A THEORIST'S VIEW OF POLICYMAKING AND A POLICYMAKER'S VIEW OF THEORY: PERSPECTIVES ON MODERN MACRO-ECONOMICS

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It is a pleasure to be in Cambridge--just thirty years after I spent a most enjoyable year here, first as a graduate student, then as a research fellow. I cannot convey the sense of intellectual excitement that pervaded Cambridge at the time. There was an intellectual discourse that knew no bounds of rank or status. I remember writing as a graduate student an essay on the distribution of income and wealth, using the tools of the then developing growth theory to disaggregate capital accumulation to the level of the household and to trace out the evolution over time patterns of inequality; the morning after I circulated a draft of that paper[2], I received a twenty-five page handwritten comment from James Meade, extending and interpreting the results that I had derived. For a student to be taken so seriously by such a great mind was truly inspiring--and I have always held that up as a role model. But Professor Meade was not alone. I remember the long conversations with Frank Hahn, who served as my supervisor after Joan Robinson. the lunches at his and Dorothy's house--where I could not always follow all the puns; the Saturday seminars and the Sunday lunches at Nicky Kaldor's; the walks to Grantchester; the long arguments with my first supervisor at Cambridge, Joan Robinson, that would begin in the morning, pick up in midday if we happened to encounter each other, whether it was at the Marshall Library or in front of Sainbury's, and continue over tea; the seminars at which Champernowne would make some modest disclaimer, and then ask a question which showed not only that he had understood the paper, but which contained within it a subtle and devastating criticism. My office was next to Lord Kahn--of the then famous Kahn multiplier-generally viewed as the precursor of Keynes; of all those I met that year, he remained the greatest enigma.

The Themes of this Lecture

The discussions at Cambridge in those days were about big themes--about alternative economic

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[1]**The views expressed here do not represent those of any organization with which the author is currently affiliated and with which he has been affiliated in the past.**

[2]Subsequently published in Econometrica (Stiglitz, 1967).

systems, about capitalism, socialism, and fascism. Economics was more than a technical subject--though theorems on aggregation (was there any meaning to the concept of "aggregate capital"?) were important. Economics was meant to be policy-relevant--but major policy issues, like what kind of an economic system worked better, not minor policy issues, like what should be done *today* to maintain the economy at full employment. Today, at the Council of Economic Advisers, I find myself involved in a host of less grandiose issues; yet I am convinced that how we answer those questions today, and how our successors answer those questions in future, not only affect what happens this year to our economic well-being, but equally important, they affect the *evolution* of our economic system and living standards for years to come. I want to take the opportunity afforded by these lectures to do some introspection: what do my experiences of the past four years have to say to economics, as practiced today within our universities; and what lessons can an economic theorist bring to the policymaking process? Though I spend a large proportion of my time focused on micro-economic issues, I will concentrate my attention today on macro-economics.

At the onset, let me admit some disappointment with the economics profession: I had expected that these years would be spent using up my human capital. I had thought that my main advantage would be my ability to draw upon the received wisdom, and apply it to the problems I confronted. In fact, in issue after issue, I found that the economics profession had little to contribute directly to the discussion. I recall poignantly a moment when we were in a heated debate about the economic consequences of reforming certain aspects of our legal system relating to joint and several liability. One well-read staff member found a paper by a leading member of the profession, arguing for the efficiency of joint and several liability: but a quick perusal of the assumptions and analysis made it clear that the paper did not address in any way the major complaints that were being raised against the system. It was simply of no use. But there was no paper to which we could turn. For me, this has been a boon: I have felt my human capital grow rather than depreciate. To be sure, this is consistent with our overall policy, which views human capital accumulation as a central tenet.

Or consider another major initiative, which has been to adopt what is called in the United States the English rule, in which the losers in a tort suit must pay the other parties legal costs. It was widely heralded that this rule would reduce litigation costs. Here again, we had to rely largely on our own analyses to assess the validity of this claim, which we showed was <u>not</u> true, under quite plausible conditions, and helped reinforce our opposition to these so-called reforms.[3]

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[3]The point was a simple one: matters go to court normally only when there is ambiguity about the outcome. Assume that each party believes that there is a 50-50 chance it will prevail, if it spends exactly the same amount on attorney fees as the other party; but that increasing its expenditures (at fixed levels of expenditure of the other party) enhances its success probability. Then the expected marginal cost (at the symmetric equilibrium) of increasing expenditures by a dollar is approximately 50 cents, since there is a 50% probability that the other party will have to pay the costs. (The marginal cost is actually lower than that: it is .5 + 2C dp/dC, where dp/dC is the change in the probability as a

My concerns about the economics of legal reform are small compared to those raised by macro-economics. For a profession which focuses its attention on the allocation of resources, it is perhaps surprising how badly research resources seem to be allocated within the profession: but perhaps this should not be surprising, since here--as in many other areas of the economy--marginal products are hard to assess and the price system works but imperfectly.

Let me be fair: I did not expect the academic profession to address problems exactly in the way that was required by policymakers--though to be sure, there were many academics who claimed that there expertise was in *relevant* economics, and in particular economics that was *relevant* for policy purposes. (On average, such research was little if any more relevant than work that did not make such claims.) Academics have a comparative advantage at looking at questions minutely, but with precision; the ability to abstract from the complexities of the world, to hone in on the essential assumptions, is absolutely vital. The economics profession has made an enormous contribution to policymaking, simply by identifying and elucidating simple ideas like adverse selection, moral hazard, incentives, externalities. This vocabulary has become, if not a staple of life, at least an everyday part of policymaking in wonkish Washington. Academics have done more than that: analytic frameworks and ways of thinking of the economist too have become part of everyday life, even if the follow-through is less than perfect. I remember soon after coming to Washington being engage in long discussions in the White House about incidence analysis: who really pays for fringe benefits, such as health care; what would be the consequences of slowing down the rate of increase in health care costs; who would really bear the cost of an employer mandate? Who would really benefit from subsidies to small businesses, structured in a variety of ways?

My complaints are not that the economics profession has not made valuable contributions to the policy dialogue, but rather than it has not made as much of a contribution as it could have. I do not mean to sound like a philistine, but I do believe that the marginal social contribution of the last paper defining a new game theoretic refinement concept or, to refer back to the fad of my generation, the last ten papers analyzing fourteen sector growth models, are as valuable--directly, or indirectly, in terms of the research to which they give rise, today, or anytime in the future--as more applied research directed at the problems facing the United States, Europe, or the developing countries. I say this partly out of frustration: repeatedly, we have not been able to answer questions, which we need to answer, if we are to design appropriate policies. In the United States, we have been going through a debate about dislocated workers. In early March the New York Times ran a long and thoughtful series on the subject--though it occasionally verged on voyeurism, as it described in intimate detail the sufferings of those who had lost their jobs. But we simply did not have the data to assess whether in the past five years, the incidence of dislocation or the costs have increased substantially. And if it did increase, we did not have analysis to know why.

Earlier, I referred to our work on clean-up of hazardous sites, and my disappointment with the

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result of an extra dollar of legal expenditure.)

absence of literature addressing the problems of the appropriate legal structure. But the lacuna in the academic literature touched every aspect of our reform efforts, which involved issues of insurance, liability, and clean-up (remedy) standards; and there had been absolutely no attempt, even at a conceptual level, to integrate these three strands.

And nowhere is the gap between the market and what I would conceive of as the socially efficient allocation of research resources greater than in macro-economics. According to one of the central fashionable doctrines, there is no unemployment, if there were unemployment, government could do nothing about it--with any action of the government being fully offset by actions of the private sector; and even if government actions were effective, they were more likely to be counterproductive than countercyclical. To be sure, we policymakers do not like to be told that our social marginal product is bounded above by zero, and in expected value is negative--any more, I suspect than they like the suggestion that their social marginal product is questionable. A few years ago, I had the occasion to discuss this matter with one of France's great economists, and he referred to this as a peculiar American academic aberration. He suggested that no one in a position of responsibility would ever maintain such positions--and not just because politics made such a position untenable.

An Outline of the Argument

In this lecture, I want to present in broad outlines a version of macro-economic theory which I have found most useful from my current perspective. It differs both from the new classical and real business cycle theories--which because they assume that the economy is essentially always at full employment and/or that there is nothing that government can do to improve matters, I find completely useless. But it also differs from standard fixed price models, which because they ignore dynamics, are also of limited value. To be fair, I should say that I believed these dynamic new Keynesian models provided a better description of the economy even before I assumed my current position. I will explain both why I believe that they provide a better description, and how their policy prescriptions and insights differ. In the second lecture, I look at two of the central macro policy questions. Increasingly, policymakers think of the long term interest rate as the "target" of economic policy. I ask, what is the relationship of this variable, on the one hand, to the variables directly under control of policymakers, and on the other, to the level of economic activity. The second question is, how aggressively we should pursue a policy of full employment, how do we trade off the risks of inflation and unemployment. We embed the issue in a decision theoretic framework--which I believe is the right way to approach such issues.

The major substantive themes which I will stress in this lecture is that the appropriate paradigm for thinking about macro-economics is the dynamic, imperfect markets model, and that macro-economic policymaking should be more firmly anchored in a decision theoretic framework, there are two sub-texts which I shall emphasize: the first, that much of modern macro-economics is out of touch with the realities as perceived by policymakers, I have already touched upon; the second is related: rational behavior

provides a powerful paradigm for explaining much of economic behavior, but its scope is limited; at least in the short run, there are institutions and behaviors that cannot be easily reconciled with it; and that policymakers--and economic theorists-- must work with the world as it is, not as they conceive that it ought to be.

Keynes and Modern Macro-economics

The gap between theory and policymaking has not always been so wide. Slightly more than sixty years ago, Keynes, an active policymaker, wrote at this great university the tome that reshaped modern economics. In some ways, I view myself as the intellectual grandson of Keynes--having been a student, all be it for a short time, of the students of Keynes. His impact on economic policy has been enormous. The institution of which I currently serve as Chairman, the Council of Economic Advisers, was established under the Full Employment Act of 1946, just over fifty years ago. With this Act, under the influence of Keynes' ideas, the United States government undertook a responsibility to maintain the economy at full employment. Keynes had shown that market economies, without government intervention, could, for extended periods of time, have persistent unemployment, and that appropriately designed government intervention could restore the economy to full employment. To be sure, one hardly needed a learned dissertation to establish the first proposition: the world had just experienced a devastating depression, in which unemployment in the United States had reached , and for over a decade, unemployment fell below only briefly; in the United Kingdom, the depression was shorter, but no less devastating, with out of non-farm workers unemployed. In the United States, GDP fell by , and in the UK , by . And to be sure, this was not the first economic downturn: modern industrial economies had been marked by economic fluctuations for more than a century and a half. Yet, until Keynes, governments often felt impotent to deal with the problem, and there was a belief that markets, by themselves, would quickly restore themselves to full employment. Keynes argued that the government could do something; and once one accepted that proposition, it became unacceptable <u>not</u> to do what one could to alleviate the problems of economic downturns.

Critics of Keynes saw this as a massive extension of the reach of government. He was attacked as a socialist. Yet, in a sense, his ideas were very conservative: he did not call for the abandonment of the market economy, but rather for targeted intervention. Indeed, the first great Keynesian textbook, that of my mentor at MIT, Paul Samuelson, put forward what came to be called the neoclassical synthesis, which held that once the government restored the economy to full employment, the market could be relied to allocate resources efficiently--in the way that Walras' and Smith had envisaged. The neoclassical synthesis was an article of faith, faith in the market economy: It was not based on a theorem or even a coherent model which integrated the macro-economic and micro-economic analyses. It always seemed to me far more plausible that whatever the market failures were that caused the economy to operate so inefficiently as to leave vast proportions of the available resources idle must also operate inefficiently in a myriad of ways that were more subtle, but in aggregate might be no less important. The depressions and

recessions which had plagued capitalist economies were, perhaps, nothing but the most visible tip of the iceberg of more pervasive inefficiencies in market allocations.

The suspicion of Keynes was, however, perhaps based on a *correlation*: governments that worried about unemployment also tended to worry about other problems facing the working population---lack of pensions, health benefits, unemployment insurance, disability insurance; and the following years saw an expansion of government into these areas, at the same time that governments began to take seriously their responsibility to ensure that everyone had the opportunity for work. The correlation was of course no accident: markets had failed to provide these important forms of insurance--a market failure which government could, and did, address. (Only in the last twenty years have we begun to understand better the reasons for these market failures, with models of imperfect information, focusing on adverse selection and moral hazard.)

Time has not been gentle with Keynes. While the major ingredients in his macro-model have become standard fare, each has been criticized, and the overall structure has been attacked as lacking micro-economic foundations. And, in the cruelest attack, it has been suggested that the behavioral hypotheses underlying Keynes' analysis are in fact inconsistent with rational behavior, including rational expectations concerning the future. It is not only that Keynes failed to provide micro-economic foundations: he simply could not have (or so goes the allegation).

Seeming inconsistencies between rationality and observed behavior

Indeed, there are a host of inconsistencies in Keynes' theory. But Keynes was trying to construct a model that provided a description of the world, and the intellectual challenge which he faced--and which we all face--is to device a logical structure which provides an accurate description of that world. There are apparent inconsistencies between "rational" behavior and what we observe. There are three reactions: to deny what our eyes show us, to deny the hypothesis of irrationality, or to look for some possible way of reconciling what we see with some, at least quasi-rational, behavior. The first approach has become the most popular within the economics profession of late. There are, for instance those that would deny the existence of involuntary unemployment: the real business cycle theory which argues that observed fluctuations in employment can be fully accounted for by shifts in preferences and technology (productivity shocks).

Information Imperfections and Modern Macro-economics

I have spent much of the last twenty years following the third course, trying to see to what extent imperfections of information can explain the seeming anomalies. Information economics has gone a long way: it can explain, for instance, why firms act in a risk averse manner even when the shareholders are widely diversified; it explains why the original owner of a firm may not himself fully diversity his ownership.

Anomalies and their interpretation

Some of the anomalies to which I called attention more than twenty years ago have in fact proved to be anomalies: the market eventually recognized the inefficiencies, and made (some) moves to correct them.[4] (dividend Paradox)

But as hard as I have worked, there remain behavioral patterns which I cannot reconcile with rational behavior. I have developed some rational models for why irrationalities persist. Institutions adapt slowly. The world is more complex than our simple models inevitably depict them, and this in itself can give rise to institutional rigidities: there is always the suspicion that those proposing a change in arrangements do so because they believe it will be of advantage to themselves. Given asymmetries of information (and the awareness of such asymmetries), the other parties which have to agree to such a change are likely to be suspicious.[5] In the end, however, the fact is that we must take our institutions and behavioral patterns as they are, and predict what will happen if we intervene in a variety of ways.

Often, what we see is a mixture of rational responses of some to irrational beliefs of others--but the fact remains that somewhere in the system there is an irrationality--behaviors which are hard to reconcile with full rationality without resorting to Ptolemaic reasoning. For instance, in the early 1970s, I noted that the manner in which firms distributed funds to households, through the payment of dividends, resulted in their paying billions of dollars in taxes unnecessarily. Simply by repurchasing shares, they could obtain the far more favorable capital gains treatment. To be sure, some firms claimed that they realized this, but argued that their shareholders did not; and if they relied on share repurchases, their stock market value would decrease. But note, this argument pushes the irrationality back from the manager to the shareholder. (The fact that some privately held firms did exactly what my theory suggested they should reinforces this perspective.) But a closer look at the data suggests that even this excuse will not do. As a series of empirical studies have shown, share repurchases have a strong positive effect on stock market value.[6] [7] And in recent years, there has been a massive shift of distributions from corporations to

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[4]See Stiglitz [1973, 1976, 199], Bagwell and Shoven [ ].

[5]Legal presumptions--that a contract is interpreted against the writer of the contract--reflect these suspicions, and serve as a deterrent to the innovation of new contract forms. See Stiglitz [ ].

[6]The theoretical prediction of this effect was contained in Greenwald, Stiglitz, and Weiss [1983]. For empirical confirmation, see Asquith and Mullins [ ] ....

[7]There are a host of other examples, some of which can be explained by capital market imperfections, others of which remain anomalies. The former category includes a number of aspects of behavior towards risk. The basic lesson of capital asset and other capital market models is that the only aspect of risk with which firms should be concerned is correlation with the market. Yet, when firms hire consultants to assess risk, that is but one aspect of risk with which they are concerned. When it is reported that the SST transport is a highly risky venture, it is not meant that it's success is highly correlated with the business cycle; indeed, for long lived investments, cyclical fluctuations should matter little in the assessment of market value. But with asymmetric

households towards tax favored forms, consistent with the predictions of the theory.[8] Such shifts illustrate a basic theme of this lecture: institutions and behaviors do adapt, but they adapt slowly, and often imperfectly. To understand the short run behavior of the economy, one must take institutions and behaviors as they are, or as they are likely to adapt within the relevant time horizon. One cannot simply reason on first principles: I think, therefore I am. The economy is rational, therefore it must look like such and such.

To be sure, we can seldom be sure that the failure to reconcile observed behavior with the rationality hypothesis reflects limitations of market participants--or limitations on our understanding. Perhaps if we really understood and had correctly modelled the constraints under which individuals operate, the behavior could be so reconciled (though the tax paradoxes have convinced me otherwise.)[9] It takes a tremendous arrogance and confidence in our analysis to dismiss out of hand behaviors which appear to be inconsistent with rationality. Bob Solow tells the story of how such economists might approach a discussion of the giraffe: because we do not understand how the giraffe can pump blood to its brain, we should not conclude that therefore the giraffe does not have a long neck.

The New Institutional Economics

Institutions and behavioral patterns do change, and policy must change with these changes. Indeed, one of important tasks of economists is not only to analyze the consequences of particular institutional arrangements, but to predict how those institutional arrangements are likely to change. To do that, they must understand both how institutions would adapt, were change costless, and the impediments to institutional adaptation. One of the strengths of information economics and the new institutional economics is that they have provided explanations for many of the institutions in our economy. And by relating these institutions to "exogenous" factors, these theories can help predict the way

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information owner/managers will not be fully diversified, and accordingly will act in a risk averse manner, where risk includes own variance. (See Stiglitz [1982]). The most noted examples of the latter category are the innumerable tax paradoxes, which include, besides the dividend paradox noted in the text, the inventory paradox (many firms continued to use FIFO accounting, when LIFO would have reduced tax payments), the depreciation paradox (many firms failed to take advantage of accelerated depreciation), and the stock option paradox (when the full tax implications of stock options is taken in to account, including the deductibility of payments from the corporation tax, they are often at a tax disadvantage relative to other forms of compensation, which can provide identical incentive benefits.) For a discussion of other anomalies, see

[8]See Bagwell and Shoven [ ]. According to their study, while in 19 approximately a third of the distributions were in tax favored forms, by 19 more than two thirds were.

[9]One of my favorite examples (where both irrationalities and market imperfections play a role) arose in my analysis of tax avoidance behavior (especially associated with capital gains taxation.) I showed that there were a variety of ways in which, with perfect capital markets, individuals could avoid all capital taxes--and much of their taxes on wages. Interestingly enough, since that paper appeared, a number of the mechanisms I described there (in mathematical form) have been employed, though typically only by high bracket individuals with well paid tax attorneys.

institutions may evolve over time, as those exogenous factors change. The fact that the economy's institutional arrangements are always evolving--for instance, that at one time they may exhibit downward nominal wage rigidity, but not at another-- is what makes economics such an exciting topic: the full employment act for economists of 1996. To anticipate our later discussion, two institutional arrangements that play an important role in the subsequent analysis are those that relate to wage and price formation, and those that relate to debt and other contracts between suppliers of capital and users of capital.

The Arrow Debreu Model as a benchmark

I want to argue that the Arrow Debreu model is useful, not because it provides a good description of the economy (at least not one that is useful for short run policymaking purposes), but because it provides a benchmark, a point of departure. We know with that model there would be no unemployment and the only fluctuations in economic activity would be variations in underlying preferences and technology. But there is unemployment, and there are fluctuations which cannot be accounted for by changes in tastes and productivity. We know that the real consumption wage and real interest rates do not change enough in the Great Depression--or even in the recession of 1981-82 in the United States--to account for changes in employment levels: it is simply not plausible to believe that the economy was operating along its supply curve of labor. We also know that the real product wage did not change enough in those instances to account for changes in output: it is simply not plausible to believe that the economy was operating along its short run supply curve of output.[10]

There are a variety of ways in which the actual economy deviates from the Arrow Debreu model. This observation by itself does not take us very far: in principle, the Arrow Debreu model could provide a good, or at least an adequate, description of the economy. The economy could operate as if it were well described by the model, as if there were a complete set of risk and capital markets, as if there were no asymmetries of information. I am asserting that for purposes of short run policymaking, this is not true. The economy does not operate as if it were well described by the Arrow Debrue model, and that model (in any of its variations) does not provide us with much useful guidance.

But even this observation does not take us far enough: there are a variety of ways in which the economy deviates from the assumptions of the Arrow Debreu model. The question is, which are the crucial deviations? Unfortunately, there is no simple way to answer this question. A priori reasoning allows us to ascertain whether certain conclusions follow from certain assumptions--it allows us to judge

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[10]For a fuller discussion of these points, see . In the United States, between 1929 and 1933, real consumption wages rose percent while unemployment rose from to ; there is no evidence of a backward bending aggregate supply curve which could account for such a movement. In the United Kingdom, between.....
Moreover, while evidence on the effect of changes in real interest rate on labor supply is at best weak, real interest rates actually rose over this interval. **Check literature**

Similarly, in the United States, the real product wage fell by percent from 1929 to 1932; in Britain, it fell by . (Other countries, dates)

the logical consistency of alternative explanations--but it does not provide us with a basis for judging whether a set of assumptions provides a good description of the economy. And empirical tests, even when, or should I say especially when, well informed by economic theory, are at best an uncertain guide. (A few years ago, it was received wisdom among students of investment theory that investment depended on the cost of capital, not on cash flow and net worth variables--in spite of the fact that earlier empirical studies, such as that of Meyer and Kuh, had strongly suggested the importance of these variables. The Modigliani Miller theorem and neoclassical economics predicted that such variables should not be important, and accordingly empirical studies either dismissed them out of hand or found that they were not important. Subsequently, when theoretical work, based on capital market imperfections derived from imperfections of information, suggested that such variables should enter into the investment equation, researchers found that they were in fact important. I shall return to this point later.) In the end, informed judgment is required--and regrettably, even well informed, and even well intentioned, economists may not agree.

As difficult as it is, it is important to come to a view about what are the crucial problems and effects--Is it, for instance, wage and price rigidities, or is it the fact that contracts are imperfectly indexed? While there may be a real balance effect, how significant a role does it play in restoring the economy to full employment? While changes in the distribution of income will, in almost any general equilibrium model, have effects on aggregate demand, how important a role do they play, say compared to the real balance effect?[11] As we shall see, it is important both because it affects short run predictions--what variables are likely to affect the economy in the next three months or three years--and policy formation. The policy prescriptions that follow from the models that I will explore here are, at least in some important ways, markedly different from those that follow from alternative models that are (all too often, only implicitly) held by policy makers and their advisers.

The Policy Framework, the Meaning of doing nothing, and why the IS-LM framework may be misleading

Policymakers are concerned with two central issues: what will happen to the economy in the absence of some government action, and what will be the effect of alternative interventions. Even posing the question this way is not quite correct: the government and monetary authorities are constantly buying and selling bonds. It is not even clear what it means for government to take no action. Traditional IS-LM models assume that "no action" means keeping the money supply constant, but even that requires so action: without active government intervention, the money supply will vary with the level of banking activity, not directly controlled by monetary authorities. From this perspective, keeping the money supply constant becomes a policy decision, one which few if any monetary authorities have adopted. For a while, some

[11]Thus, the issue is not whether the postulated effects exist: it is easy to construct simple models in which they plausibly arise. The issue is more of an empirical one.

monetary authorities tried which could be viewed as a slight generalization of this policy--expanding the money supply (M_2) at a constant rate. They found not only that maintaining the economy closely on target was not as easy task as the simple models suggested--and more importantly, that controlling the money supply did not "control" the economy in the desired manner. The velocity of circulation, long held to be a constant, was not only changing, but changing in ways which were hard to predict. This has an important implication: analyses of, say, fiscal policy which are predicated on the assumption that the monetary authorities will keep the money supply constant, are simply misleading. When the same parties control both monetary and fiscal policy, this is an obvious truism; but it is even correct when the monetary authority is independent.

The Basic tenets of the dynamic, imperfect markets macro-model

In this lecture, I will set forth the outlines of a macro-economic model which is distinctly different either from the fixed price model which has underlay so much of recent New Keynesian analysis and from the new classical and real business cycle models, whose days of popularity seem to be fading quickly. I wish to argue that this macro-economic model, which focuses on the dynamics of adjustment, has markedly different policy implications from either of the two other models, and it is one which is far more useful for thinking about the short run problems of the economy--and far closer to how policymakers actually do think about the short run problems of the economy--than the alternatives.

Let me first state in bald form the basic tenets of this model, and how it differs from the two alternatives. It holds that imperfections of information give rise to capital market imperfections, in particular, at various times, to capital and equity rationing. As a result of the latter, firms and financial institutions are imperfectly diversified and therefore act in a risk averse manner. It is in fact this behavioral hypothesis (which can be motivated in a variety of ways) which underlies the theory presented here. This risk averse behavior can explain observed patterns of adjustments of wages, hours, employment, inventories, and capital. It can also explain patterns of lending and borrowing. The theory predicts that cash flow and net worth variables are important, and that unanticipated changes in the rate of inflation result in redistributions of wealth, which have real effects. (Contracts are not fully indexed.) This theory focused on the dynamics of adjustment.

By contrast, the fixed price models focus on the *lack of adjustment*.[12] They seem to say, *if only prices and wages were flexible, then the economy would quickly be restored to full employment.* Our

[12]This both under and overstates the points of disagreement. We find the menu cost theory an unconvincing explanation of rigidities--appropriately trivialized by its name. When demand curves shift, firms must either adjust output, prices, or inventories. A theory of adjustment must focus on the *relative* costs of adjustment; it makes absolutely no sense to focus one moment on the costs of adjustment of prices, ignoring other costs; and then later to focus on these other costs of adjustment. One must take an explicitly portfolio approach, as in Greenwald and Stiglitz [ ]. Still, we agree with that version of New Keynesian economics that prices and wages do not adjust instantaneously, and that it is important to understand the reasons and consequences of this stickiness.

theory suggests that on the contrary, the *short run* dynamics of the economy may be destabilizing: if wages and prices were more flexible (assuming other institutions did not change), then economic fluctuations might well be worse.

And the new classical models and real business cycle models simply assume that labor market adjustments occur with sufficient rapidity that one can assume the economy operates as if it were always at full employment--an assumption that few if any policymakers take seriously.

We can thus think of a two by two classification of models: those that focus on static versus dynamics; and those that assume perfect versus imperfect markets.[13] The objective of this lecture is to begin filling in the bottom right hand side of the matrix: dynamic models with market imperfections. As always in economics, there is a trade-off, here, between a more complete articulation of a dynamic model, whose assumptions clearly make it irrelevant for studying short run cyclical problems, at least as faced by policymakers (represented by the real business cycle and new classical models); and a somewhat less complete articulation of a model, I believe, which better captures what is actually going on.

Dynamics enters not only in the formation of expectations and behavior of *private* agents, but also of government. We noted before that the traditional IS-LM analysis *assumed* that the money supply was fixed--an assumption which is not only an inaccurate description of what government *tries to do* but not even a good first approximation of what actually *does* happen. Monetary authorities, whether when they are independent or not, will respond to a change in the fiscal stance. Predicting how and when they react--and how and when the private sector reacts to those reactions--is one of the central, perhaps the *central* issue in short run policy analysis.

ARE INTERVENTIONS NECESSARILY INEFFECTIVE?

While I have been dismissive of the new classical and real business cycle theories, I have found them, like the Arrow Debreu model, a useful point of departure, for helping to think my way through the morass of models with market imperfections.

The non-interventionist doctrines (a term which I shall use to describe collectively new classical and real business cycle and related theories, without paying close attention here to the distinctions among them) hold that not only is the economy normally (always) at full employment, but also that interventions typically are ineffective, usually because the effects are offset by private actors. Indeed, one of the main insights of rational expectations is exactly that: as individuals rationally expect the price increases that follow upon an increase in the money supply, the effect of the increase in the money supply is completely

[13]The Arrow Debreu model, which I have put in the upper right hand corner, does embrace many periods, but markets are all cleared at date 0, and in a fundamental sense, is therefore not dynamic.

offset; the real money supply remains unchanged; one does not even have to wait for a lagged response, as in the earlier adaptive expectations models.

As a matter of theory, the result that private sector actions perfectly offset government actions is valid only under extreme, and unrealistic assumptions. The most obvious case where government actions cannot be offset entail changes in relative prices, e.g. associated with taxes. Many interventions have effects because they affect market participants beliefs about future relative prices (interest rates). It simply does not appear to be the case that actions of monetary authorities leave those expectations unchanged.[14] [15] We shall return to this theme later.

It is easy to see, moreover, why even slight market imperfections could result in monetary policy having real effects *even with rational expectations*--even with fully anticipated changes in the money supply. Assume, for instance, that the price level moves proportionately to the money supply, and changes int he money supply are always perfectly anticipated. For instance, assume that the monetary authorities announce that dlnM/dt = f(s), the rate of change of the money supply is a function of the state of nature, s. Assume, further, that there are no asymmetries of information, so that s(t) is observed contemporaneously by both the monetary authorities and government. Assume that as a result the price level moves in tandem with the money supply, so that M/p remains unchanged--a necessary condition if monetary policy is to have no real effect in the standard models. But then the distribution of returns to holding money

$$-d \ln M/dt = f(s)$$

depends on the monetary policy, f. A change in monetary policy will affect the distribution of returns. Assume, for simplicity, that s is i.i.d. over time. It is still the case that the demand for money will depend on the monetary rule, even if we restrict the government to considering monetary rules with the same expected rate of increase in M (i.e. Ef(s) = K), *so long as individuals are not risk neutral*, or, more

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[14]Verifying this assertion is more difficult that it might seem. In countries, such as the United States, where there do not exist indexed bonds, one has to make inferences about market participants' beliefs about future real interest rates. Standard techniques suggest that those beliefs do change markedly in response to actions of monetary authorities. **(evidence)**. In countries like the United Kingdom, real interest rates do seem to change markedly **(evidence)**. But even there, there are a host of factors which could affect real interest rates; there is always the danger that a specification error would result in it appearing as if monetary authorities affected the real interest rate, when in fact, some other variable affected, say, both the actions of the monetary authority and the real interest rate.

[15]Analytically, a more interest case is that where there are asymmetries of information: the information set of government and private parties do not coincide. If government (the monetary authorities) has information not available to private parties, then their actions may *convey* information, and thus have real effects. Even if government does not have differential information, if private actors believe it does, then the actions of the monetary authority have real effects. And even if the *only* information that the monetary authority has which is not known to private parties concerns their current (future, past) actions, and if private parties believe those actions have real consequences, then in general they will have real consequences.

generally, so long as money is not a perfect substitute for other assets in the economy.[16] Note that much of the rational expectations literature has assumed exactly that--the individuals are risk neutral, an assumption which if true would leave unexplained a vast amount of economic activity.

The conclusion that particular government policies are ineffective thus depends no so much on the assumption of rational expectations as on other assumptions concerning markets. Indeed, in some circumstances, rational expectations can enhance the efficacy of government interventions. With rational expectations, and fixed wages and prices, multipliers associated with increased government expenditures are actually increased: consumers anticipate that some of the "leakage" to future periods will result in higher incomes in those periods, and, anticipating those higher incomes, they consume more today. (Neary and Stiglitz, 198).

While it is apparent that one can create models in which private sector actions fully offset those of the public sector, there are two issues: one, analytic--under what conditions is that true and are those conditions highly restrictive?--the other empirical--in practice, is government policy fully, or almost fully, offset?[17] I attempted to address the first question in a series of papers written some years ago, and the results were instructive: under the highly idealized assumptions conventionally made, I could prove a far stronger result than the Barro-Ricardo theorem; I could show that all public financial policies--from exchange rate policies, to the term structure of debt, to whether it should issue indexed bonds--were irrelevant. Indeed, if those assumptions were correct, many of my colleagues over at the Treasury Department, and their compatriots on Wall Street, were engaging their talents and energies in activities with no social returns--and in the perfect market assumptions which underlie those analyses, there should have been no private returns as well. But a close look at the assumptions--ranging from no transactions costs to no bankruptcy and full collateralizability of future receipts, to fully integrated dynastic utility functions--provides an easy explanation of why the conclusions of those models seem at odds with what is in fact observed.

While academics may debate whether private sector actions fully offset government actions, few of those, either on Wall Street, Main Street, or in Washington, believe it does--and for good reason. The empirical evidence overwhelming suggests that government actions do matter. There are real consequences to the Fed lowering interest rates; and while the immediate impact of those actions may be attenuated by

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[16]Even if there are other real assets which is a perfect substitute for money, when the government uses rule f_1, or rule f_2, if it switches from one rule to the other, it will have real effects; in one case, money will crowd out the real investment that is correlated with f_1, in the other, the real investment that is correlated with f_2.

[17]In a general equilibrium model, one would expect some reactions to any action taken by the government, and that under quite plausible conditions, those private actions would partially offset the government action. A tax on cigarettes, designed to discourage consumption, leads producers to lower their prices, so that the net increase in prices paid by consumers is less than it would be if producers kept their prices fixed; but standard incidence analysis takes such reactions into account.

anticipations, it is only because market participants believe that future actions do have effects that current behavior is affected by anticipations.

THE DYNAMIC IMPERFECT MARKETS MACRO-MODEL

Before setting out the macro-economic perspectives as I see them as a policymaker, I want to present a broad theoretical perspective, one which my colleagues Bruce Greenwald, Andy Weiss, and I have been developing over the past ten years. I will not take the time to repeat the details, but I will sketch the framework. Because of capital market imperfections, firms act in a risk averse manner. We can think of them as maximizing

$$EU^j(P^j(x^j_t, x^{j-1}_t, Y^j_t, s_t)$$

where P is the jth firm's profit functions, x^j is the vector of actions undertaken by the firm (new hires, fires, prices charged for the goods produced, wages paid to workers, output, etc), x^{j-1} is the vector of actions undertaken by all other firms, Y^j is the firm's state variables (employment, inventories, etc.), and s is the state of nature (which includes the state of information), the realization of a random variable. Maximizing EU with respect to x for each j and solving simultaneously, we obtain the Nash equilibrium of the system.[18] Then

$$Y^j_t = f(Y^j_{t-1}, x_{t-1}, s_{t-1})$$

describes the evolution of the state variable, from which we can derive the evolution of the action variables.

This (or higher) level(s) of abstraction may help clarify issues--but they do not translate simply into policy. For that, we need to add more structure to the model, such as assumptions about risk aversion (concavity of the utility function) and costs of adjustment.

Earlier, we argued that "doing nothing" is not well defined: for the monetary authorities, does it mean attempting to hold the money supply constant or the interest rate constant; for a firm, does it mean holding price or quantity constant. Doing nothing is not independent of the "coordinate" system in which the problem is framed. While, to be sure, an important insight of modern psychology is that how issues are framed does affect behavior (Tversky....), to date, for the most part, economic theory has not gone down that path.

Elsewhere, we have argued that a convenient decomposition of behavior in the presence of uncertainty is into a passive response--actions required to minimize uncertainty--and an active response--deviations from the risk minimizing strategy to take into account trade-offs between risk and variance. In a sense, the reason we often think that doing nothing is the appropriate "base" response is that it minimizes risk, since we know something about where we are, and less about where we might be. This approach formalizes that intuition.

This formulation provides an explanation of which variables vary a great deal in the short run, and which adjust more slowly. I want to show briefly how this formulation allows insights into adjustments

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[18] We could also think of x^{j-1} as the jth firm's beliefs about the actions undertaken by other firms. This can be modelled as a "state variable," with an updating equation describing how those beliefs respond to observations.

of prices, outputs, inventories, employment, hours, and capital.

Consider first the following simple problem. A firm which produces a storable output has a shift in its demand curve. Will it reduce price, quantity produced, or inventories. The firm may be more uncertain about the consequences of changes its price than the quantity produced; for the former depends critically on the reactions of its rivals, which are hard to predict. In the short run, if there are costs of adjusting inputs and/or the production function is strongly concave, but storage costs are low, then production will be smooth, but inventories allowed to vary.

In practice, we do see sluggish adjustment of prices, but typically as the economy goes into a recession, inventories are cut back, rather than accumulate. They do not seem to perform this production smoothing role. Again, the model provides a simple explanation: As the economy goes into a recession, firm's net worth decrease; they become more risk averse; and there is greater uncertainty about the value of their inventories. Thus, standard risk averse portfolio theory suggests that firms will wish to hold less of their wealth in the form of inventories; and even if they wanted to hold a constant fraction of their wealth in the form of inventories, since their net worth has decreased, inventories would decrease.

Consider another seemingly anomalous aspect of cyclical dynamics: as the economy recovers from a recession, hours worked always increases faster than employment. At first blush, this makes little sense, since firms are forced to pay overtime--at a marginal cost one and a half times or more that of straight time. But firms are risk averse. They are not sure that the recovery will be sustained. There are large fixed costs associated with hiring and training workers. These investments are risky--and only as the recovery proceeds is the risk reduced (and risk aversion reduced, as a result of an increase in net worth) to the point where investments in new hires become desirable.

Finally, consider investment. In a sense, I should be proud of neoclassical investment theory, for it represents a triumph of economic theory--or should I say ideology--over evidence. It postulated that desired capital stock was simply related to factor prices (cost of capital) and output, and that investment was a partial adjustment of actual to desired capital stock. Never mind the theoretical lacuna in this theory: if there were no transactions costs, the adjustment should have been complete; and if there were transactions (adjustment costs), those adjustment costs should have been formally introduced into the dynamic analysis; moreover, investment decisions had to take into account irreversibility and uncertainty--as modern option theory has done (see Pindyk and Dixit).[19] Given these lacuna, it would have been

[19]This list of limitations is not meant to be comprehensive: capital was putty clay, rather than putty putty as most of the neoclassical investment literature assumed, and technological change was at least partially embodied in new investments.

remarkable if the simplistic version had succeeded.[20] But my complaint with neoclassical investment theory was that it should have been apparent from Meyer and Kuh's studies, done well before Jorgenson's work, that investment depended on financial variables. But Modigliani and Miller said that financial structure did not matter; economy theory said that financial variables, or even economic variables like net worth, simply could not matter. And thus, by the dictates of the time, those variables had to be omitted from the investment equation. It was only decades later, when information economics made it clear that financial structure did matter and that net worth and cash flow variables should affect investment decisions, at least for a significant number of firms, that empirical studies admitted the possibility that these variables might matter: and when they did, the evidence was overwhelming that they did matter. And they mattered more precisely for firms for whom one would have thought they should have mattered more--small and medium size firms that were more likely to face credit and equity constraints; but it was precisely the investment of these firms that accounted for so much of the volatility of aggregate investment.[21]

Once cognizance is taken of financial variables, the banking (or more broadly, the financial system) becomes an important determinant of macro-economic activity. Note that in the neoclassical theory, banks are but an intermediary, a veil easily pierces by all market participants--borrowers and lenders: never mind that historically, many of the downturns of the economy have been associated with financial panics. In the new perspective, financial intermediaries are real institutions, not only depositories of funds, but repositories of information, specialized information about particular potential borrowers. In the short run, destruction of particular institutions may entail the destruction of information for which there is no perfect substitute elsewhere in the economy, which cannot be easily transferred to others, and which gets re-established only gradually by investments in information acquisition. Within the general theoretical framework we have established, these financial intermediaries are like other firms; like other firms, they are typically risk averse (though once their net worth becomes small enough, they may become "gamblers.") Their risky "production" activity is lending; and when they become more risk averse, they cut but on this risky production. Thus, when adverse shocks hit particular banks, they cut back on their lending, and because information is specialized, particularly small and medium size borrowers may not

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[20]And indeed, a large literature developed trying to incorporate these various elements into investment equations. It was remarkable, however, that in spite of the consensus on the importance of these factors, the simplistic version continued to dominate empirical work--simply because it was easier to use.

[21]Interestingly enough, these theories provide partial resuscitation of the multiplier-accelerator model, though on quite different theoretical grounds. The earlier (Samuelson) version of that theory had been criticized on the overly simplistic expectations assumptions that were built into the analysis. In the new version, as output expands with an economic recovery, profits expand, and these profits provide the cash flow for investment to expand, and the net worth that allows firms to borrow even more, to support further investment.

be able quickly to find alternative sources of funds; this problems becomes particularly acute when most of the banks in a region are affected similarly, so that even if there are several banks that might have been willing to lend to the firm, all of them cut back their lending. Thus, in an economic downturn, it is not only expectations about the future which may have adverse effects on a firm's investment:[22] Their willingness to invest may decrease, both because economic downturns are accompanied by decreases in firm's net worth, which decreases their willingness to undertake risk, and because in economic downturns perceived risk is likely to be greater; and their ability to invest may decrease, as both their cash flow is reduced and their access to capital is impaired--as their lenders are less willing to make loans (both because of the increased perception of risk and their decreased ability to absorb risk, given bank's reduced net worth). In short, while we may have to resort to changes in animal spirits--inexplicable changes in business confidence--to "explain" some of the variations in investment, much of the variability can be explained in terms of the underlying financial and net worth variables that we have identified.

Why does it matter?: Contrasting implications of alternative models

I have sketched out here some of the elements of a dynamic macro-economic model. Before I took up my present position, I often thought of dynamics as a refinement: we need to get the basic static theory right in the first place. To be sure, one needed a time perspective: the fact that it might take the economy 250 years to recover from a recession, if the real balance effect were the only restorative force suggests that that was hardly the effect on which economists should focus their attention.

But from my current vantage point, dynamics appears to be, if not the whole show, at least a very large portion of it. Through 1993, the economy appeared to be in a robust recovery, with aggregate hours increasing markedly. But the hours were not being quickly translated into jobs. Some called it the jobless recovery. The theory I sketched above helped us understand this, and gave us hope--which turned out to be justified--that the jobs were just around the corner.

Just a few months ago, there were great worries about the economy heading into a downturn. With the government shut down in December and January, and then a weak long blizzard that interrupted normal activity along the East Coast, the usual statistical indicators gave at best hazy signals. A reported 200,000 job loss in January sent chills down the economy, as deep as the arctic winds that had accompanied the blizzard. Our statistical analysis suggested that more than 100% of the job loss could be accounted for by weather; but what worried us was that the loss of business confidence would set up a negative dynamic--reduced investment that would self-confirm the weakness in the economy.

To some extent at least, macro-economics is an applied subject which should be able to help us address these very short run movements. But even if it cannot help us predict these very short term

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[22]Indeed, given excess capacity in the economy, economic downturns might, in terms of the cost of cap[ital, be a particularly good time to engage in investment.

movements, dynamic analysis is important for understanding movements over somewhat longer periods.

To those who believed in the simple IS-LM framework, the failure of monetary policy to stimulate the economy quickly in 1991 came as surprise. But to those of us who emphasized the importance of financial institutions, it was perfectly predictable (and was, in fact, predicted.) In the aftermath of the financial crisis that lead to the S & L debacle and the weakening of the banking system, there was good reason to believe that banks would be reluctant to increase lending, even with low interest rates--a response which was reinforced by the over-reaction of regulators to their (almost deliberate) policy of regulatory laxity and forbearance which had contributed so much to the ultimate magnitude of the problem.

Price rigidities have played a critical role in traditional Keynesian theory--but as prices and wages have become more flexible, these underlying dynamic assumptions have become more questionable. Indeed, traditional explanations focused on downward money rigidity; yet it was clear that with the stagflation of the 1970s, one could have economic downturns with inflation--so that inability of prices to fall did not appear to be the binding constraint.

Consider a thought experiment: what would happen if all the sudden prices became more flexible. In the traditional fixed price model, presumably this would improve matters. Prices would more quickly converge towards their equilibrium level--at which all markets clear.[23] By contrast, in the models on which I have been focusing, in which imperfect contracting that is the central problem, more rapid price deflation increases the magnitude of redistributive effects, and can actually exacerbate the economic downturn. Rapid unanticipated price declines (or smaller than anticipated price increases) erode net worth of debtors, leading to a retrenchment of investment--far larger in magnitude that the increases that follow upon the unanticipated increases in net worth of creditors.

This thought experiment helps set the stage for contrasting effects of monetary and fiscal policy. In the traditional fixed price model, with fixed money supply, increased government expenditure (with fixed taxes) typically leads to an increase in interest rates: government expenditures partially crowd out private investment. By contrast, in the Greenwald-Stiglitz models, increased government expenditures can generate increased profits and net worth, generating an increase in investment: government expenditures and investment may be effective complements rather than substitutes.

Or consider the effect of increasing the money supply. Here, the central concern in standard theory is whether it leads to increased prices or output. If prices remain unchanged, then interest rates will fall, generating increased investment. But if prices move in tandem, the real effects are completely obliterated. By contrast, in the Greenwald-Stiglitz model, the immediate impact of an open market operating is to induce banks to extend more credit, which stimulates the economy. But if prices were to

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[23] Actually, matters are more complicated, even in a fixed-price model, once intertemproal substitution effects are taken into account. See, e.g. Neary and Stiglitz [ ] (other references).

rise proportionately, it would have real effects: debtors would be better off, and as a result would be able and willing to invest more than they previously had. This induced demand response as a result of price increases may be even larger than the induced demand which results if prices do not increase; for the latter depends on the responsiveness of the banking system.

LONG TERM INTEREST RATES

Much of macro-economics, from Keynes on, talks of the "interest rate," as if there were a single number describing the cost of capital. Yet, there are long and short interest rates; government bonds and corporate bonds; bank loans and equity. In a "neoclassical world," firms would have chosen a portfolio of capital sources in such a way that the marginal cost of finance *regardless of how the funds are raised* would be the same. Were that the case, life as a macro-economist would be so much easier! We could look at *any* method of raising funds, and that would test us the marginal cost associated with *every* method of raising funds. Yet, the flip side of the equity premium puzzle and the dividend paradox is that the cost of raising funds does not appear to be equated. (As an aside, the empirical work in this area is badly flawed[24] ; typically, they look at the average cost of capital, *given* the firm's financial structure, not the *marginal* cost of capital, assuming that the firm can *choose* a capital structure. Indeed, I showed (Stiglitz, 1973, 1976, 199), that with tax deductibility of interest, a firm would typically borrow for all financial needs in excess of retained earnings,[25] and that the corporate income tax would accordingly not distort the level of investment of the firm *under the conventional hypothesis that bankruptcy risk could be ignored.*)

Today, most economists believe that the single number most relevant for determining the level of economic activity is the medium or long term real interest rate. In Britain, since there are real bonds, one knows what that is; but in most other countries, one only know the nominal long term interest rate; one has to *infer* the real rate, by estimating the long term inflationary expectations.

What is interesting about this number is that it is neither the number which is directly controlled by monetary authorities, nor the number which is directly relevant for firm decision making. In the U.S., monetary authorities focus on the federal funds rate, but more generally, they focus on short term interest rates. And firms focus on the rates at which they can borrow, the medium or long term bonds rates and bank lending rates. Presumably, the medium or long term U.S. bond rate (until recently, viewed as a risk free rate) is highly correlated with those rates--and is far easier to observe. (But there are instances where the two may differ. The recent concern about default of U.S. bonds is a case in point. Presumably, this default risk would not affect the risk associated with corporate bonds; hence an increase in the interest rate paid on U.S. government bonds because of the default risk would have no *direct* effect on lending rates--a point missed in much of the discussions on the cost of default. At the same time, many mortgages are

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[24]The logical inconsistency of this work is striking: under the assumptions which underlie the neoclassical investment function (Jorgenson and Hall) the Modigliani-Miller theorem would be true, so that financial structure would not matter. But then we could simply look at the marginal cost of borrowing; yet typically, these models include a weighted average of the cost of equity and the cost of debt, with the two components differing--which is inconsistent with the underlying theory.

[25]This oversimplifies slightly; it ignores bankruptcy risk, and the result is somewhat sensitive to the tax rate on capital gains.

indexed off the U.S. government borrowing rate, and interest payment on *outstanding* bonds would accordingly be increased; this illustrates the importance, especially in the short run, of institutional arrangements; in the longer run, the margin charged by mortgages over, say, the T bill rate, would presumably adjust to take into account this previously unanticipated contingency.

The Short Rate

Traditional monetary theory focused on the short rate. The LM curve provides a simple explanation of its determination.

$$M = M(Y,r)$$

The demand for money is a function of nominal income and the interest rate. Money is needed for transactions purposes, and these increase with Y. And the opportunity cost of funds is the (nominal) interest rate--one could have held short term bonds. Seldom has a theory which has held such sway for so long had so weak underpinnings. Most transactions (in dollar or pound terms) are not related to income, but involve exchanges of assets, and there is no simple relationship between the two.[26] Most transactions do not require money to be intermediated; credit will suffice, and again, there is no simple theory that explains the use of one or the other; the fact that there has been such an increase in credit cards recently in the United States suggests how easy it is to substitute credit for money. And most money today is interest bearing--and there is no simple theory explaining why more of it is not interest bearing. In a fairly competitive market, the difference in interest rate between "money" and T bills is determined solely be transactions costs; it is this difference which should appear in the money demand equation

$$M = M\,(Y,\ r^{CMA} - r^{T})$$

where r^{CMA} is the interest rate on interest bearing money accounts, and r^{T} is the treasury bill interest rate. This equation makes it clear that the money supply does <u>not</u> determine the short term interest rate--at least not plausibly through this mechanism.

If

$$r^{CMA} - r^{T} = k$$

a constant related to technology, and if we could ignore the first two caveats above, then we would have restored monetarism: controlling the money supply would control money income. But one of the lessons of the 1980s and 1990s has been that the relationship between money and income has been variable and hard to predict (and <u>not</u> accounted for by the minuscule variations in $r^{CMA} - r^{T}$.)

Far more plausible that these traditional monetary theories are those that focus on the effect of open market operations on the balance sheet of banks, the reactions of banks to those changes in balance sheets, and through that, the effect on lending activity and lending rates, on the one hand, and interest rates on bonds (both short term and long term)--an extension of the kind of portfolio theory approach pioneered

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[26] Calculation of the variability over the cycle.

some time ago by James Tobin.

THREE PUZZLES IN THE DETERMINATION OF LONG RATES

While to an economic theorist, the natural approach to macro-economic analysis is the construction of general equilibrium models, in which everything depends on everything else, and in which one simply calculates the total derivative of the system with respect to some set of variables under the control of the government, to a policymaker, this formulation, while faultless, is also close to useless. The policymaker attempts to cut through the nexus of complicated interrelations, to identify a few variables upon which to focus, either because they directly affect the variables of interest, or because they are highly correlated with variables of interest, and thus can serve as surrogates. As I have suggested, today, the variable upon which attention is centered is the long term interest rate. But movements in the long term interest rate are complicated. There are, in particular, three puzzles upon which I wish to focus.

Excess Volatility

First, why are the movements in long term interest rates as large as they are? For instance, on March 8, 1996, the long bond rate increased by 30 basis points, or almost 5 percent in one day. The precipitating event was the announcement that employment had increased during the month of February by 300 to 400 thousand more than had been expected. Could one plausibly believe that beliefs about the average marginal product of capital *over the next ten or thirty years* increased by 5% in one day? To be sure, the news revised beliefs about Fed policy in the immediate future; Fed futures markets suggested an upward revision of these short term rates of basis points. But the news hardly held out much evidence of a structural change in the economy. And while the unemployment rate fell to 5.5 percent, this was little different from the level at which it had hovered over the past 18 months, during which inflation had remained stable. Hence, few interpreted the news as indicative of large inflationary pressures.

There is a tautological way of approaching this issue: the long rate is the expectation of the product of the short rate plus a risk premium.[27]

$$r^L = r^t + p$$

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[27] There is another paradox here. On theoretical grounds, it is not obvious whether there should be a positive or negative risk premium; if all interest rates were "real" then the long bond would be safer for those who have long term consumption objectives. See Stiglitz, 1972. But long term bonds are not indexed, and it appears historically that a sequence of short term bonds is actually safer than a long term bond, even for someone with long term consumption objectives. Thus, long term bonds, which have greater capital risk, also have greater consumption risk. Thus, they should have a positive risk premium, as generally observed.

The paradox appears from the perspective of the lender. Long term bonds impose greater real risk on the borrower, and the borrower has to pay a higher return. (Short borrowing has further *monitoring* advantages (see Rey and Stiglitz [ ]). Why then would anyone borrow long? The answers relate to market imperfections: anxiety about capital rationing some time in the future, and differences in expectations about inflation between lenders and borrowers (differences which are not fully arbitraged out because of capital market imperfections).

where r^L is the long rate, r^t is the short rate at time t, and p is the risk premium. An event such as that of March 6 either changes expectations of short rates, or the risk premium. While the news may not have had much effect on beliefs concerning short interest rates 4 years hence, it could have increased the risk premium, since there was now more uncertainty associated with the direction of the economy. Again, I believe that it is hard to account for the magnitude of the volatility of long term interest rates by *rational* changes in expectations or risk premium.

The best way to understand what is going on is to view long term bonds as assets, a major component of the value today being beliefs about what those assets can be sold for tomorrow. There appears to be "excess volatility" in asset values--an observation which in other contexts has been documented by Shiller. Keynes got in right when he described asset markets as like a beauty contest, in which the objective is not to guess who is the most beautiful person, but who the others will believe to be so. Conventions develop, and so long as those conventions "work" in the sense of providing a rough accounting of movements in the relevant variables, those conventions have sway in the market. Thus, if market participants believe that higher employment leads to lower bond prices (by a certain amount), it will tend to do so.

These conventions may play an even role in foreign exchange markets. During 1993 and 1994, there were two striking observations: Whenever trade negotiations with Japan went badly, the dollar fell relative to the yen; and when the dollar fell relative to the yen, long term interest rates increased.

Pundits had a ready explanation of the first phenomenon. The United States would "punish" Japan by devaluating the dollar, making U.S. goods cheaper. Thus, if it could not negotiation a better trade balance, it would use market weapons. Newspaper pundits conjured the image of the U.S. government having a dial, with which it could set the foreign exchange rate. To my knowledge, there is no such secret instrument, hidden away in the closet of the Treasury or the Fed. But while the <u>story</u> made no sense, the correlation was there--at least for a while. In the first episodes in which trade negotiations ran into difficulty, the dollar declined in value.

The link between that and the bond market was explained in a similar way. It was believed that under these circumstances Japanese investors sold some of their dollar holdings (they appeared more risky), driving the dollar and long term bonds down. Evidently, in the <u>very</u> short run, markets are far from perfectly arbitraged.

In one sense, whether we could *explain* these movements made little difference; if they were there, or even if there was a widespread belief that they were there, it affected our actions as policymakers. We worried about the effects of our negotiations on the exchange rate and on the interest rate.[28] If there was overwhelming evidence that in the longer run, fundamentals would win out *perhaps* policymakers could

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[28]Footnote on variations in the exchange rate from other sources--January June fluctuations

have been convinced to ignore these short run movements. The theories--such as that intervention made no difference in the long run or that exchange rates are determined by macro-economic fundamentals--even while they may have a brief moment in court simply do not hold sway when so much of the short run evidence runs contrary.[29]

The basic conclusion is that variations in asset values--in long term interest rates-- cannot be simply related to the underlying fundamentals--either to movements in expectations about future interest rates or risk premium. But policymakers do need to understand the current conventions, for their actions can have significant effects on long term interest rates, and thus on economic activity. I now want to look closer at the link between these interest rates and economic activity.

Why does the nominal rate matter?

The second puzzle is why is it that it *appears* as if the nominal long rate has an independent effect on investment. In theory, it should only be the real rate which matters, but when reasonable proxies for inflationary expectations are put into investment and savings equations, the nominal interest rate seems still to matter. The answer again relates to capital market imperfections. Increases in the nominal interest rate offset by inflationary expectations have adverse effects on investors who are cash flow constrained. Again, in theory, investors should be willing to lend more if prices are expected to be higher; all cash flows should in principle adjust to changes in the price level. But they do not. Given that not all contracts are fully indexed, it is not irrational for the market not to offset fully price changes. Because not all contracts are fully indexed, changes in the rate of inflation have marked real wealth redistribution effects; and a rational response by lenders to such redistribution effects is that loans are not automatically adjusted.

There is another reason that changes in the nominal interest rate may have a direct effect. Typically, models talk about market expectations of inflation, but in fact different individuals have different expectations. In a full Arrow Debrue economy, trades would ensure that the ratio of marginal utility weighted probabilities for all events be the same for all individuals (the marginal rate of substitution of income across states of nature); but in the real world, this is not true. Individuals hold different beliefs. The real interest rate that borrowers believe that they are paying may differ from the real interest rate that lenders believe that they are receiving.[30] It is well documented that the variance of inflation increases with the rate of inflation. Assume that Wall Street (lenders) are systematically more pessimistic about inflation than is Main Street (borrowers). Then increases in the average expected rate of inflation, leading to an offsetting increase in the nominal interest rate, would imply that borrowers believe that the real interest

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[29]Footnote on Greenspan/economists controversy at Jackson hole? Impact of deficit reduction on exchange rate

[30]In earlier work (Stiglitz, 1972), I emphasized that one of the reasons that bankruptcy mattered was that it resulted in a difference between the expected payments made by the borrower and the expected receipts of the lender.

which they pay has increased, while lenders believe that the real interest rate which they receive has decreased. In effect, the market would entail a shift in the demand and supply curves of funds (as expressed as a function of the average expected long term interest rate); the new equilibrium which emerged might involve a real interest rate little different from the original one, but with a lower level of investment and savings (See Figure).

Alternatively, so long as some market participants *believe* that nominal interest rates matter, then they do matter. Those who believe that they matter will believe that real investment will decrease, and therefore that the real marginal product of capital will be larger in the future; they will believe that the real long term interest rate will rise, and they will accordingly push bond prices down. Thus, while the nominal long term interest rate will increase with inflationary expectations, they will increase more than an offsetting amount. Accordingly, the increases in long term interest rates associated with increases in inflationary expectations will have real effects.

Perverse Movements in Long Rates

The third puzzle--one which has become of increasing concern to policymakers-- is why is it that at times the long rate moves opposite to the short rates? If the two always moved together, the policymaker would have a relatively simple task. Having targeted the long rate, he moves the short run down by the amount required to reduce the long rate the desired amount. It may take more steps than anticipated at first, but the task will be accomplished, even if the long rate responds less to the short rate than at first anticipated. But when they may move in the opposite direction, the policymaker has a difficult task. If he wants the long rate lowered, he could make matters worse by lowering the short rate.

In the United States there have been several recent instances when they have moved in opposite directions. Some of these cases (such as) entail the market having anticipated the actions of the Fed, and when it failed to move as much as expected, the long rate adjusted accordingly. Thus, the long rate was adjusting, say, not to the fall in the short rate, but to the fact that the fall was less than expected; or not to the rise in the short rate, but to the fact that the rise was less than expected.

But there are some instances where the market (or the markets' pundits) argue that, say, lowering interest rates will stimulate the economy, increasing inflation, and the long rate increases in response to these inflationary expectations. But note that if the long rate increases in response to inflationary expectations, it would have no real effects, if it were only the real interest rate which mattered.

On the other hand, if the main channel through which monetary policy stimulates the economy is the long interest rate, then an increase in the long rate in response to a reduction in the short rate would depress the economy (This is in fact the policymaker's nightmare.) But then the hypothesized inflationary pressures would not be realized; on the contrary, lowering the rate would be deflationary. In short, it is hard to reconcile the perverse movement of the yield curve within a closed economy with even approximately rational expectations.

In an open economy, there is another channel: the lower short term rate leads to a devaluation of the currency, leading to increased exports and decreased imports. But note, the perverse effect could only set in if market participants believed that the yield curve effect exceeded the terms of trade effect; but again, the perverse effect would be self-contradictory, since if the net effect was negative, unemployment would increase, and inflation would decrease.

But a major theme of this lecture is that the policymaker cannot *assume* rationality on the part of the market. Nor because he cannot explain the giraffe has a long neck, can he simply assume it away. It is possible that bondholders in particular may have "extreme" expectations--they may simply associate lowering interest rates with such large increases in inflation that long term real interest rates--as perceived by borrowers--increase; in that case, lowering interest rates may depress the economy. Still, it is my belief that such instances are the exception rather than the rule, and that unless there is strong evidence to the contrary, the policymaker is better guided by the presumption that there will not be a perverse response, though the response in the long rate may clearly be much weaker than the change in the short rate.[31]

[31]It is also possible that the lowering of the interest rate generates an increase in the risk premium. The issue is one of plausibility: why should say a decrease in the federal funds today of .25 lead to a significant increase in the risk premium associated with the returns over a 10 or 30 year period?

A THEORIST LOOKS AT POLICYMAKING: POLICYMAKING UNDER UNCERTAINTY

In yesterday's lecture, I suggested that there was some disjunction between the way that policymakers and theorists view the economy. It is not so much that much of what academic economists is irrelevant, or that there are many issues on which academic economists have failed to provide insights, but that so much of academic writing seems simply wrong, predicated on assumptions the validity of which seems so patently questionable, that it would take more than a simple "willing suspension of disbelief" to believe that any insights based on "as if" reasoning would be of any value.

Today, I want to look at the matter from the other side: a theorists view of economic policy making. Overall, I have been impressed with the intelligence, dedication, and yes, even wisdom of most of those with whom I have come into contact in the policymaking process. The speed with which economic ideas have infiltrated into policymaking is indeed impressive. I recall Keynes' famous quote (get exact quote) about policymakers ideas reflecting those of a by-gone theorist. Soon after I entered the Administration, I came late to a meeting on health care, in which I heard one of the policymakers explain the problems posed by adverse selection. I raised a question, and he went on to give me a reasonably competent articulation of the theory of adverse selection--much to the amusement of my staff that had accompanied me to the meeting.

Even when there are disagreements, the economists' arguments, for instance concerning the dangers of rent seeking, special interests, and distortions are well understood. They do not always win the day, but typically, we do not even have to articulate them: our presence in the meeting simply serves to remind the other participants of their importance, and perhaps to increase their feelings of guilt should other considerations dominate the economic logic.

The greatest challenge that we as policymakers face is the appropriate response uncertainty--uncertainty about what the future will be like without our intervention (uncertainty about the state of nature) and uncertainty about the effects of our interventions (instrument uncertainty). Over the past twenty five years, economic theory has contributed greatly to our understanding of a "rational" response to this uncertainty: while the mathematics underlying theoretical tools like decision trees, loss functions, and sequential decision making, may not be part of everyday discussions, the concepts are increasingly understood--though there remains, here as elsewhere, a large gap between best and average practices. I want to apply that analysis to the issue of the appropriate response to uncertainty about the NAIRU. For the moment, I will accept that the economy cannot for long be kept at an unemployment rate below the NAIRU without inflation increasing at an accelerating rate, and that the NAIRU is well defined, and unaffected by policy. (Thus, for purposes of this discussion, I accept the hypothesis of a vertical long run Phillips curve.) I focus on an economy, such as the United States, where the inflation rate has been moderate--at official statistics, the CPI has been increasing at 2.6%, but adjusted for the well known biases in the CPI, at something between 1 and 2 percent per year (or perhaps even lower, given that some

economists estimate the bias at 2.0% or higher).

Even accepting a vertical long run Phillips curve, there remain three elements of disagreement about the appropriate course of policy.

The Precipice

First, while there are some who seem to suggest that the economy stands on the verge of a precipice: exceed the NAIRU for ever so short a time, and inflation *rapidly* accelerates. The evidence does not support this view. The standard wisdom has been that the NAIRU in the U.S. has been around 6 percent, and yet the economy has operated for more than eighteen months with an average unemployment rate of without any marked acceleration of inflation. More broadly, one can provide a weak test of the "precipice" hypothesis by asking whether, holding the unemployment rate fixed, an increase in the inflation rate one period is followed by a even greater increase of significant magnitude in the inflation rate in succeeding periods. That is not the case. The evidence is the contrary: slight deviations above or below the NAIRU seem to lead to slight increases or decreases in the rate of inflation, and if there is an acceleration in the rate of inflation, it is very slight. The economy does not stand on a precipice.

Costs of disinflation

The second disagreement concerns the costs of "disinflation"--reducing the inflation rate. Assume policymakers make a mistake, and push the unemployment rate below the NAIRU. Inflation increases slightly. What would it take to reduce inflation? Clearly, the economy would have to operate for a while at a higher level of unemployment--at a level above the NAIRU. Those who advocated a cautious policy--making sure that the unemployment rate never fall below the NAIRU--worry that the costs of reducing inflation are very high. In particular, they looked to the experience of the 1970s and 1980s: to wring the inflationary expectations of the 1970s (when inflation hit double digit levels) out of the economy, the United States had to go through a deep recession--the deepest recession since the Great Depression.

But the evidence from attempts to reduce more moderate inflation suggests that the costs are low. Indeed, the loss in output and employment from "killing" inflation are matched by the gains in output and employment during the period in which unemployment remained below the NAIRU. The Phillips Curve is, in the relevant region, approximately linear, as Figure illustrates.[32]

Costs of Inflation

The third issue is the costs of slight increases or decreases in inflation. If the economy were fully indexed, presumably the costs of inflation would be negligible. There is a large literature detailing the costs of high *and uncertain* inflation, but what I am concerned with here is the costs of low inflation.

Econometric estimates have not established a strong relationship between productivity growth and

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[32]More precisely, the relevant concept is the sacrifice ratio: the months of unemployment above the NAIRU required to reduce the inflation by 1 percent, compared to the months of unemployment below the NAIRU required to generate an increase in the inflation rate by 1 percent.

inflation at low levels of inflation. Barro--a strong advocate of anti-inflationary policies--estimates that reducing the inflation rate from 2 to 1 percent would result in an increase in the rate of productivity growth of only percent.[33] At the current low levels of inflation, inflation does not appear to be a significant factor in decision making. Indeed, even institutions are adapting to the disappearance of the threat of inflation: today percent of all workers are covered by COLA's, a marked decrease from the levels a few years ago. (Expand)

From a theoretical perspective, the major costs are associated with the holding of money, the growth of the financial sector, and tax distortions. Today, most money is interest bearing, and accordingly the returns adjusts with the rate of interest; thus the inefficiencies resulting from moderate inflation on this account cannot be considered significant.[34]

The recent growth of the financial sector in the United States has been driven by factors other than concerns about inflation--increasing the ability of the economy to share and allocate risk, and in doing so, they have increased the ability of the economy to deal with risks associated with inflation, to the extent that those risks are viewed to be meaningful.[35] There is no evidence that the pace of expansion of that sector has been affected in any significant way by variations in the inflation rate within the ranges recently observed. (To be sure, past episodes of moderately high inflation may have generated some growth in the industry; but many of the costs, e.g. associated with developing appropriate financial instruments, are fixed costs; the marginal costs today may accordingly be very small indeed.)

The third cost, that associated with the fact that our tax system is imperfectly indexed, is potentially the most serious. The allegation is that because depreciation allowances are not indexed, the real value of depreciation allowances decreases when the rate of inflation increases, and this discourages investment. Of course, if the monetary authorities keep the economy at full employment, and the monetary and fiscal authorities coordinate their policies appropriately, then by changing the interest rate, the level of investment can be set at the desired level. Thus, the real issue is not the level of investment, but distortions in the composition of investment.

Here, the issue is far more complicated, because even in the absence of inflation, our tax system is distortionary. Neutrality could be achieved with *true economic depreciation*, that is, depreciation that

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[33]And there are reasons to believe that his estimate is an overestimate. The residuals at low levels of inflation....

[34]Of the total money supply (M2), today percent is interest bearing. Using a broader definition (M3), percent is interest bearing. If the remaining uses of non-interest bearing money are relatively interest inelastic, then the deadweight loss associated with the inflation tax is not very great. (estimates)

[35]Some of the developments in financial market may be attempts at "rent seeking," broadly defined. See Hischliefer and Stiglitz

is distortionary. Neutrality could be achieved with *true economic depreciation*, that is, depreciation that corresponds to the actual decrease in the market value of the asset. This can be seen by observing that the value of an asset is

$$V(t) = \int R(t)\, e^{-rt} dt$$

where R is the return on the asset at time t, T is the life of the asset, and r is the real interest rate. Differentiating, we obtain

$$V = rV - R.$$

Assume now we impose a tax at the rate t, and depreciation allowances equal V. The differential equation becomes

$$V = r(1-t)V - R(1-t) + tV$$

or

$$V(1-) = r(1-)V - R(1-),$$

or

$$V = rV - R$$

independent of . Since the boundary value condition

$$V(T) = 0$$

holds independent of , it is clear that the value at each date t is independent of . Hence investment decisions are completely unaffected by the tax.

Actual depreciation allowances differ from true economic depreciation. With straight line depreciation, the depreciation allowance

$$D = V(0)/T$$

the cost of the asset (which, for the marginal asset, equals its value), divided by its life. Consider an asset which yields a constant stream of dividends over its finite life. The difference between true economic depreciation and actual depreciation is illustrated in Figure , where it is clear that the present discounted value of depreciation allowances under straight line depreciation exceeds that under true economic depreciation. The tax laws thus *increase* the value of the assets; there is a pro-investment distortion.

How does inflation affect all of this. Assume that the real interest rate remains unchanged and that the nominal interest rate increases in tandem with the rate of inflation. The value of the asset (without taxes) is now\-

$$V = \int Re^{it}e^{-(r+i)t}dt = \int R\, e^{-rt}dt$$

where i is the rate of inflation. Notice that inflation does not affect the equation at all. It follows that inflation does not affect the differential equation for V. By the same token, so long as nominal interest payments are tax deductible, the differential equation for V is unaffected when taxes are imposed, if there is true economic depreciation. But this in turn has one important implication: since V is unchanged, the true depreciation allowance at time t is unaffected by inflation. There is a simple intuition behind this

result. True economic depreciation tracks the actual path by which the value of an asset decreases from its initial value V(0) to zero. With or without inflation, the value decreases to zero at time T. Inflation simply does not affect the path by which it approaches zero, and hence it does not affect true economic depreciation allowances. Inflation does affect the present discounted value of depreciation allowances with straight line depreciation, since it affects the rate at which (nominal) dollars get discounted. But note that in the example given earlier, of an asset which yields a fixed return of R for T years, the faster the rate of inflation, the less the distortion. While the exact effect of changes in inflation depend critically on the time profile of returns, there is a general lesson: given the distortionary nature of current depreciation allowances, reducing inflation need not reduce the distortions.

A simple example illustrates how an increase in inflation may make some investments even more attractive, assuming tax deductibility of interest and straight line depreciation. Consider an asset which lives for two years, producing $100 each year. Assume the interest rate is 10%. The asset is worth approximately $170. Assume it is a marginal asset, costing $170. The firm borrows to buy the asset. By construction, the revenues generated by the asset will just cover the costs of the asset, enabling the firm to repay the loan in the second year. Now a 50% tax is imposed. The net interest cost is reduced to 5%. With true economic depreciation, depreciation the first year would be $70, and in the second $100. With straight line depreciation, the depreciation allows are $85 each year. The (present discounted value of the) positive bias is (evaluated at time 0) approximately $.68.[36] Assume now inflation increases by 1 percentage point.[37] Since we know that in the absence of inflation, with offsetting increases in the nominal interest, nothing would happen, we focus only on tax changes. We know that with true economic deprecation, the present discounted value of the project remains unchanged. With straightline depreciation, the present discounted value of the accelerated depreciation allowances has decreased by approximately

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[36]$15 is moved from period 2 to period 1; this is worth $1.50. The value of this at time 0 is $1.35. With a 50% tax rate, this is worth $.68

[37]Originally, the firm borrowed $173; at the beginning of period 1 it owed $190. If it used its entire $100 proceeds to repay the bank, at the end of the period, it owes only $90. At the beginning of period 2 it owes $99, which it repays with its $100 income.

With a 50 percent tax rate, with true economic depreciation equal to $73, and with tax deductible interest payments of $17, total taxable income is $10. The firm pays $5 in tax. Using the remaining proceeds to repay the bank, at the end of the period it owes $95. At the beginning of period 2 it owes $104. With true economic depreciation equal to $100, and interest deductions of $10, it is just able to repay the loan.

If inflation increase by 1 percent, interest payments increase by $1.73, revenues are $1 higher than before, tax payments are reduced by $ .36 in period 1. In period 2, indebtedness has increased by $.36, interest payments have increased by $1, income in the second period by $2, tax payments by $.50, just enough to offset the increased obligations due . (check)

8 percent.[38]

The Ever-changing Structure of the Economy

If the economy never changed, economic policy would be a simple matter. There would be agreement about what the level of the NAIRU, the unemployment rate below which inflation would accelerate. By and large, there would be a consensus among economists that the government should attempt to keep the economy at that critical level of unemployment. To be sure, there would be shocks that put the economy temporarily at a higher level of unemployment, and other shocks that put it temporarily at a lower level of unemployment. So long as on average the unemployment rate remained at the NAIRU the rate of inflation would be relatively constant.

Whether we like it or not, however, the economy is constantly changing, and with those changes, the NAIRU itself changes. In the 1960s, the economy experienced price stability with very low levels of unemployment, while in the 1970s, the economy experienced high and increasing inflation at relatively high levels of unemployment.

In recent years, there has however been considerable controversy over the true value of the NAIRU. Until recently, many economists had believed that the NAIRU was around 6 per cent. From late 1994 through early 1996, unemployment hovered around 5.4 to 5.7%, but the inflation rate remained low and showed no sign of increasing. More and more economists have come to the view that the NAIRU had in fact decreased. And there were theoretical reasons to believe that the NAIRU might be lower. Much of the unemployment that remains when the economy is working at full capacity is "frictional," as workers move from one job to another; and such job movements are much larger among new entrants to the labor force. Thus, periods--such as the 1970s, as the baby boomers and more women entered the labor market--in which there are many new entrants are associated with a high level of NAIRU. There are reasons to believe that the 1990s are likely to be more like the 1960s, when the pace of new entry was lower, and the NAIRU was lower. Moreover, with more competitive labor and product markets, workers are less able to demand wage increases not justified by productivity increases; there is less scope for "cost-push" inflation.

If the NAIRU has indeed declined significantly, this would have important implications for fiscal and monetary policy. If the Fed, for example, had maintained a policy of targeting a 6 percent unemployment rate, the inflation rate would fall and output would be under the full-employment level.

Given the uncertainty about the NAIRU, some argue for caution, while others argue that the Federal Reserve should take a more aggressive stance, lowering interest rates to stimulate the economy, so that it operates at a lower unemployment rate. To analyze these alternative policy stances, we need to

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[38]The present discounted value of the bias is $15 x .11 / 1.11, as opposed to $15 x .10 / 1.10

calculate the costs associated with error: with acting as if the NAIRU has decreased, when it has not versus acting as if the NAIRU has not decreased, when it has. In either case, a "mistake" can be reversed. If the Fed has been too aggressive, and the NAIRU has not decreased, the slight increase in inflation from being temporarily below the NAIRU can be offset by being temporarily above the NAIRU for a short period of time. A more aggressive policy risks a temporary increase in the inflation rate, with a future increase in the unemployment rate above the NAIRU, should the NAIRU turn out to be higher than it thought; a more cautious policy risks postponing non-inflationary growth opportunities; and since a dollar today is worth more than a dollar in the future, there is a real loss in economic value from such postponement. Those who believe that the benefits of a slight decrease and the costs of a slight increase in inflation are low compared to the real loss in economic value from postponing growth opportunities believe that a more aggressive stance is desirable.

Figure depicts a stylized decision tree, an analysis of the outcomes if the Fed pursues a cautious policy (targeting unemployment at 6 percent) or an aggressive policy (targeting unemployment at 5.2 percent); and if the NAIRU truly is 5.2 percent or 6.0 percent. In either case, it is assumed that after three years, it becomes apparent what the true value of NAIRU is.[39] For simplicity, we assume that if it finds itself wrong, it "reverses" policy, restoring the inflation rate to its previous value, and that it does this over a three year period.[40] Initially, the unemployment rate is 6 percent and the inflation rate is 3 percent. Keeping the unemployment rate below (above) the NAIRU by 1 percent for one year results in an increase (decrease) in the inflation rate by 2 percent. (The sacrifice ratio, the amount that unemployment must be reduced for one year to reduce inflation by 1 percent, is assumed to be .5) Thus, if the Fed pursues a cautious strategy, and the NAIRU is 6 percent, then inflation remains stable. If the Fed pursues a cautious strategy, and the NAIRU is 5.2 percent, then inflation will fall to .6 percent (.8 (difference between unemployment rate and NAIRU) x 2 (percentage point lowering in inflation from a 1 percentage point increase in unemployment) x 3 (number of years during which gap persists). Then, to return the inflation rate to its previous level, the economy can operate "beyond full employment": if it operates at 4.4 percent unemployment for three years, the inflation rate will return to 3 percent.

But if the Fed pursues an aggressive strategy, and the NAIRU is 5.2 percent, output each year will be 1.6 percent higher (assuming, by Okun's law, that a 1 percentage point reduction in the unemployment increases output by 2 percent). In a 10 trillion dollar economy, this amounts to $160 billion. Note that eventually, even with a cautious policy, by running at more than full capacity, the

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[39]We also assume, for simplicity, that it believes that either outcome--a 5.2 percent NAIRU or a 6. 0 percent NAIRU are equally likely.

[40]A more complete analysis would allow for the possibility that the Fed does not reverse course: if the NAIRU turns out lower than it thinks, it simply allows the inflation rate to drift down.

economy will be able to make up for most of the shortfall. But there is still a benefit at having the higher output earlier--on average by three years. With a real return on capital of around 7 to 8 percent, the total value of this is about $120 billion (7 percent compounded over three years is slightly less than 25 percent; postponing one year's extra growth of $160 billion by 3 years thus has a cost of $40 billion; postponing three year's extra growth by 3 years has a cost of $120 billion.) This amounts to about $1200 for every American family--a not inconsiderable sum.

On the other hand if the Fed pursues an aggressive policy and the NAIRU is 6 percent, it will have to reverse course, raising the unemployment rate to 6.8 percent. Compared to the more cautious strategy, output the first three years is higher, and the last three years lower. After the deviation, the inflation will be back to where it was, and the present discount value of the higher earlier production is still $120 billion.

Thus, the more aggressive strategy has, in either case, yielded a pay-off in terms of real output. There is a cost--higher inflation in the six years. If the Fed is cautious, and the NAIRU is 5.2 percent, we saw that the inflation rate declined to .6 percent before it was restored to 3 percent; while if the Fed is aggressive, and the NAIRU os 6 percent, the inflation rate will increase to 5.4 percent, before declining back to 3 percent. The question is, what is the cost of the economy of the slight temporary increase in inflation rate if the Fed pursues an aggressive policy, and it turns out that the NAIRU is 6 percent; or the benefit to the economy of the temporary decrease in the inflation rate, if it pursues a cautious policy, and it turns out that the NAIRU is 5.2 percent. If one believes the costs of slight increases in inflation (or the benefits of slight decreases in inflation) to be low--less than $120 billion--then the Fed should choose an aggressive strategy; if one believes these costs to be high--greater than $120 billion, then it should follow a more cautious strategy.

Implications of being initially at optimum

To elucidate further the optimum strategy in response to uncertainty about the NAIRU, it may be useful to consider the following thought experiment. Assume the economy were initially in a long run equilibrium; the NAIRU was known, and policymakers had carefully weighed the trade-offs. For instance, if unemployment were temporarily increased slightly, by say, one percentage, output would increase by, say, G, and the inflation rate would increase by i. If then unemployment were restored to its previously level, the economy would, forever, have a higher inflation rate. If the cost of a higher inflation rate per year is i, then it must be that

$$G < i/r.$$

By the same token, if it does not pay to increase the unemployment rate,

$$G > i/r,$$

i.e.

$G = i/r$.

Now assume that with certainty, we know the NAIRU has been lowered, by one percentage point. Then it pays to go immediately to the new NAIRU. Assume one delayed a year. One would lose G, but permanently gain a lower inflation rate, the value of which would be i/r. But we know that G i/r, so it does not pay to delay.

Now assume there is some uncertainty about the NAIRU, uncertainty which will be resolved in one year. The benefit of delay is now

$V(i)/r$

where V(i) is the "utility" of disinflation. If this is concave, then the expected utility of gains from disinflation are clearly less than the cost of delay, G. On the other hand, whether it pays to expand the economy up to or beyond the new expected value of the NAIRU depends on whether the utility of disinflation function has a positive or negative third derivative.[41] With a quadratic utility function, the optimal policy is to set the unemployment rate at the unemployment rate at which the expected value of the rate of disinflation is zero. Given the very low costs associated with low inflation, a quadratic approximation provides a good approximation to the utility function, and, in this instance, can be thought of as serving as a reasonable guide to policy.

Hysteresis

In Europe, the high unemployment rates which have persisted for more than a decade now are often attributed to a hysteresis effect--prolonged unemployment results in workers losing skills that make them employable in the workforce (at wages exceeding the minimum wage.) By the same token, high levels of employment increase skill levels, and thus even a temporary increase in the employment rate may

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[41]Let the trade-off between the increase in the inflation rate and increased output be described by

$$i = aG + e - k$$

where $E\,e = 0$. Initially, $k = 0$ and there is no uncertainty about e. G is chosen to maximize

$$V(-i) + G,$$

where V(-i) is the lifetime expected utility (in current dollar terms) from disinflation by -i, so that, at the initial situation, where the economy is in steady state

$$V'(0)a = 1.$$

It does not pay to disinflate further (or to inflate). Now assume k increases. The optimum value of G still satisfies

$$V'(0)a = 1,$$

which implies that G increases to the new NAIRU. With uncertainty, we obtain

$$aEV'(aG^* + e - k) = 1.$$

With a quadratic utility function,

$$V' = b - ci,$$

so

$$G^* = k/a,$$

that is, G is set again so that the expected inflation rate is zero.

serve to lower the NAIRU. In this case, aggressive policies, which may entail at least temporarily going beyond the NAIRU, can have long run pay-offs, in helping the NAIRU fall.

production functions are approximately linear, and storage costs small, but costs of adjusting inputs are significant, firms will