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Theory Ahead of Language in the Economics of Unemployment

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Why do measured unemployment rates vary so much across countries at a point in time and over time within a given country? This question has long attracted the interest of economists. Progress toward answering questions like this are achieved through the combined efforts of many individual researchers, often working independently. Communication of findings among researchers thus plays an important role in the effort to answer such questions. Findings may also need to be communicated to policymakers or other interested individuals. Communication is enhanced by the use of clear and precise language and concepts, thereby allowing issues to be sharply defined and results to be disseminated effectively. Have the language and concepts developed by economists in their study of unemployment served their role of fostering clear communication of findings and allowing issues to be sharply defined? That is the question I deal with in this essay.

One unemployment concept that macroeconomists have used extensively is the natural rate of unemployment. In a search of the literature, I came across the following uses or definitions of this term. Blanchard and Fischer (1989), in their graduate macroeconomics textbook, first equate the natural rate of unemployment to the average rate of unemployment (p. 349), only to later equate it to the equilibrium rate of unemployment (p. 545). In their chapter of the *Handbook of Labor Economics* devoted to the natural rate, Johnson and Layard (1986, p. 921) write: ''In this chapter we deal with unemployment in the long run. We do not bother about the movement of unemployment over the cycle, but only with its average level. In other words, we are looking at what we call the equilibrium unemployment rate.

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. . . This is what Friedman called the 'natural unemployment rate'. . . .'' Also in the *Handbook of Labor Economics*, Hall and Lilien (1986, p. 1021) write: ''The natural rate is the normal unemployment rate that results from this process of labor allocation when workers and firms correctly perceive the levels and rates of change of price and wages.'' Lilien (1982, p. 777) had earlier written, ''Because it takes time for separated workers to be matched to jobs, some positive level of unemployment will always exist. Economists have long recognized this fact and have labelled this necessary quantity of unemployment the frictional, natural or equilibrium unemployment rate.'' In his undergraduate textbook, Mankiw (1994) defines the natural rate of unemployment to be the steady state rate of unemployment, whereas in their undergraduate text, Auerbach and Kotlikoff (1995, p. 426) refer to the natural rate of unemployment as the ''lowest sustainable rate of unemployment.'' Bean (1994) defined the natural rate to be the equilibrium rate, whereas Christiano defines the natural rate to be the trend component of unemployment generated by the Hodrick-Prescott filter.[1] Clark and Summers (1979) suggest that it is the efficient rate of unemployment, and Hahn (1980) defines the natural rate of unemployment to be unemployment at full employment.

If transitivity is assumed to hold, then the above list of quotations would tell us something like: long run = frictional = average = equilibrium = normal = full employment = necessary = steady state = lowest sustainable = efficient = Hodrick-Prescott trend = natural. It would seem doubtful that any concept that is sufficiently ambiguous as to promote this many different uses can be helpful in guiding scientific inquiry. I am by no means the first to question the clarity of this concept. Solow (1986, p. S24) has written, ''[I]t is not clear what we are talking about when we talk about the natural rate.''

In a larger context, the natural rate of unemployment was only one of many terms that were introduced supposedly to clarify key issues and lead the search for a theory of unemployment. Primary among the other terms were several decompositions of measured unemployment; there was equilibrium and disequilibrium unemployment, voluntary and involuntary unemployment, and frictional and cyclical unemployment. There was also the notion of full employment unemployment. Milton Friedman (1968) was adding to this list in his presidential address to the American Economic Association when he introduced the concept of the natural rate of unemployment. Much of this ''language of unemployment'' continues to be used today. Is this because these terms have turned out to be the precise and powerful concepts that facilitate clear communication and allow issues to be defined sharply? In this essay, I will argue that they are not. In his 1972 AEA presidential address, Tobin (1972, p. 1) wrote, ''Full employment—imagine macroeconomics deprived of the concept. But what is it?'' My conclusion is that economics *would* benefit from being deprived of these concepts. I see no benefit to the use of vague

[1] Christiano's definition was communicated to me in private conversation.

concepts, and there is a potential cost. Their use may lead to vaguely stated theoretical results, vague characterizations of the data and vague policy implications.

I should stress that the above mentioned terms were all introduced by theorists whose primary theoretical tools were models that were static and deterministic. The modern economist approaches these same substantive issues equipped with an advanced array of techniques for handling dynamic stochastic models and time series data. Modern theories of unemployment stress dynamic and stochastic elements. It is perhaps not surprising, therefore, that much language that once may have been viewed as useful is now either empty of meaning or dominated by clear and precise terms that are standard in dynamic stochastic economic theory. As my title suggests, we have reached the point where our theories of unemployment are ahead of language.

In the next section, I discuss the unemployment concepts that emerged out of the 1960s, with a focus on Friedman's concept of the natural rate of unemployment. Then I discuss what a modern theory of unemployment looks like and illustrate by discussing a model that has proven useful. By contrasting the characteristics of unemployment in the model with the inherited language of unemployment and the natural rate, I try to illuminate the limited usefulness of the previously mentioned concepts and offer several interpretations of the natural rate of unemployment based on its uses.

Language Ahead of Theory

One can certainly sympathize with the difficulty facing an individual economist who is given the task of accounting for large and persistent measured unemployment, but whose sole analytical tool is the static supply and demand model familiar today to any student in the principles of economics course. Although this framework can be used to account for changes in total hours worked in response to shifts of the demand and/or supply curve, it does not account for the observation that unemployed individuals are seeking employment but remain without it.

In any scientific endeavor, departure of observation from theory calls for modification of theory. One might also expect that new language would emerge in order to guide this modification, and it did. The basic idea of macroeconomists at the time seemed to be that some unemployment could probably be understood in the context of the existing paradigm, but most of it could not. The key role of the language that was developed was to separate that part of unemployment that was ''understandable'' from that part that was not. Frictional, voluntary and equilibrium unemployment were the names given to that part that was understandable using existing theory, while involuntary, cyclical and disequilibrium unemployment were the names given to that part that was not explainable in terms of the received theory. These terms were not necessarily distinct; in Tobin (1972), for example, it is clear that involuntary unemployment is disequilibrium unemployment and that frictional unemployment is both voluntary and equilibrium.

In his presidential address to the American Economic Association, Milton Friedman (1968, p. 8) introduced another concept, that of the natural rate of unemployment. In his words: ''The 'natural rate of unemployment,' in other words, is the level that would be ground out by the Walrasian system of general equilibrium equations, provided there is imbedded in them the actual structural characteristics of the labor and commodity markets, including market imperfections, stochastic variability in demands and supplies, the cost of gathering information about job vacancies and labor availabilities, the costs of mobility and so on.''

At a minimum, this definition is rather peculiar. As Robert Hall (1979, p. 154) noted, ''This definition is hardly more than a list of things to think about . . .'' Moreover, it is also clearly not a definitive list, given that it ends with the catchall phrase, ''and so on.'' One could even claim that it is self-contradictory since it at one point claims to be studying the Walrasian general equilibrium equations, which are built on perfect competition, only to say next that market imperfections must be included. The ambiguity of Friedman's definition is surely one reason why the term is so protean; moreover, I suspect that some economists have adopted the terminology of the natural rate without much consideration for Friedman's intended use of the term.[2]

There are, however, several statements elsewhere in Friedman's address that, although they do not remove all ambiguity, perhaps do serve to clarify what he intended with this definition. Consider these comments, picked out of his exposition (Friedman, 1968, pp. 9, 9, 10, and 10, respectively): ''I use 'natural' for the same reason that Wicksell did—to try and separate the real forces from monetary forces.'' ''To avoid misunderstanding, let me emphasize that by using the term 'natural' rate of unemployment, I do not mean to suggest that it is immutable and unchangeable. On the contrary, many of the market characteristics that determine its level are man-made and policy-made.'' ''The 'market' rate [of unemployment] will vary from the natural rate for all sorts of reasons other than monetary policy.'' ''[T]he 'natural rate [of unemployment]' will itself change from time to time.''

Let us assess the usefulness of these terms by viewing them from the perspective of a modern theory of unemployment.

A Framework for a Theory of Unemployment

What does it mean to have a theory that accounts for differences in measured unemployment across time and across countries? I take it to mean that one can

[2] There is at least some support for the latter view that Friedman's use of the term has been disregarded, as evidenced by Tobin's (1982) comment that he assumes the natural rate to have the usual efficiency properties of a Walrasian equilibrium, and Feldstein's (1975) introduction of the term ''permanent rate of unemployment,'' which he distinguished from the natural rate to accommodate the possibility that government programs influence the rate of unemployment.

write down a model that generates time series for measured unemployment that are able to mimic quantitatively the important features of the actual data.

This model should function in the context of a broader methodology that is built on three foundations. First, it must contain an explicit description of the economic environment, which includes economic agents, preferences, technology, endowments, information structure, exogenous stochastic elements, and so on. The second ingredient is an equilibrium definition. The definition of equilibrium provides a mapping from the economic environment into outcomes. Implicitly, then, I am adopting the methodology of dynamic general equilibrium analysis, a methodology that economists have found very useful for studying aggregate economic phenomena. I will refer to an outcome thus generated as an equilibrium of the model. The third ingredient that I include is individual optimization, which implies that the equilibrium outcomes be consistent with private agents solving explicit constrained maximization problems in which they do the best they can subject to the constraints they face. This third ingredient is often subsumed in the definition of equilibrium, but I include it as a separate ingredient for emphasis since I think it is essential if one is to use the model to think about decentralized economies.

This framework is sufficiently rich to accommodate a large number of possible economic models. It may also be informative to say what I am trying to rule out. I wish to exclude reduced form models that are simply a collection of equations. Obviously, there is room for disagreement on what the starting point should be for an economic analysis; unlike physicists, whose starting point for analysis is often dictated by nature's laws, economists have no laws that dictate the starting point for their analysis. To me, however, the issue of insisting on systematic methodology that is built on specifying an environment and defining an equilibrium that includes individual optimization is one of practicality, not aesthetics. Since resource allocation is a fundamental issue in many analyses, I think it is important that the analysis includes a well-defined resource allocation problem. Moreover, to analyze changes in policy, one must be able to address how self-interested individuals will change their behavior in response to the policy change.

By building models and comparing their equilibria to actual economic data, the hope is to be able to disentangle what factors are important in accounting for differences in unemployment across countries and the changes in unemployment over time within countries.[3] For example, what types of shocks are primarily responsible for fluctuations in unemployment? How much do particular policy differences contribute to unemployment differences across countries? A model that can successfully account for movements in unemployment will presumably be useful in analyzing how alternative policies would affect unemployment and what the welfare consequences of these policies would be.

[3] I do not wish to imply that the issue of how to confront theory with data is straightforward. See, for example, the recent symposium on ''Computational Experiments in Macroeconomics'' in this journal with contributions by Kydland and Prescott (1996), Hansen and Heckman (1996) and Sims (1996).

A Modern Theory of Unemployment

One way to assess the usefulness of various theoretical concepts of unemployment is to examine them from the perspective of modern theory. In this section, I briefly describe one modern theory of unemployment. I stress that it is a theory of unemployment in the literal sense; in this model there are economic agents who would be counted as unemployed if they were surveyed according to U.S. rules for measuring unemployment. The model I examine here is an example of what is known as a matching model, and the version I present here draws heavily on the material in Mortensen and Pissarides (1994).[4]

I do not claim that this model, especially in the simple form I consider here, can successfully account for all the time series observations on unemployment. However, the model's focus on the dynamics of the formation and dissolution of employment matches must be central to any theory of unemployment. As an empirical matter, since new entrants and workers on temporary layoff account for a small fraction of total unemployment, match dissolution is the proximate cause of most unemployment. Put somewhat differently, most unemployed individuals have been employed at some point in the past.

Moreover, this model and its variants have proven themselves to be useful in studying unemployment. One could plausibly argue that much of our headway in accounting for the aggregate time series behavior of measured unemployment has taken place in some variant of this model. For example, Mortensen and Pissarides (1994) show that the model can account for some key features of unemployment at business cycle frequencies. Mortensen (1994) and Millard and Mortensen (1994) use it to evaluate how institutional differences between the United States and United Kingdom in unemployment insurance systems, income taxation, job protection legislation and job subsidies account for differences in average unemployment between the two countries. A version of the model has also been used by Millard (1994) to study the effect of job protection measures on cyclical fluctuations in U.S. and European economies. Related models are used by Ljungqvist and Sargent (1995) to study the role of social programs in the recent rise in European unemployment, and by Andolfatto and Gomme (1996) to analyze the increase in Canadian unemployment. Lastly, much empirical work on individual employment histories treats these histories as stochastic processes, and since this model provides a theoretical structure in which individual employment histories have this feature, it provides a framework in which much of the microeconometrics work on unemployment is easily interpreted.

As already noted, the essence of the model is the process of match formation and dissolution in a context in which match formation requires time and resources.

[4] There is also a large body of related work that extends the model in various ways, including, for example, Blanchard and Diamond (1989, 1994), Bertola and Caballero (1994), Caballero and Hammour (1996), Merz (1996), Aghion and Howitt (1994) and Andolfatto (1996).

New opportunities create an incentive for some existing matches to be dissolved and for new matches to be formed. The process of reallocating workers from existing matches to new matches entails search on the part of workers, and hence unemployment. In what follows, I attempt to fill in some details of the model.

There are two types of individuals in the model: workers and entrepreneurs. Each type of individual seeks to maximize the present discounted value of their future stream of consumption. In the simplest form of the model, each worker is endowed with one unit of time in each period, and individuals receive no utility from leisure, although it is straightforward to add leisure to the model, if desired. The distinguishing feature between an entrepreneur and a worker is that entrepreneurs have the ability to create production sites, which can be done costlessly. (The reader may want to identify a production site with a ''job.'') To produce output, however, a production site must be matched with one (and only one) worker, and the process of finding a match requires time and resources. An entrepreneur with a vacant (that is, unmatched) production site who is searching for a worker is said to ''post'' a vacancy, which costs the entrepreneur a fixed number of units of consumption. (One can alternatively assume that there is an initial higher cost when a site is created and then a lower cost that is incurred each period in which a vacancy is posted.) There is no restriction on the number of production sites for which an individual entrepreneur can post vacancies. For simplicity, it is often assumed that unmatched workers can search costlessly and that on-the-job search does not exist.[5]

There are two technologies in this economy, one that describes how output is produced by a matched worker-entrepreneur pair, and another that describes the process by which workers and entrepreneurs become matched. We begin with the former. The output of every matched worker-entrepreneur pair is made up of two parts; an aggregate part that is the same for all worker-entrepreneur pairs during that time period, and an idiosyncratic part that differs across individual matches. To simplify, assume that the aggregate shock during any time period can be either good or bad and that there is some constant probability that the value does not change between periods. The idiosyncratic outcome in the first period of a newly formed match can be viewed as a random draw from some given distribution. Subsequently, the idiosyncratic element of productivity evolves stochastically.

To model the process whereby entrepreneurs who post vacancies get together with unemployed workers, we specify an object known as a ''matching function,'' which describes the number of matches that form, given the number of vacancies posted and the number of unemployed workers searching. Intuitively, this relationship can be viewed analogously to a production function that maps inputs into outputs. For example, the matching function should have the property that either more vacancies or more unemployed workers should lead to a higher number of matches.[6] These new matches that form become productive in the following period.

[5] Pissarides (1994) extends the matching model to allow for on-the-job search.

[6] Other common assumptions in the most basic model are that the matching function m is non-negative, concave, displays constant returns to scale and is less than the minimum of vacancies and unemployed

The sequence of events in any given time period is the following. At the beginning of a period, each match that produced in the previous period receives its current realization for the idiosyncratic shock, and all new matches receive values for their idiosyncratic productivity. Subsequently, everyone observes the realization of the aggregate shock, at which point all matched pairs decide whether to continue or separate, and search decisions are made. If a match terminates, the production site becomes a vacant site, subject to the same stochastic opportunities as other vacant sites.

In thinking about an equilibrium for this model, one item that needs to be described is how wages are determined. In this environment, a matched worker-firm pair constitutes a bilateral monopoly. One way to determine an outcome in this situation is to assume some form of a bargaining rule. Here, I assume that outcomes are generated by generalized Nash bargaining, which provides a rule for how the two sides share the surplus generated by their match. The surplus is the value of the match over and above the value of what the two sides can obtain outside of the match. The worker's outside alternative is the value of being unemployed, and the entrepreneur's outside alternative is the value of an unmatched vacancy (which in this simple version of the model is zero in equilibrium). If the surplus associated with the match is positive, the worker receives a wage that corresponds to a fixed share of the surplus in addition to the value of their outside alternative. In this framework, wages will be higher if the match produces more output. This is true regardless of whether the higher output is a result of a good aggregate shock rather than a bad one or whether it is because idiosyncratic productivity turns out to be higher.

To understand the workings of the model it is helpful to describe the decisions that individuals take in equilibrium. There are two key decisions in this model: the separation decision and the decision of entrepreneurs to post vacancies. Consider the situation of a matched worker-entrepreneur pair who are deciding whether to separate, and begin with the worker's perspective. The existing match offers a current wage, which depends both on the aggregate and idiosyncratic components of productivity, and the option value of future wages associated with the match as determined by the stochastic evolution of the aggregate and idiosyncratic factors. A worker who separates becomes unemployed. An unemployed worker, as mentioned earlier, will have a certain probability of finding a match that is derived from the ''matching function'' in the economy and that depends both on the number of vacancies and the number of unemployed workers. If a new match is found, the worker also faces uncertainty over the idiosyncratic component of future productivity (as discussed earlier, this will be a random draw from some distribution). Thus, from the worker's perspective, the key elements in the decision to separate are current and future expected prospects in the existing match, the probability of forming a new match, and the future expected prospects at a new match conditional

workers. Constant returns to scale implies that the probability p of an unemployed worker finding a job or the probability q of a particular vacancy being filled are functions only of the ratio v/u, where v is the number of vacancies and u is the number of unemployed.

on finding one. As long as the present discounted value of employment associated with the existing match exceeds the present discounted value of unemployment, the worker prefers not to separate.

Now consider the decision from the perspective of the entrepreneur. As mentioned above, if the match terminates, the future expected return on that position is zero (in equilibrium). Since this match does not preclude the entrepreneur from creating other matches, the entrepreneur wants to stay in the match as long as future expected returns are greater than zero.[7] It may appear that there is a possibility of disagreement between a worker and entrepreneur about whether to separate. It turns out that this is never the case. To understand why, consider again the bargaining rule that determines wages. To continue in a match, both the worker and the entrepreneur must receive a return above their outside alternatives. But since the sharing rule implies that the pair both share in any surplus over and above outside options, it is advantageous for both of them to stay together whenever the surplus is positive.

Next, consider the decision of an entrepreneur to post a vacancy. In assessing whether it is optimal to post a vacancy, entrepreneurs must take into account the probability that they find a worker, what the productivity of the match will be conditional upon finding a worker, how the match productivity will evolve, how much they must pay to the worker and the probability that the match will terminate. As more entrepreneurs post vacancies, the probability that any one of them finds a worker decreases (holding all else constant), thereby decreasing the expected return to posting a vacancy. In equilibrium, entrepreneurs will post vacancies until the expected return to posting a vacancy, net of the posting cost, is zero.

Many properties of the equilibrium are intuitive. For example, the value of a match to both workers and employers is higher in good times. Thus, it will be relatively easier for a worker to find a match in good times than in bad times, because entrepreneurs have greater incentive to post vacancies in good times. Conversely, entrepreneurs will find it harder to hire a worker in good times, because more entrepreneurs are posting vacancies in an attempt to hire workers. Some additional properties of the equilibrium are that separation rates are lower in good times than in bad times, unemployment duration is lower in good times than in bad times, and wages are higher in good times than in bad times.

An important feature of the model is that in general the equilibrium allocation need not be the same as the efficient allocation, and average unemployment in the model may be either higher or lower than it would be under an efficient allocation. Efficiency of the equilibrium allocation is intimately tied to the share of the surplus going to each of the two parties in their (Nash) bargaining solution. Hosios (1990), however, found a simple condition that determines whether the equilibrium allocation is efficient. For example, if the ''matching function'' is Cobb-Douglass—that is, if $m(v, u) = Av^{1-\alpha}u^{\alpha}$, where v is the number of vacancies and u is the number of

[7] In a more elaborate version of the model, the entrepreneur may have some physical capital tied up in the match, and if the match dissolved they would be able to sell this capital.

unemployed—then the Hosios condition says that equilibrium allocations are efficient if and only if the share of the surplus received by the entrepreneur is equal to the exponent $1 - \alpha$ in the matching function. Intuitively, when a given entrepreneur posts a vacancy, that entrepreneur makes it more difficult for other entrepreneurs to find matches, thus creating an externality. By choosing the share of the surplus going to the entrepreneur appropriately, one may internalize this externality. I note, however, that the fact that all separations are jointly optimal for a given entrepreneur-worker pair holds independently of whether the equilibrium allocation is efficient.

Useful Theoretical Concepts

The model sketched above is an example of a dynamic stochastic general equilibrium model. In thinking about the outcomes in such a model, several theoretical concepts are of central interest. Here I briefly describe three of them. The first is the notion of equilibrium implicit in the model. In a dynamic stochastic model such as this, the equilibrium itself will be a stochastic process.

A second object of interest corresponds to how the economy would behave in the absence of aggregate shocks. I call this the deterministic equilibrium of the model. To obtain this equilibrium, the aggregate shocks are removed by setting all aggregate exogenous stochastic variables equal to their unconditional means; in the model above, this corresponds to setting the value of aggregate shocks equal to the average of the good and bad outcomes. Using this deterministic version of the economy, one can also define a deterministic steady state equilibrium, that is, an equilibrium in which all aggregate variables are constant over time.[8] If a unique deterministic steady state equilibrium exists and it is stable, then loosely speaking one may think of the actual equilibrium as fluctuations around the deterministic steady state equilibrium.[9]

A third object of interest in this model, both for the stochastic and deterministic versions of the model, are efficient allocations. In the version of the model described here, efficient allocations are those that maximize the expected present value of aggregate consumption subject to the feasibility constraints.[10]

Is the Early Language Useful?

With the framework of the Mortensen-Pissarides matching model in mind, I now use it to assess the usefulness of the language of unemployment developed

[8] More generally, the notion of a balanced growth path allows for the possibility that some variables grow at a constant rate.

[9] It should be emphasized that in general, such a steady state is not the true mean of the equilibrium for the stochastic economy, although as a practical matter they may be quite similar in some contexts.

[10] The key assumption here is that all individuals must have preferences that are linear in consumption.

earlier. I begin with the language that predated the terminology of the natural rate. This conceptual apparatus, as discussed earlier, was based on the premise that it was important to distinguish between voluntary and involuntary unemployment, between frictional and cyclical unemployment, and between equilibrium and disequilibrium unemployment. Subsequent developments in economics over the last 25 years have cast serious doubt on this premise.

The simplest way to illustrate this is to consider how the Mortensen-Pissarides model described above exposes the emptiness of all such distinctions. In the equilibrium of this model, it is clear that all unemployed workers are between jobs. Hence, all unemployment is necessarily frictional. However, unemployment fluctuates at cyclical frequencies, so some part of it must also be cyclical. In this model, all separations are voluntary on the part of the worker in the sense that the worker could offer to work at a wage that leaves the match intact.[11] Yet unemployment is also involuntary in the sense that at any point in time, any unemployed worker would prefer to switch places with any employed worker. Finally, the outcomes just described are clearly an equilibrium in the context of this model, but if one attempted to rationalize them as an equilibrium outcome in a static, ''frictionless'' demand and supply model in which the workers do not value leisure (as assumed above), one could not do so.[12] The message should be clear: one cannot separate unemployment into voluntary and involuntary components, frictional and cyclical components or equilibrium and disequilibrium components in this model. All unemployment is partly voluntary; cyclical unemployment is frictional; and what is not an equilibrium in one model may be an equilibrium in another.[13]

Now turn to the natural rate of unemployment, in the sense that Friedman (1968) introduced the term. In this model, what part of unemployment is natural and what part is not? First, there is no money in the model, so everything that happens in the model must be due to real forces. Second, all unemployment is due to ''frictions'' in matching. Third, all unemployment in the model is part of an equilibrium. One might conclude from Friedman's statements, therefore, that all unemployment in the model is natural. Yet Friedman stressed that even apart from monetary forces, there are many reasons why the actual (in his terms, ''market'') unemployment rate will not equal the natural rate, suggesting that in this model there should be some distinction between actual and natural unemployment. It is not clear where this leaves us. In what follows, I shall at least make some effort to rescue it, albeit without ultimate success.

[11] One could imagine situations in which legislated minimum wages preclude a match from continuing because the only wages acceptable to both parties are less than the minimum wage. I think it is fair to say that such legal restrictions are not thought to be a major factor in accounting for aggregate unemployment.

[12] Many of these points have been made forcefully elsewhere, for example, in Lucas (1978).

[13] Of course, one could argue that the model's inability to give clear meaning to these terms is a shortcoming of the model, not of the language. My response to this is that since the class of models of which this is an example have proven to be very useful in accounting for real-world observations, the problem lies with the language and not with the model.

By examining in more detail the contexts in which the natural rate of unemployment arises, it is possible to develop insight into what purposes the concept is being used to serve. In particular, the idea of the natural rate is often used not as an explanation of unemployment, but rather as an explanation of inflation or a guide to monetary policy. Therefore, I will consider theoretical, empirical and policy contexts and how they fit with the language of unemployment developed here. My discussion here will go beyond the simple model presented earlier.

Is the Natural Rate a Useful Theoretical Concept?

I argued earlier that a dynamic stochastic general equilibrium model of unemployment, and in particular the Mortensen-Pissarides model, offers three useful concepts of unemployment: equilibrium unemployment, deterministic steady state unemployment and efficient unemployment. Identifying the natural rate of unemployment with one of these terms would give the concept a clear and useful meaning.

Moreover, one could readily argue that what Friedman had in mind was the deterministic steady state equilibrium level of unemployment. Using modern language, one might frame his definition as follows. Consider a dynamic monetary economy in which the monetary authority can issue money. Consider the class of monetary policies that specify money growth of k percent per period. For each value of k, imagine solving for the steady state equilibrium (or balanced growth path equilibrium) of the model. At least in principle, if such equilibria exist and are unique, the steady state equilibrium unemployment rate will depend upon the value of k. If the unemployment rate in each of these steady states is the same—that is, independent of the growth rate k of the money stock—then this unemployment rate can be defined to be the natural rate of unemployment. In fact, I believe that this is what many people have in mind when they talk of the natural rate of unemployment, although they rarely say so explicitly.[14] It certainly captures Friedman's point there is no permanent tradeoff between inflation and unemployment.

One could easily extend this definition by requiring that steady state values of all real variables are invariant to changes in k.[15] As a technical matter, however, I should point out that in most monetary models this property does not hold. Azariadis (1981) shows this in the context of the overlapping generations model of Samuelson (1958). Cooley and Hansen (1989) illustrate this in a cash-in-advance model. Nor does it hold in the search-theoretic models of money pioneered by Kiyotaki and Wright (1989). Furthermore, the data do not strongly support the proposition either, as Friedman (1977) himself suggested. Of course, the steady

[14] Phelps (1968) used exactly this language to make a substantive point very similar in spirit to that contained in Friedman's presidential address.

[15] This generalization allows one to address the issues raised by Friedman (1968) even in a model in which unemployment in a literal sense does not obtain.

state unemployment rate is a useful concept independently of whether it fits the natural rate definition of being invariant to changes in k percent money rules.

So, one could define the natural rate of unemployment to be the deterministic steady state equilibrium unemployment rate in a certain class of models. But why do this? I cannot see the logic of using a term without a fixed meaning in place of a term that has a very clear and precise meaning in dynamic economic theory. Should we have ''natural'' values for any other variable that is constant in a steady state? What would this achieve?

As only one example of how language can clarify communication, consider how Blanchard and Summers (1986) describe their main theoretical finding: ''Increases in unemployment have a direct impact on the natural rate of unemployment.'' Surely it is more clear and effective to say: ''This model has multiple steady state equilibria. For any given initial conditions the economy converges to a steady state equilibrium, but which steady state it converges to depends on the initial unemployment rate.''

Is the Natural Rate a Useful Empirical Concept?

Perhaps the natural rate should be thought of not as a theoretical concept, but as an empirical one. Maybe it summarizes a feature of the data that is useful for economists who are building models trying to account for observations. Here I suggest one possibility along these lines. It is common practice to develop models that are geared toward capturing time series movements at particular frequencies. For example, in the case of analyses of movements in national output, there is a literature on high-frequency (seasonal) movements, a large literature on midrange frequency (cyclical) movements and a large one on low-frequency (trend) movements. The underlying idea is that the time series for a given variable can be decomposed into a ''slowly changing'' trend component and ''fluctuations'' about this trend, often with ''seasonal adjustments'' netted out. I think it is fair to say that such distinctions have proven to be useful in economic analysis.

Thus, one could define the natural rate of unemployment to be an empirical concept, equal to the trend component of the actual time series for measured unemployment; that is, the rate of unemployment that would exist after seasonal and cyclical components are taken out. Moreover, this usage is not inconsistent with some of Friedman's statements. In his Nobel lecture, Friedman (1977, p. 458) wrote, ''[T]he natural rate has clearly been rising in the U.S. for two major reasons. First, women, teenagers and part-time workers have been constituting a growing fraction of the labor force. . . . Second, unemployment insurance and other forms of assistance to unemployed workers have been made available to more categories of workers and have become more generous in duration and amount.'' This emphasis on slowly changing demographic and institutional features certainly sounds like factors one would expect to show up in the trend component.

Although there are many ways to construct a trend component of a given series, the trend rate of unemployment seems to be a useful empirical concept with a

generally understood meaning. But again, we must ask, why replace a commonly used and generally understood term with an ambiguous term like the natural rate of unemployment?

Is the Natural Rate Useful in the Conduct of Monetary Policy?

When Friedman (1968) introduced the natural rate concept, widely held views on monetary policy maintained that the Phillips curve correlation defined a stable relationship between inflation and unemployment. Since the monetary authority was assumed to be able to choose inflation, monetary policy could pick any paths for inflation and unemployment that were consistent with the Phillips curve and then keep the economy in a vicinity of those target values. One of the main points of Friedman's address was that monetary policy as practiced at that time was based on a deeply mistaken view of the choices facing the monetary authority. In particular, he argued (p. 11), ''[T]here is no permanent trade-off between inflation and unemployment.'' According to Friedman, if a monetary authority were to restrict attention to monetary policy rules of the form ''target unemployment at u^* percent,'' then at any point in time only one target was feasible—the natural rate of unemployment. Friedman, however, did not support such a monetary policy rule; in fact, he argued strongly against it.

Nonetheless, much effort has been devoted to produce estimates of this one magic value of unemployment that is feasible as a target for monetary policy. In its simplest form, common practice is to run a regression of changes in inflation on unemployment, past values of inflation, and possibly some other variables, and then to manipulate the coefficients from the regression to produce an estimate of this value of the natural rate. An associated monetary policy rule is then based on how the monetary authority should react given the gap between actual unemployment and the estimated natural rate of unemployment.

There is no doubt that the procedure of running a regression, feeding the coefficients into a formula to compute a number and comparing this number with actual unemployment can be used to define a monetary policy rule. However, one cannot help but be amazed at the status this procedure has attained. In fact, such work often seems to proceed on the assumption that the economics profession can improve the conduct of monetary policy by fine-tuning this procedure to obtain smaller standard errors on the constant term of a regression of one endogenous variable on several other endogenous variables. There is apparently a great deal of confusion between getting more precise specifications of one particular ad hoc rule for monetary policy and getting a better understanding of what constitutes good monetary policy. I do not see how the issue of understanding what constitutes good monetary policy is related to getting smaller standard errors on the estimated coefficients of a regression of changes in inflation on unemployment.

At an abstract level, the issue of choosing an optimal policy is straightforward. The key is to have a model that can be used to trace out the mapping from all

specifications of policy to the resulting allocations. In general, this will be a mapping from stochastic processes to stochastic processes, since both the description of monetary policy and the equilibrium allocations are typically stochastic processes. One can then use some objective function to evaluate the resulting stochastic processes for the allocations. As a practical matter, the exercise just described presents severe difficulties. For example, it requires that one have a reliable model to trace out the implications for allocations of different monetary policies. This presumably requires that one specifies what shocks are hitting the economy and what the important propagation mechanisms are. As difficult as this may be, however, I think there can be little argument that this is required to provide an intellectual foundation for choosing a monetary policy rule.

Is the Natural Rate Useful in Forecasting Inflation?

Lastly, let us consider the argument that the natural rate of unemployment is an important concept simply because it is a key element in forecasting future inflation, without addressing the significance of producing such a forecast. While we do not currently have models of the sort I described earlier that are effective in forecasting, it is still instructive to consider what dynamic stochastic general equilibrium theory has to say about such an exercise.

Note first that in a stochastic model, it is necessarily the case that future outcomes are random, so we can only talk of the expected change in a given variable. Which variables are likely to be important for determining the expected change in some economic variable, be it inflation, output, or even unemployment? Theory suggests that current values of all ''state'' variables will potentially be important. State variables summarize the information from the past that is relevant for the evolution of the economy and would typically include things like accumulated capital stocks, both physical and human, inventories, the number of employment matches, unemployment, various institutional parameters and the values of any persistent shocks hitting the economy like the price of imported oil, technological advances, tariff policy of other countries, and so on. In the context of a given model, knowing the values of all the state variables allows one to determine whether a given variable is expected to increase. More generally, for any given variable of interest, the model would tell us that the space of all possible values for the state variables could be partitioned into two sets, one set for which the given variable was expected to increase, the other for which it is expected to decrease.

Note that theory in no way suggests that one need only look at a single variable, say unemployment, to determine whether inflation is expected to increase. One would also need to know, for example, what shocks are affecting the economy. Put somewhat differently, it is essential not only to know what the unemployment rate is, but also what happened to give rise to such an unemployment rate. As a practical matter, many shocks are not readily

observable, and one may try to get information about these shocks by looking at the behavior of variables that respond relatively quickly to them. This would suggest that variables that are not state variables in the technical sense may be important in forecasting if all the information about true state variables is not available to the forecaster.

As an empirical matter, I think the findings in the paper by Staiger, Stock and Watson in this symposium accord well with this general message from dynamic stochastic general equilibrium theory. First, they find that while unemployment is one variable that is useful in forecasting future inflation, it is only one of many variables that are useful. Second, they find that the coefficients in a regression of changes in inflation on unemployment (that is, the information often used to compute the natural rate) are not useful in predicting future inflation. This does not seem surprising. After all, why would one believe that these coefficients provide information about current values of other state variables to help us assess what shocks are currently affecting the economy?

Measured Unemployment and Resource Allocation: A Caution

One factor that motivates much work on unemployment is the question of whether the economy is using its resources efficiently. Much discussion of the natural rate of unemployment seems premised on the notion that unemployment is a powerful indicator of the state of the economy. In this section, I argue that although measured unemployment is certainly relevant as an indicator of how society uses its endowment of labor time, as such it is at best incomplete and at worst misleading. A few examples will serve to illustrate the point.

At cyclical frequencies, there is a very strong negative correlation between measured unemployment and the fraction of available time devoted to market work; that is, higher unemployment effectively means a lower fraction of society's available labor time being committed to market work. However, there are also significant changes over the cycle in weekly hours of employed individuals. In this context, measured unemployment is an incomplete measure of changes in the allocation of time.

In other contexts, measured unemployment may even be a misleading indicator of time allocation. For example, the measured unemployment rate of U.S. women changed relatively little between 1950 and 1990, but the fraction of their time allocated to market work has increased tremendously. Similarly, individuals who are not employed but do not search for work are for the most part not included in measured unemployment. Does this mean that they do not matter from the perspective of evaluating efficient use of time? A final consideration is that there is considerable heterogeneity in the population, and hence, from the point of view of efficient resource allocation it is not only a matter of how many people work, but who works and in which positions.

To summarize, if one's motivation for studying unemployment is efficient re-

Table 1
Employment and Output Changes in the 1980s

	Δ *E/P*	$\Delta Y/N$
Canada	+1.9	2.0
France	−5.1	1.6
Germany	−1.2	1.7
Italy	−0.6	2.4
UK	−1.7	1.8
US	+6.7	1.5

source allocation, then the primary concern should be the allocation of society's time across various activities. Economists should be concerned with all those factors that influence the allocation of time across activities, regardless of whether they are associated with changes in measured unemployment.

To emphasize these considerations, take a glance at recent labor market developments in Europe and the United States from the perspective of resource allocation.[16] Much has been written on the dramatic rise in measured unemployment in Europe relative to the United States, with the implication typically being that Europe is using resources less efficiently than is the United States. I do not want to make any definitive judgments here, but Table 1 certainly seems of interest in such a discussion. In the first column of Table 1, E/P is the fraction of individuals between the ages of 15 and 64 who are employed. The change in E/P is computed as the difference between the average of E/P over 1974–79 and its average over 1990–93, so as to minimize the impact of short-term variation on the comparison. In the second column of Table 1, the change in Y/N is the annual growth in GDP per capita over the time period from 1979–1989. The basic message that emerges here is that relative to the United States, European economies simultaneously reduced the fraction of people who are working in the market and increased the amount of market output per capita at a faster rate. From the perspective of efficient use of resources, this suggests that Europe is making a more efficient use of its aggregate labor resources than is the United States, despite the lower measured rate of unemployment in the United States! Given such developments in the real world, it is perhaps not surprising that regressions of unemployment on other variables may appear to be unstable.

[16] The reader is also referred to Andolfatto, Gomme and Storer (1996) for a related discussion that focuses on the United States and Canada.

Conclusion

Economists have long recognized that dynamic and stochastic elements play an important role in shaping real-world outcomes. In the *Wealth of Nations*, Adam Smith describes what he calls the ''natural price of a commodity.'' He goes on to say that at any point in time the actual price of a commodity may be higher or lower than its natural price. However, ''the actual (market) price of any commodity is continually gravitating toward its natural price.'' He also points out that ''accidents,'' some natural, some man-made, may affect the market price. Reading Smith's description today, it is hard not to see it as a portrait of a dynamic stochastic model of a perfectly competitive industry, in which his natural price is simply the deterministic steady state equilibrium price. Of course, this language was not available for him to use.

Reading Friedman's (1968) AEA presidential address, I think he is also describing an economy in which at any moment actual unemployment may be either above or below its natural rate, but it is continually gravitating toward its natural rate. (He further stipulates that this level to which it gravitates is unaffected by the ''permanent'' inflation rate.) Again, it is hard not to see his natural rate concept as the deterministic steady state equilibrium rate of unemployment, although once again this language was not standard in macroeconomics at that time. I think that the evolution in terminology toward discussions of the natural rate of unemployment is rather unfortunate, because it has been confusing rather than clarifying. Starting from the position that there is a steady state level of unemployment that is invariant to k percent money growth rules, it would apparently be clear to all that one had in hand neither a theory of unemployment nor a theory of optimal monetary policy.

However, the development of a modern language of unemployment over the last 25 years does not detract from the power of Friedman's argument. Friedman was implicitly critiquing simultaneously the two main paradigms of macroeconomics at that time. The ''short-run'' Keynesian model was at fault because it did not distinguish temporary from permanent changes in monetary policy in terms of their effects on unemployment. And the ''long-run'' growth model was at fault because it assumed no unemployment at all.

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