployment. Very little in the equilibrium business cycle framework addresses the issue of unemployment.[30] Indeed, it has been common in this approach to work with the level of output as the key macroeconomic variable, and to treat unemployment as a secondary and not very interesting issue.[31]

Even if the unemployment issue is left aside, the equilibrium approach to the business cycle runs into its greatest problem in the labor market. Real wages simply do not show the movements that are needed for this theory to explain the facts, and it is unclear that the assumption of indivisible labor solves the problem. What then could explain the facts? We have already noted that theories that do not require labor market equilibrium may do the job.

Alternatively, the reported real wage may not accurately reflect the marginal product of labor and marginal disutility of work. For instance, imperfect capital markets may result in firms paying workers a constant real wage over the cycle, with the allocation of labor nonetheless sensitively reflecting shifts in the productivity of labor and marginal valuation of time.

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[29]This point is emphasized by Heckman (1984) and Heckman and Macurdy (1987).

[30]Ham (1986) argues that the unemployed cannot be interpreted as being on their labor supply functions in any useful sense.

[31]This tradition goes back at least to Friedman's Presidential Address (1968). For an examination of the issue of involuntary unemployment, see Lucas (1978a).

Labor adjustment costs.

The real wage may differ from the marginal product of labor in the short run when there are costs of adjusting inputs.[32] Labor adjustment costs reduce the response of hours of work to the real wage: the firm changes its labor input in response to a transitory shock to productivity or the wage, by less than it would without costs of adjustment. In response to a permanent shock to the wage or productivity, the firm eventually adjusts all the way, setting the marginal product equal to the wage. But the adjustment takes time.

With respect to cyclical adjustments to real wage movements, this model has exactly the opposite implications to the intertemporal substitution model. Costs of adjustment therefore do not help account for the cyclical pattern of real wages and employment.[33]

Search unemployment.

Unemployment is modelled in an equilibrium framework as resulting from search, where the search is not only that of unemployed workers looking for jobs but also that of vacancies looking for workers. Mortensen (1970) develops a search-theoretic unemployment model and derives an explicit expression for the natural rate of unemployment as a function of the determinants of rates of job loss and acceptance. Lucas and Prescott (1974) present a complete model of the unemployment process generated by stochastic

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[32]Models with labor adjustment costs have been studied by Solow (1965) and Sargent (1978).

[33]An extended version of the adjustment cost model is often used in explaining the cyclical pattern of labor productivity. In that version not only are there costs of adjusting the input of labor, but also the existing labor force may work harder at times of high demand, or may be used in times of slack on maintenance and other investment-like tasks.

shifts in demand among sectors and a one-period lag by workers in moving between sectors. More recently Diamond (1981, 1982) and Pissarides (1985) have developed and worked with sophisticated continuous time search models.[34] Howitt (1987) is a particularly tractible search model, embodying adjustment costs for labor, and generating dynamic adjustment of employment and unemployment to productivity and demand shocks.

One theme of modern search theories of unemployment is that because job matches require an explicit search process, there is no market to set the wage. (Mortensen, 1982) Rather it is assumed that the wage is set in a bargain which divides the surplus from the job between the worker and the firm.

Typically equilibrium is inefficient in these models, reflecting a search externality which arises because a worker's decision to search makes it easier for a firm to fill its vacancy--but there is no direct compensation from the hiring firm to the searching worker for his or her decision to become unemployed. The inefficiency may make a case for unemployment compensation. In the opposite direction, the congestion externality created for the unemployed by the decision of a worker to join their ranks could suggest a tax on unemployment.

Lilien (1982) argued that most of the variance of unemployment in the United States in the period 1958-1977 was a result of relative rather than aggregate shocks to the economy, which set off shifts of workers between sectors and thereby affected the aggregate unemployment rate. Abraham and Katz (1986) and Murphy and Topel (1987) question this interpretation of the

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[34]Sargent (1987) presents several search theoretic models, mostly from the side of the worker or consumer.

data: the former because differing supply and demand elasticities in any event imply differences in sectoral responses to aggregate shocks, and because the behavior of vacancies is inconsistent with the relative disturbance hypothesis; the latter because rising unemployment is in fact associated with a decline in the mobility of labor between sectors.

More direct evidence on the role of search in unemployment comes from surveys showing that the time of the unemployed is mostly spent waiting. The notion that individuals can search more efficiently when they are unemployed, and therefore optimally enter unemployment to seek new jobs has little empirical support. They could as well be working at MacDonald's. The theory of search unemployment might thus be replaced by a theory of optimal wait unemployment, which would presumably stress the influence of aggregate demand on the creation of job opportunities.

IV. The New-Keynesian Revival: Price-Setting Without the Auctioneer.

Evaluating the contribution of the General Theory, Keynes remarked that the disappearance of the notion of aggregate demand for almost a century was an extraordinary episode in the history of economic thought (Patinkin, 1988). Much of the sophisticated development of the microeconomic foundations of macroeconomics in the 1950's, such as the permanent income-life cycle theory of consumption, inventory and portfolio theories of the demand for money, and flexible accelerator theories of investment, elaborated on the determinants of demand.

There have been significant developments in the empirical modelling of aggregate demand since 1975, though no real departures from earlier theoretical approaches. The life cycle-permanent income consumption function remains the mainstay of consumption theory, with new testing methods having developed following the key contribution of Hall (1978). Hall tested the implications of the Euler equation or first order condition for intertemporal consumer optimization, which under specified conditions implies that consumption should follow a random walk. It is not yet clear whether consumption is excessively variable or excessively smooth, the issue turning on whether detrended income follows a stationary process or not.[35] Empirical work on liquidity constraints and other causes of potential deviations from the permanent income hypothesis has turned to cross-sectional data (e.g. Zeldes, 1985). Tobin's Q theory of investment has received much attention and is widely used, though empirical results relating investment to stock prices are still far from satisfactory (Summers, 1981).

The last decade has seen real progress in the theory of aggregate supply on Keynesian lines. The Phillips curve was exactly the empirical construction the Keynesian model needed to model the supply side, endogenizing the dynamics of the wage rate and the price level. But the theory of aggregate supply underlying the Phillips curve remained underdeveloped. Although Phillips (1958) and Lipsey (1960) both explained the Phillips curve as an application of the law of supply and demand, the law itself lacked microfoundations. Arrow (1959), discussing price setting, argued that the assumption of competition made explicit study of price-determination difficult.

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[35]For a review of the issues, see Hall (1988).

The Friedman-Phelps addition of the expected rate of inflation to the Phillips curve both stimulated further work on the microfoundations of price setting, and tended to focus the reasons for the real effects of shifts in demand on output on errors in expectations. By 1970, Phelps and Winter were able to announce in the landmark Phelps volume that a "landing on the non-Walrasian continent has been made". The papers in the Phelps volume were mainly search theoretic, and implied that anticipated changes in prices would have no effects on output.[36] The radical implications of that result did not become clear until Lucas (1972, 1973) combined the Friedman-Phelps Phillips curve with the assumption of rational expectations.

Sticky Wages.

The contributions of Fischer (1977) and Taylor (1980)[37] clarified the distinction between the implications of rational expectations and of wage or price stickiness in accounting for real effects of money and aggregate demand on output. In each case sticky nominal wages determined in long-term labor contracts were the source of nominal inertia. Each model implied a potential stabilizing role for monetary or aggregate demand policy even in the presence of rational expectations, and provided a framework for examining the dynamic effects of changes in policy on prices and output.[38]

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[36]Nordhaus (1972) worked on the microfoundations of the Phillips curve, showing that there was no necessary inconsistency between markup pricing and competition.

[37]Phelps and Taylor (1977) also showed that nominal disturbances could produce real effects in a rational expectations setting with sticky prices.

[38]For simplicity adjustment in both models is built entirely on the dynamics of wages and prices. In practice, other propagation mechanisms, such as inventory adjustment and others described in Section II above, affect the dynamic adjustment of the economy to demand and supply shocks.

Contractual wage setting allows for potentially interesting price and output dynamics in response to disturbances to supply or demand. Particularly in the Taylor model, where workers are concerned over relative wages and wages are held at a constant level throughout each contract, wage leapfrogging can produce protracted adjustments[39]. Because the dynamics depends significantly on whether contracts are staggered or co-ordinated, there has been extensive investigation of the determinants of the staggering structure[40]. Since real world contracts are co-ordinated in some countries (e.g. Japan) and staggered in others, it is likely that both structures may be stable, depending on the predominant sources of disturbances to the economy (Fethke and Policano, 1986). The efficiency of different staggering structures has also been investigated (e.g. Ball, 1986).

Although the contract wage setting approach has been fruitful, it too lacks microfoundations. In particular, as pointed out by Barro (1977), it leaves open the question of why quantities are determined by demand.[41] More generally, the fundamental question posed by any non-equilibrium approach to fluctuations in which wages or prices are sticky is why, if fluctuations are economically costly, private agents do not make arrangements that avoid such costs.[42] The notion that there must be some market failure, an externality or

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[39]Calvo (1983) develops a very tractable contract model.
[40]These are reviewed in Blanchard (1988).
[41]Fischer used the General Theory assumption that firms are always on the demand curve for labor, while Taylor assumed markup pricing and the aggregate demand determination of output.
[42]Lucas (1987) has argued that the costs of aggregate fluctuations, as measured by the variance of consumption, are small. He asserts that in the post-World War II period, elimination of all variability of aggregate consumption around trend would have raised utility, in a representative agent model, by the same amount as an increase in the level of consumption of one-tenth of one per cent. McCallum (1986) questions this estimate on the grounds that it assumes the trend is independent of stabilization policy.

coordination failure, is an old one that has not until recently received satisfactory formal treatment, despite the suggestive analysis by Okun (1981).

When sticky wages are responsible for unemployment, the obvious question is "Why don't the unemployed bid down wages?" Keynes argued that wage flexibility would not in any case help maintain full employment, because of adverse effects of expected deflation on demand and employment. More recently, de Long and Summers (1986) have re-examined this argument, finding for some parameter values in the Taylor overlapping contracts model that wage flexibility is indeed destabilizing.[43]

Solow (1980) forcefully addressed the question of wage stickiness, arguing that several causes each tend to create sticky wages nd/or prices, and that the stickiness is a key fact in understanding business cycle fluctuations. We examine theoretical developments of three of the causes of wage stickiness that he discussed: long-term labor contracts[44], the role of unions, and efficiency wages. In reviewing these topics, we should note the distinction between nominal and real rigidity of wages and prices: whereas the Fischer and Taylor models build on sticky nominal wages or prices, in order to develop models in which monetary policy has real effects, some of the work to be reviewed produces real but not nominal price stickiness.

Labor contracts: Baily (1974) showed that for any pattern of employment, an individual without access to the capital markets would prefer more stable to less stable income. Azariadis (1975) examined optimal labor contracts between

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[43]Taylor (1986) claimed on the basis of an empirical analysis comparing the periods 1891-1914 and post-World War II that greater stickiness of wages and prices in the United States in the latter period increased the amplitude of fluctuations given the disturbances affecting the economy.

[44]This is a much and well surveyed field. See Azariadis (1979), Hart (1983), Rosen (1985), Stiglitz (1986), Hart and Holmstrom (1986).

risk averse workers without access to income insurance markets, and risk neutral firms, finding that the real wage in the optimal contract was state-independent, with the firm essentially smoothing the individual's consumption stream by paying a constant real wage. Azariadis assumed that workers worked either full time or not at all, and that firms made payments only to the employed, the unemployed receiving unemployment compensation or some other source of income.

The Baily-Azariadis result seemed to provide a reason for stickiness of real wages and variability of real output: with real wages sticky rather than increasing with output, perhaps increases in demand would call forth a greater increase in output than in competitive markets. However, it turns out that with constant marginal utility of income, output in the Azariadis model would be the same in each state of nature as in a competitive labor market.[45] Further, if payments could be made to the unemployed, employed and unemployed workers in the Azariadis model would receive the same income and the employed would envy the unemployed.

Insight into the output results in the Azariadis model was provided by Hall and Lilien (1979), following an earlier contribution of Leontief (1946): in any bargaining situation between workers and a firm, the employment contract should in each state of nature satisfy the efficiency condition that the marginal value product of labor be equal to the marginal disutility of work. The terms of compensation can then be set separately, and do not necessarily imply that the wage is equal to the marginal value product of labor in each state.

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[45]If workers' utility functions are such as to produce an upward sloping labor supply curve, employment varies more with labor contracts than in a competitive market.

The mid-seventies approach, which built labor contracts around differences in risk-aversion and access to capital markets, does not account for the fact that firms set employment decisions. The later asymmetric information approach assumes that the firm knows the state of nature but the worker does not.[46] The firm and the employees agree on an optimal contract that specifies wage-employment combinations in each state of nature. Because of the asymmetric information, contracts have to satisfy an incentive compatibility constraint whereby the firm does not have an incentive to misrepresent the state.

These contracts do imply that the firm sets the employment level. In general they do not satisfy the ex post efficiency condition, and thus can account for departures from Walrasian quantity levels. However, it also turns out that unless firms are more risk averse than workers, optimal asymmetric information contracts generally imply more employment in bad states of natures than would occur in a competitive non-contract labor market. This--together with the difficulty of deriving results--has led to some discouragement over the contract route to explaining economic fluctuations.[47] Nonetheless, the fact that asymmetric information--which certainly exists--makes for inefficient employment levels, is itself an important result.

Unions: The labor contracting approach to wage and output determination assumes that there is free entry into the labor pool attached to each firm. When workers are unionized, the union may control access to the firm's labor force, and may have its own utility function.[48]

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[46]See the surveys noted above; Hart and Holmstrom provide a concise summary.

[47]Grossman, Hart and Maskin (1983) have embedded asymmetric information labor contracts in a general equilibrium model and shown that shocks that change the variance of a variable relevant to firms' employment decisions may affect the aggregate level of employment.

[48]For surveys on unions, see Farber (1986), Oswald (1986) and Pencavel (1986).

McDonald and Solow (1981) showed that in contracts between a union (with given membership) and a firm, and given certain assumptions on the determinants of the bargaining outcome, the behavior of the real wage over the cycle is determined by the cyclical behavior of the wage elasticity of demand for labor. Thus with a constant elasticity of labor demand, the real wage would be invariant over the cycle, so long as not all members of the union were employed. This is another potential reason for real wage stickiness.

However, as noted by McDonald and Solow, their model is partial equilibrium and deals with wage and quantity determination in a single period. Unemployment occurs within the period when the demand for labor is low. But the average level of unemployment in a succession of one-period models realizations would depend on the dynamics of the reservation wage. If unions are to produce a higher average rate of unemployment than would occur in competitive markets, they have somehow to maintain a higher reservation wage than the competitive wage.

If unions succeed in obtaining high wages that cause unemployment in the short run, the dynamics of employment depends on whether it is possible for a non-unionized sector to develop. The existence of a pool of unemployed workers provides the opportunity for new firms to undercut existing firms by employing the current unemployed at wages below union rates. If this process works slowly, the presence of unions may account for slow adjustment of unemployment towards the natural rate. If unions rigorously control entry, they may be responsible for permanently higher unemployment.

There has been much interest, particularly in Europe, in using union models or related insider-outsider models to explain persistent high

unemployment (Lindbeck and Snower, 1984). Unions may be able to affect the average level of unemployment if they control entry into the workforce. The key issue then is what is the union utility function. For instance, if unions are concerned only with the interests of their current membership, they may totally ignore the unemployed, and can produce long-term unemployment (Blanchard and Summers, 1986).

The policy implications of insider-outsider models are not unambiguous. Presumably they justify open shop legislation and other steps to break union control over entry into the workforce; alternately, Layard (1986) argues for subsidization of the unemployed outsiders to allow them to break in.

Efficiency Wages: The efficiency wage hypothesis is that the wage affects worker productivity.[49] In underdeveloped countries, low wages may impair strength and concentration and raising the wage may reduce the unit cost of the effective labor input.

There are several rationales for the efficiency wage hypothesis even where physical strength is not an issue. The simplest is the sociological explanation, that firms that pay higher wages generate a more loyal and therefore more productive work force. In the shirking model (e.g. Shapiro and Stiglitz, 1984) firms can only imperfectly monitor worker performance. Workers who are caught shirking can be punished only by being fired, in which case they receive the alternative wage. By paying wages above the alternative rate, firms provide an incentive to workers not to shirk. One criticism of this model is that shirking can also be prevented by alternative mechanisms, such as the posting by workers of performance bonds.

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[49]Katz (1986) presents an excellent survey and empirical examination of the efficiency wage hypothesis.

The shirking model provides an explanation for dual labor markets, in which higher wages are paid for primary jobs than for secondary (in which shirking is difficult) perhaps even for workers with the same ability. Whether the shirking model generates unemployment depends on how large the secondary market is relative to the primary; certainly it is possible to generate wait unemployment in a dual labor market if workers are willing to work at the primary but not the secondary wage (Hall, 1975).[50]

The implications of efficiency wage theories for macroeconomic fluctuations depend on their rationale.[51] Solow (1979) showed that the wage may be constant (at the unit labor cost minimizing level) in an efficiency wage model. In underdeveloped economies, this would peg the real wage at a level determined by physical efficiency. In the shirking model, the efficiency wage would be set as a differential above the secondary wage. It would not then provide a justification for sticky real or nominal wages without further explanation for the stickiness of the secondary wage, or some explanation of why the primary wage itself was sticky. In both these cases, it is, if anything, the real wage rather than the nominal wage that would be sticky.

Sociological theories that build on the adverse effects of wage cuts on morale could account for either nominal or real wage stickiness. Casual observation certainly supports the notion that wage cutting has an adverse effect on morale, but the deep reasons for that are unclear. Conceivably this is a self-justifying convention. Alternatively, relative wages may affect

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[50]Katz (1986) discusses also turnover, adverse selection, and union threat effiency wage models.

[51]Startz (1984) builds an almost-textbook style Keynesian model with an efficiency wage as the only departure from a classical model.

morale[52], and wage stickiness may result from the difficulty of co-ordinating wage cuts across decentralized firms.[53]

Summary: With one possible exception, contract theory, union wage models, and efficiency wage theories account for real rather than nominal wage rigidity. The possible exception is the nominal wage version of the argument that wage cutting reduces worker morale--but this hypothesis amounts to little more than restating the puzzle of the apparent inflexibility of wages.[54]

The union and efficiency wage models may also help account for unemployment[55]. To the extent that they produce both unemployment and rigid real wages, they also account for the fact that cyclical changes in the rate of employment are accompanied by only small changes in the real wage.

Sticky Prices.

The Keynesian tradition and the Phillips curve emphasize nominal wage stickiness. Strictly interpreted, the aggregate supply theories outlined above account for real wage stickiness. Coordination problems--the fact that given other wages and prices, any change in a wage is a change in both the real and relative wage--could perhaps generate nominal wage stickiness out of real wage stickiness. However, coordination probleme fail to explain why all

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[52]Certainly observation of the economics profession suggests a keen interest in relative wages, and sometimes discontent over relative wage reductions that are also absolute wage increases.

[53]This is the General Theory argument that the aggregate wage level may be sticky because workers concerned with their relative wages resist cuts in their own wages which, given other wages, would imply a reduced relative wage.

[54]Nominal wage cuts in the early eighties in the United States certainly establish that nominal wages are not completely inflexible downward, but those cuts nonetheless appear to have been regarded as exceptional rather than the establishment of a new norm.

[55]Bulow and Summers (1986) press the case for the efficiency wage as an explanation of unemployment and other ailments.

wages are not routinely indexed. The conclusion is either that the original emphasis on nominal wage stickiness was misplaced, or that nominal wage stickiness still awaits an explanation. The preoccupation with nominal wage rigidity could be misleading though, a reflection of hysteresis in the development of macroeconomic models, for rigid real wages are also a real world problem with important macroeconomic consequences (e.g Bruno and Sachs, 1985).

More recently the emphasis has shifted from sticky wages to sticky prices. The new approaches generally start from a now widely-used model of imperfect competition in the goods markets that builds on the work of Dixit and Stiglitz (1977).[56] That imperfect competition is widespread is suggested both by observation and by the work of Hall (1986) on markups in U.S. industry.

Imperfect competition general equilibrium: The General Theory and the monopolistic or imperfect competition revolutions occurred simultaneously. The notion that there should be close connections between them is an old one, but the connection has only recently been made explicit. The intuitive reason there may be a link is that the Keynesian assumption that suppliers are always willing to sell more if demand at the existing price increases is a characteristic of a monopolistic equilibrium. The reason to doubt the link, at least in the case of nominal disturbances, is that monopolistic equilibrium determines a set of relative prices, which will surely be invariant to nominal shocks.

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[56]See also Hart (1982) and Weitzman (1982). I draw here on Blanchard and Fischer (1988, Chapter 7), which in turn is based on Blanchard and Kiyotaki (1987).

The following general equilibrium model monopolistic competition can be used to make both points. There are n producer-consumers, each consuming all goods but producing only one, with the following utility functions:

$$(1)\quad U_i = (C_i/\gamma)\,((M_i/P)/(1-\gamma))^{(1-\gamma)} - (d/b)Y_i^{\beta} \qquad 1>\gamma>0;\ d>0;\ \beta\geq 1$$

$$\text{where } C_i = n^{(1/(1-\theta))}\left(\sum_{j=1}^{n} C_{ji}^{(\theta-1)/\theta}\right)^{(\theta/(\theta-1))}$$

$$\text{and}\quad P = \left((1/n)\sum_{i=1}^{n} P_i^{(1-\theta)}\right)^{(1/(1-\theta))}$$

Utility depends positively on consumption, C_i and on real money balances M_i/P, and negatively on the output of good i, Y_i. The production of good i uses labor; the labor input enters the utility function in the form shown either because production is subject to diminishing returns or because labor is subject to increasing marginal disutility. The consumption of all goods enters the utility function symmetrically.

The utility function implies a constant elasticity of substitution between goods, equal to θ. Constant terms in the utility function are introduced for convenience. Real money balances enter the utility function, and play a key role in transmitting effects of money stock disturbances to demand.[57]

Each individual faces the budget constraint

$$(2)\qquad \sum_{j}^{n} P_j C_{ji} + M_i = P_i Y_i + \underline{M}_i \equiv I_i$$

where $\underline{M}_i$ is intial holdings of nominal balances.

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[57]Ball and Romer (1987) derive the same results using a Clower constraint.

Working from the first order conditions of the consumer, and making some substitutions, the demand curve facing each producer can be shown to be:

$$(3) \qquad Y_i = (P_i/P)^{-\theta} (\gamma/(1-\gamma)n)(\underline{M}/P) \equiv (P_i/P)^{-\theta} (M'/P)$$

where unsubscripted variables represent aggregates.

Producer i sets price to maximize utility, taking the actions of other producers (their prices) as given. This implies the relative price:

$$(4) \qquad P_i/P = [((d\theta/(\theta-1))(M'/P)^{\beta-1}]^{(1/(1+\theta(\beta-1)))}$$

So long as there are increasing marginal costs of production ($\beta > 1$), an increase in (M'/P) results in both a higher relative price and higher output. With constant costs of production an increase in (M'/P) would result in no change in the relative price, and an increase in output.

Finally, recognizing the symmetry, all relative prices are equal to one, which implies from (4) the equilibrium value of the aggregate price level P, and the level of output of each producer:

$$(5) \qquad P = ((\theta-1)/\theta d)^{(1/(1-\beta))} M'$$

$$Y_i = ((\theta-1)/\theta d)^{(1/(\beta-1))}$$

Note first that in equilibrium the quantity theory holds: the nominal price level is proportional to the money stock. It is also true though that if M' were to increase, and producers for some reason were to keep their nominal prices constant, the utility of each would increase. This is because price exceeds marginal cost. That is the source of an aggregate demand

externality: if prices are fully flexible, each producer raises price when the money stock rises, and all producers acting together thereby reduce aggregate demand and welfare.

The PAYM insight: The derivative of the profit function of a price setting firm with respect to price is zero at the optimum. Thus divergences of price from the optimum produce only second order reductions of profits. Parkin (1986), Akerlof and Yellen (1985) and Mankiw (1985) observed that, combined with even small costs of changing prices, this implies that changes in demand may lead monopolistically competitive firms not to change price and instead to satisfy demand.[58]

Thus shifts in aggregate demand may lead to changes in output. Further, the increase in demand may make everyone better off, in a first order way, because of the excess of price over marginal cost in the initial situation.

More precisely, the PAYM insight is that if all firms are at their optimal price, and there are some fixed costs of changing price, a sufficiently small increase in aggregate demand will lead to a welfare-increasing expansion of output.

Costs of price change are often described as menu costs, implying a physical cost of resetting a price. It is difficult to think of many goods for which such costs could be non-trivial. There may be a fixed decision cost to the firm of reconsidering the price it charges for a particular good. Or there may be a loss of goodwill for firms that change price. Okun (1981) argued that the goodwill cost is incurred by firms that change prices in

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[58]Rotemberg (1987) named this the PAYM insight.

response to demand shocks, but not by firms whose price rises merely pass cost increases on to customers.

The assumption in these cases is that there is a fixed cost to changing price. Rotemberg (1982) investigates the effects on price and output dynamics of quadratic costs of price change. Whereas with fixed costs of changing price, a large enough shift in demand will produce small effects on output because most firms will adjust price, with quadratic costs of price change, larger shifts in demand cause larger changes in output.

More careful examination of the PAYM insight raises several other interesting issues. First, there may be multiple equilibria. In response to a given shift in demand, both no change in price by any firm and full response in price by all firms may be Nash equilibria (Rotemberg, 1987; Ball and Romer, 1987). In this sense, Ball and Romer argue that sticky prices may represent a coordination failure.[59] Second, there is the question of why firms would find it more costly to adjust price than quantity. Changing production plans too appears to involve decision costs. One possibility for a large firm selling to sophisticated buyers in that whereas the production decision is internal and has to be made daily, the price decision has to be communicated to a large group of actual and potential buyers, and is thus more costly.

Third, there is the question of the effects of aggregate demand shifts on output and prices when not all firms are at their optimum price at any one time. Caplin and Spulber (1986) show that if firms are uniformly distributed over the interval in which prices are set, and if the firms follow s-S pricing policies[60], then the distribution is maintained even after demand changes, and

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[59]See also Cooper and John (1985) on coordination failures.

[60]Barro (1972) introduced s-S pricing rules for a monopolist. Sheshinski and Weiss (1977) show that if the aggregate price level is increasing at a constant rate, and if there are fixed costs of changing price, then it is optimal for firms to use an s-S pricing policy in which relative price is allowed to drop to a level s before being adjusted upwards to level S. See Rotemberg (1987) for discussion of optimal pricing policy.

the average price level changes smoothly in response to demand changes. This appears to destroy the effects of the PAYM insight that produces Keynesian results in the monopolistic competition model. However, the Caplin-Spulber result is not robust either to the effects of discrete shock changes in the money stock (Rotemberg, 1987), or to the possibility that prices may fall as well as rise (Blanchard, 1988).

It is not yet known what form optimal pricing behavior takes when the aggregate price level is not growing steadily. An interesting result has been obtained by Tsiddon (1986), who examines the adjustment to an unexpected change in the aggregate inflation rate. When the inflation rate falls, the s-S range falls. This means that at the moment of the change, a number of firms find themselves below the new optimal s, and should therefore raise price to the new S. Some firms will be above the new S; they however may find it optimal to let their excessively high price be eroded by inflation rather than adjust it. The implication is that a reduction in the growth rate of money may initially lead to an increase in the price level.

Staggering and Price Dynamics: Blanchard (1988) draws the distinction between state dependent pricing rules, such as the s-S rule, and time-dependent rules, in which prices are reset at particular times. The extent of time dependency varies across firms, for example between firms that print catalogs and those that sell perishables. Further, even for firms that usually set prices at particular times, large shocks may well disturb the regular pattern.[61]

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[61] Time dependent wage setting appears to be relatively more widespread than time-dependent price setting.

Nonetheless, it is interesting to explore the implications of time-dependency of price setting. A key issue for dynamics in this case, as in the case of wage setting, is whether price setting is staggered or synchronized. Blanchard (1983) has used a stage of processing model to show how even short lags in adjusting prices can produce long aggregate lags if price setting is staggered.

Also as in the case of wage setting, the question of the stability of the staggering structure arises. If an increase in the aggregate price level increases the desired price of a given firm, price staggering is unlikely to be stable. For instance, where prices are fixed for two periods, if more than half the prices are adjusted in even periods, those who adjust price in odd periods have an incentive to move their adjustment to the even period--because the price rise that they observe after the first period causes them to want to raise price. Of course, price adjustments are not synchronized in practice; the staggering may to some extent be due to seasonality and the non-synchronization to the idiosyncratic shocks hitting the firm (Ball and Romer, 1986).

Real Wages and the PAYM Insight: It is not obvious in the monopolistic competition model outlined above why worker/firms are willing to supply more output when demand increases. In that model, increases in labor input are called forth by increases in the real wage, with larger β implying greater sensitivity of the real wage to output.

If β were close to one, output would change without much change in the real wage. But if β were close to one, equilibrium business cycle theory would have no difficulty accounting for the observed real wage-employment

relationship. New Keynesians have taken two alternative routes in explaining the cyclical behavior of the real wage in monopolistic competition models. Blanchard and Kiyotaki (1987) model each worker as a monopolistically competitive seller of labor. At their optimum quantity of labor sold, workers suffer little change in utility from working slightly more or less. That could explain the cyclical real-wage employment relationship if all variations in labor input were in hours, but is less persuasive when a considerable part of the variation takes the form of unemployment of the worker.

Akerlof and Yellen (1985) instead assume monopolistic competition in the goods markets and an efficiency wage model in the labor markets. The real wage is held constant at the efficient level, and variations in demand for goods are translated into shifts in output at the same real wage.

V. Other Developments.

In this section I briefly review recent developments in areas that have not so far been discussed.

Multiple Equilibria.

There are now many rational expectations models with multiple equilibria.[62] There is nothing exceptional in the result that changes in expectations affect the equilibrium of the economy; the interesting feature is that those changed expectations (animal spirits) may be correct and thus self-justifying. This is a rigorous justification of the notion that optimism itself may be sufficient to create a boom, or that all we have to fear is fear itself.

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[62]Rotemberg (1987) categorizes and concisely reviews these models, which include contributions by Azariadis (1981), Cass and Shell (1983), Diamond and Fudenberg (1982) and Shleifer (1986).

Rotemberg (1987) reviews the varieties of multiple equilibria and their implications. Among the striking results are those by Kehoe and Levine (1985), showing an extreme multiplicity of equilibria in overlapping generations models; by Grandmont (1985) showing that deterministic cycles of virtually any order can--under some restrictions on utility functions--be generated as rational expectations equilibria in an overlapping generations model with money as the only asset; and by Roberts (1986) producing a multiplicity of unemployment equilibria at Walrasian prices.

Policy analysis appears difficult when it is not clear at which equilibrium the model will start, nor to which equilibrium a policy change or other shocks will move it. One possibility is that multiple equilibria enhance the role of policy, because the government may be able to provide some focus for expectations about which is the relevant equilibrium (for instance the full employment equilibrium). An alternative view is that models with multiple equilibria are incomplete, awaiting the improved specification that will remove the multiplicities.

Credit Rationing.

The recent concentration on the aggregate supply question of why output varies with only small variations in real wages has supplanted a similar earlier question, of how monetary policy affects real activity when interest rate movements are relatively small. In part the earlier question has been obscured because interest rate movements--both nominal and real--have become much larger in the 1970's and 1980's than in earlier decades; in addition, doubts have arisen about the effects of monetary policy on real output, as the rise of the real business cycle approach testifies.

Participants in credit markets believe that credit is rationed, in the sense that individuals or firms cannot typically borrow as much as they want to at the going interest rate. Credit rationing was part of the transmission mechanism for monetary policy in the MIT-Penn-SSRC model; with sticky interest rates, monetary policy affects the availability of bank credit and thus the volume of investment without necessarily affecting interest rates.

Credit rationing is certainly understandable when interest rates are controlled, say by usury ceilings.[63] But credit is likely to be rationed even without interest rate controls, for at least two reasons arising from incomplete information under uncertainty.[64] First is adverse selection: as interest rates rise, banks are likely to attract riskier borrowers. The second is moral hazard: as interest rates rise, borrowers tend to undertake more risky projects. In each case an increase in the interest rate may reduce the bank's expected return; the bank therefore rations credit. In his innovative thesis, Keeton (1979) demonstrates these two effects. He also draws a distinction between Type I and Type II rationing: the former applies when each individual receives less than the amount he or she would want at the going interest rate; the latter when among identical individuals some are rationed and some are not.

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[63]Allen (1987) provides a comprehensive survey of the credit rationing literature. Stiglitz and Weiss (1987) review their earlier contributions and criticisms of them.

[64]The case for the importance of credit market phenomena, arising from imperfect information, in accounting for economic fluctuations and the apparent role of money in them has been made most vigorously by Greenwald and Stiglitz (1987).

Although credit rationing produces the appearance of non-clearing markets, it does not necessarily imply an inefficient allocation of resources (English, 1986). Along similar lines, Yotsuzuka (1987) shows that even with credit rationing, Ricardian equivalence may hold.

The sense that credit rationing is an important component of the monetary mechanism was reinforced by the findings of Friedman (1983) that the debt-GNP ratio was among the most stable of macro ratios. However, in an example of Goodhart or Murphy's Law, the debt-GNP ratio began to diverge from previous behavior shortly after the Federal Reserve started announcing targets for the growth rate of debt.

Bernanke (1983), re-examining the Great Depression, argues that the increased cost of financial intermediation was largely responsible for the collapse of investment. Beyond the effects of credit on demand, Blinder (1985) claims that credit rationing affects aggregate supply. This is a variant on the familiar Keyserling-Patman-Cavallo-and-many-others argument that higher interest rates are inflationary because they increase costs. A sophisticated general equilibrium model of credit rationing and its impact on the macroeconomy has been developed by Bernanke and Gertler (1987), who start from asymmetric information between borrowers and lenders and show that firms' balance sheets matter, and that in some circumstances government bailouts of weak firms may be appropriate.

Banking.

Fama (1980) and Fischer Black (1975) re-examined the theory of the banking firm, providing an abstract view of its role, as portfolio manager and operator of the accounting system. By and large this so-called new view of

banking had no implications for the monetary mechanism beyond those already clear from Patinkin (1965).

The common literary notion that bank runs may be self-justifying prophecies was confirmed by Diamond and Dybvig (1983), who also discussed how deposit insurance could be a self-denying prophecy.[65] King (1983) assessed theoretical issues that have to be faced in analyzing the nineteenth century question of whether a competitive banking system with free entry would be viable--an issue that the banking deregulation movement makes more than academic.

Bubbles and Excess Volatility.

Shiller (1979) inaugurated a protracted and fierce debate over the issue of excess volatility of the stock market. The simple-minded observer watching the U.S. stock market rise by a factor of almost three between 1982 and 1987 asks whether anything objective could possibly account for that increase, or whether some bubble or other irrationality might be responsible.[66]

It was Shiller's considerable achievement to propose a way of answering that question: because a rational stock price is the present discounted value of dividends, the variance of stock prices should be related to characteristics of the joint stochastic processes for dividends and the discount factor. Shiller assumed the discount factor constant, and argued that stock prices fluctuated excessively. The Shiller tests were rapidly applied to the term structure of interest and exchange rates, with asset prices typically being found to fluctuate excessively.

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[65]Jacklin (1986) describes and extends subsequent developments.
[66]This sentence appears in the September 1987 first draft of this paper.

The subsequent debate seemed to pit finance economists against macroeconomists, with the advantage shifting over time to finance.[67] The key issue is the stationarity of the dividend process; most recent work tends to find that the stock market does not necessarily fluctuate excessively (see for example Kleidon (1986) and Marsh and Merton (1986)), though anomalies remain in stock price behavior.

At the same time as the empirical literature on excess volatility developed, so did a theoretical literature on the possibility of bubbles in asset prices. A bubble is a self-justifying departure of the stochastic process for an asset price from its fundamentals, and is another example of multiple equilibria. At a given rate of return, r, on an asset, the expected value of the bubble component of price has to grow at rate r. The first bubbles were deterministic: but a bubble could typically not be expected to grow at rate r if the economy was efficient, because it would eventually come to dominate the economy. Blanchard (1979) produced partial equilibrium examples of stochastic or bursting bubbles which would be expected to grow at rate r but would almost surely have burst by some point. In general equilibrium, Tirole (1985) has shown that bubbles can exist only in inefficient equilibria in which the growth rate exceeds the interest rate, and that bubbles tend to be welfare-increasing.

Ricardian Equivalence and Fiscal Policy.

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[67]This sentence too was written before October 1987; it remains to be seen how Black Monday will affect both the statistical and the polemical debates.

Barro (1974) inaugurated another protracted debate, this one over the question of whether individuals treat government bonds as net wealth. Patinkin (1965, p289) had discussed the implications of the issue for the neutrality of money and the effects of open market operations on interest rates. It seemed clear that if the debt floated by the government is to be paid off by future generations, then the future taxes implied by current debt would not offset the asset value of the debt. Barro's contribution was to show that finite lived individuals concerned about the welfare of their descendents might nonetheless behave as effectively infinitely lived, and thus take into account the taxes to be levied on future generations.

Although the issue was posed as "is the debt wealth", the answer is also key to the questions of whether in fully neoclassical models fiscal policy affects real interest rates, whether federal budget deficits affect national saving and the trade account, whether open market operations are neutral, whether social security affects the capital stock, and so forth.

Bernheim (1987) presents an account of the analytic and empirical literature; it is clear that there are many reasons that Ricardian equivalence could fail to hold, and it is also clear that the evidence at this stage is insufficient to change the prior views of most economists by very much. Poterba and Summers (1987) argue that the concentration on finite horizons is misleading, in that typically most of the debt will be paid off by those currently alive. The U.S. fiscal policy experiment of the early 1980's should, one might hope, have settled the issue once-for-all: the major change in the deficit raised real interest rates and did not increase private saving. However that is only one episode, and its influence in regressions appears insufficient to reject Ricardian equivalence (Evans, 1987).

Sargent and Wallace's (1981) startling claim that monetary financing of a government budget deficit could produce a higher inflation rate than monetary financing increased the awareness of the intertemporal implications of the government budget constraint. The argument is that if the deficit will ultimately be financed by money printing, then the accumulation of interest on the debt will require higher seigniorage revenue in the future--which would imply a higher steady state inflation rate with bond financing, and could even imply higher inflation now. The subsequent debate clarified not only the reasonably general conditions under which the result holds, but also the relationship between budget deficits and inflation (Drazen and Helpman, 1986), which depends on the policies that are expected to be used to reduce the deficit to a sustainable level.

Indexation.

In 1974 Milton Friedman returned from Brazil convinced that indexation would protect the real economy from monetary disturbances and thereby reduce the costs of inflation. Gray (1976) and Fischer (1977) confirmed that indexation indeed neutralized the effects of monetary shocks on real variables; indexation in the capital markets would also neutralize the effects of nominal shocks. But indexation might amplify the real effects of real shocks to the economy.

Given the clear results on indexation and nominal shocks, the minimal adoption of indexation in private contracts remains difficult to explain. Evidently there are major advantages to nominal contracting that are not captured by existing models. One possibility is that nominal shocks account for only a small part of the uncertainty about the outcomes of contracts,

which, together with small costs of adding complexity to contracts, prevents indexation.

The experience of accelerating inflation in heavily indexed economies such as Brazil and Israel has been a chastening experience for proponents of indexation. The fact that high inflation reflects problems in policy making was not taken sufficiently into account; if as a result of indexation the real effects of inflation are reduced, the result may be an increase in the rate of inflation to achieve similar real effects.

Weitzman's much-discussed proposal that workers take part of their compensation as a share of profits bears some similarity to indexing of the wage to profits, at the firm level. Weitzman (e.g. 1986) argues that firms are more willing to hire labor in a profit-sharing scheme, which would enhance macroeconomic stability. The extent to which superior Japanese unemployment experience reflects their bonus system is a key issue in evaluating profit-sharing. There has been intensive examination of the issue in Britain, where incentives for profit-sharing have been provided in the budget.[68]

The Theory of Growth.

After rapid development in the fifties and sixties, the theories of economic growth and capital received relatively little attention for almost two decades, despite the absolutely central importance of growth to economic performance. The Ramsey-Solow and Samuelson's overlapping generations models became workhorses of micro-based macroeconomics, but the theory of growth as

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[68]Blanchflower and Oswald (1986), who present evidence that profit-sharing has been widely used in Britain, and Estrin, Grout and Wadwhani (1987) take a sceptical view of the stabilizing and other beneficial effects of profit-sharing.

such was neglected. The worldwide growth slowdown made it inevitable that interest in growth would revive, though neither theory nor intensive empirical work has yet provided a persuasive explanation for the slowdown. Recent work has emphasized the role of economies of scale in the growth process (e.g. Romer, 1987).

The Theory of Policy.

The rational expectations revolution in macroeconomics and game theory have combined to produce a far more sophisticated approach to the analysis of policy than was state-of-the-art a decade ago. A key paper here is Kydland and Prescott (1977), which introduced the problem of dynamic inconsistency of optimal policy and argued that the dynamic inconsistency arising from discretionary policy-making could be prevented by adopting policy rules. Developing the game theory approach, Prescott (1978) dismissed the use of optimal control theory for the design of optimal policy on the grounds that economic agents do not respond mechanistically to changes in policy rules.

The game theoretic approach to policy makes if possible to model notions such as reputation and credibility that have long been staples of policymakers' own discussions of their actions.[69] The predictive content of these applications, as opposed to their usefulness in providing insights, remains to be developed. Barro and Gordon (1983) showed that discretionary monetary policy-making could produce an inflationary bias, but subsequent developments that allow for reputational effects have weakened that result; nor is it clear how to test it.

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[69]This large and rapidly growing literature receives little space here because it has been surveyed at length by, among others, Fischer (1986) and Rogoff (1987).

VI Concluding Comments.

Any comparison of the contents of this survey with that of Barro and Fischer (1976) must conclude that there has been a tremendous increase in the breadth and depth of macroeconomics in the past decade. Technical progress from the side of both theory and econometrics has made it possible to address and illuminate issues that were simply too difficult before--such as the excess volatility of asset prices, the macroeconomic implications of monopolistic competition, coordination problems in the macroeconomy, bank runs, and the existence of multiple equilibria, to pick just a few examples.

There is no question that macroeconomics is far more microeconomics-based than it used to be. In a sense the microeconomic foundations of macro now exist, in equilibrium models of the Prescott-Kydland type in the equilibrium approach, and in models such as the Akerlof-Yellen model in the post-Keynesian approach. But to a considerable extent the earlier notion that once the microeconomic foundations had been laid, a set of standard macro models could be used, has not been justified. Rather the tendency has been to build a variety of micro-based models, each making or emphasizing a specific point.

A three equation macromodel, consisting of the IS-LM apparatus plus an aggregate supply equation is frequently used. In the simplest version the IS-LM side is reduced to the quantity equation or a Clower constraint, and a Lucas aggregate supply equation, or one in which exogenous productivity shocks drive output, is added. In the more Keynesian versions, velocity becomes a

function of the interest rate, and there is more detail on the demand side. In terms of this model, there has been advance in testing of the aggregate demand side (e.g. Hall (1978) on consumption) but not to the same extent in understanding of the structural determinants of demand; there has been real progress in analysis of the financial markets, though not necessarily in understanding of the transmission mechanism of monetary policy; and there is greater understanding of the theoretical underpinnings of the supply side.

Has macroeconomics progressed? Yes: there has been remarkable progress in understanding many theoretical issues, some specified above, that were only imprecisely understood before. There has also been progress in understanding the structure of the basic macro model.

And yet: there is greater not less confusion at the business end of macroeconomics, in understanding the actual causes of macroeconomic fluctuations, and in applying macroeconomics to policy-making. Revealing untruths is of course progress, and it is possible that the greater uncertainty that now exists is part of the process of rubble-clearing that precedes the erection of a new structure.

Probably it is not. Rather there are two factors at work. One is the increasing realization of the extraordinary difficulty of settling disputes with econometric evidence. Take for instance the issues of Ricardian equivalence and excess volatility of asset prices. Both are quite fundamental, both have been the subjects of intensive empirical scrutiny, but neither has yielded to the time series evidence brought to bear.

What the implications of the lack of cutting power of time series macroeconometrics may be remains to be seen. The use of panel data, statistical events studies as in finance, and careful case studies of particular episodes, are all obvious possibilities.

The second factor is that it has become fashionable, at least in the United States, to claim that economists have little to say on the policy issues of the day, beyond recommending institutional reforms. That is the comparative advantage of some. But it would not be progress for macroeconomists in general to avoid current policy issues, for instance by arguing that while we can (perhaps) design a good budget rule, we cannot answer the question of whether the budget deficit should be cut now or not. The decision will be made, one way or the other, and the abdication of serious macroeconomists leaves the policy advice business to those either ignorant or unscrupulous enough to claim full understanding of the issues. Macroeconomists will not be able seriously to participate in such analyses without the use of models, small or large, that attempt to quantify the impact of policy decisions.

Finally one has to ask where the field is heading. There are two correct answers. One is that the field is no longer a field, that it is too big for any researcher to describe her or himself as a specialist in it, and that much of macroeconomics will gradually meld into subspecialties and partly be absorbed in existing fields.

The second is that macroeconomics will continue just as long as macroeconomic fluctuations. If one further takes the (appropriate) view that business fluctuations are not caused by one major set of shocks, nor

propagated mainly by a single important mechanism, then progress will have to be made in evaluating the significance of each mechanism and fitting the pieces together. That is what macroeconometric models attempt to do; it is also what Kydland and Prescott attempt in their calibrated (1982) model. Within such models, the aggregate supply side remains the outstanding challenge.

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