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ORIGINAL ARTICLE

The macroeconomics of the labor market: three fundamental views

Marika Karanassou · Hector Sala ·
Dennis J. Snower

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Abstract We distinguish and assess three fundamental views of the labor market regarding the movements in unemployment: (1) the frictionless equilibrium view; (2) the chain reaction theory, or prolonged adjustment view; and (3) the hysteresis view. While the frictionless view implies a clear compartmentalization between the short- and long-run, the hysteresis view implies that all the short-run fluctuations automatically turn into long-run changes in the unemployment rate. We assert the problems faced by these conceptions in explaining the diversity of labor market experiences across the OECD labor markets. We argue that the prolonged adjustment view can overcome these problems since it implies that the short, medium, and long-runs are interrelated, merging with one another along an intertemporal continuum.

M. Karanassou (✉)
Department of Economics, Queen Mary, University of London,
Mile End Road, London E1 4NS, UK
e-mail: M.Karanassou@qmul.ac.uk

H. Sala
Departament d'Economia Aplicada, Universitat Autònoma de Barcelona,
08193 Bellaterra, Spain
e-mail: hector.sala@uab.es

M. Karanassou · H. Sala
Iza, Bonn, Germany

D. J. Snower
Kiel Institute for the World Economy, Dusternbrooker Weg 120,
24105 Kiel, Germany
e-mail: d.snower@ifw-kiel.de
URL: http://www.uni-kiel.de/snower/

D. J. Snower
Christian-Albrechts-University of Kiel, Kiel, Germany

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1 Introduction

This paper is concerned with one of the most important questions in the macroeconomics of labor markets: How are movements in employment and unemployment to be interpreted? Over the past forty years, different areas of the OECD have experienced strikingly different changes in employment and unemployment. How can we account for these differing experiences? A lot hinges on our interpretation of the events.

A wide variety of explanations have been proposed for the observed movements in employment and unemployment: the natural rate hypothesis, the NAIRU, real business cycles, the Keynesian deficient demand hypothesis, union theories, bargaining models, efficiency wage theories, insider-outsider theories, search and matching theories. This paper distinguishes three fundamental economic views with very different implications for our conceptual understanding, predictions of labor market and macroeconomic activities, and policy advice.

- First the *frictionless equilibrium view*[1] according to which the labor market adjusts quickly to external shocks (such as shocks to productivity, product demand, raw material prices, or interest rates) and thus this market spends most of the time at or near its frictionless equilibrium position, i.e. the position it would occupy in the absence of any labor market adjustments. This view of the labor market is manifested in static multi-equation models, where labor market adjustments are ignored, or dynamic single-equation unemployment rate models, where all adjustments are suppressed into the autoregressive coefficients of the unemployment equation. The frictionless equilibrium labor market models predict that unemployment evolves around its natural rate, and thus conform with the natural rate of unemployment (NRU) hypothesis.
- Second the *prolonged adjustment view*, or chain reaction theory (CRT) of unemployment,[2] in which the labor market adjusts only slowly to external shocks. The reason is that many labor market decisions are subject to

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[1] Prominent developments within this view are those that focus on the role of shocks and institutions (see, among others, Layard et al. 1991; Blanchard and Wolfers 2000), on the structuralist theory of unemployment (see, for example, Phelps 1994; Phelps and Zoega 2001), or have a purely institutionalist focus (e.g., Nickell et al. 2005). See Blanchard (2006) for a review and an appraisal of this literature.

[2] The CRT was developed by Karanassou and Snower (1996, 1997, 1998). See also Karanassou et al. (2003, 2004, 2006).

adjustment costs, such as costs of employment adjustment, wage staggering, price stickiness, or labor force participation adjustment. Consequently, current decisions may depend on past labor market outcomes.

This view of the labor market is manifested in interactive dynamics models, i.e. dynamic multi-equation systems with spillover effects. In CRT models external shocks may have prolonged after-effects due to the lagged labor market adjustment processes, and so unemployment can be away—possibly far away—from its natural rate for substantial time spans. In this case the frictionless equilibrium view is an unsatisfactory approximation of labor market activity.

Furthermore, when the exogenous variables have nonzero long-run growth rates (e.g., capital accumulation, population growth) unemployment does not gravitate towards its natural rate due to *frictional growth*, a phenomenon that encapsulates the interplay of lagged endogenous variables (frictions) and growing exogenous variables (growth drivers). It can be shown that in CRT models the long-run unemployment rate is given by the sum of two components: the natural rate and frictional growth. Clearly, frictional growth is zero in static models (due to zero lags) and in single-equation unemployment rate models (due to zero growth as the exogenous variables are trendless).

- Third the *hysteresis view*,[3] according to which all the short-run fluctuations automatically turn into long-run changes in the unemployment rate. Thus unemployment tends to get stuck at wherever it happens to be currently, and transitory business cycle fluctuations lead to permanent changes in the unemployment rate. Here the long-run equilibrium is indistinguishable from the cyclical fluctuations.

We can thus argue that the distinction among the three views derives from their treatment of the short-run and long-run states of the labor market. In the frictionless equilibrium (NRU) models, the short-run and long-run are compartmentalized. In the prolonged adjustment (CRT) models, the short-run and long-run are interrelated due to frictional growth. In the hysteresis models, the short-run translates into the long-run due to the permanent effect of temporary shocks. This is in contrast with both the natural rate and chain reaction views in which temporary shocks dissipate with the passage of time.

Within the frictionless equilibrium view, the models of labor market equilibrium are diverse. In market-clearing models, for example, the labor market equilibrium lies at the intersection between the labor demand and supply curves; whereas in models of non-clearing labor markets, the equilibrium is off the labor supply curve, so that there is involuntary unemployment. But what all these models have in common is the presumption that labor market activity is usually not far from its frictionless equilibrium. In this equilibrium, the

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[3] See the influential contribution of Blanchard and Summers (1986) and Raurich et al. (2006) for a recent work in this area.

decisions of different agents are consistent with one another. For instance, the employment decisions made by firms under the prevailing wages are consistent with the wage decisions made by the wage negotiators under the prevailing employment levels.

According to this approach, movements in employment and unemployment are therefore to be explained in terms of shifts in the underlying frictionless equilibrium. Such shifts could be caused by shifts in labor demand (e.g. due to productivity shocks), labor supply (e.g. due to changes in participation rates), or wage setting (e.g. due to changes in union power).

Within the prolonged adjustment view, the models of labor market adjustment processes are diverse as well, as are the costs of adjustment. A key element that these various models have in common is the presumption that current labor market activity is conditioned by what has happened in the past, and that the process of adjustment may take a long time to work itself out.

In this view, movements in employment and unemployment are the outcome of the interplay between external shocks and lagged adjustment processes. The external shocks can, and generally do, of course affect the long-term equilibrium; but that is not their only influence on the labor market. Temporary shocks—such as temporary oil price hikes, or exchange rate fluctuations—can have persistent effects on employment and unemployment. Permanent shocks—such as productivity increases, or rises in the working-age population—may not manifest themselves fully right away, but may require substantial time before their long-run effects are present.

Figuratively speaking, each labor market shock leads to a wave of labor market effects, flowing through time. In practice, however, we are never able to observe any such wave in isolation. That would be possible only if, after the occurrence of a each shock, nothing happened to the labor market until all the after-effects of the shock had worked themselves out. But labor market shocks are not isolated events; they occur all the time, in rapid succession, month after month, year after year. So long before any shock has had a chance to work itself out through time, another shock occurs, carrying another wave of labor market effects. Consequently, in this view, the movements of employment and unemployment may be understood as the cumulation of waves, released by the succession of shocks.

The hysteresis view should be seen as more than just an extreme case of prolonged adjustment. In contrast to the frictionless equilibrium and prolonged adjustment views, it makes no distinction between the short-run and long-run. In the frictionless equilibrium view, this distinction is sharp, as in basic micro theory: in the short-run, the labor market adjusts to the given technology, the capital stock, and the number of firms; in the long-run, the technology and the capital stock may change, and the labor market adjusts to these changes as well. In the prolonged adjustment view, this distinction is blurred, since labor is no longer considered a purely variable factor. Due to costs of adjustment in the labor market, labor becomes similar to capital; both are difficult to vary instantaneously. Both tend to move gradually with the passage time. Just as the movements of the capital stock reflect the additions in the form of investment and the subtractions in the form of depreciation and obsolescence, so the movements in employment reflect the additions in the form of hiring and the subtractions in the form of firing and quits. In this context, the difference between the short- and long-run is a difference in degree rather than kind. In the hysteresis view, by contrast, there is no distinction at all between short- and long-run, since each short-run *is* the long-run.

The observation that labor market adjustment costs make labor analogous to capital should not, however, lead us to believe that the associated labor market analysis will be equivalent to the analysis of physical capital. The reason is that the adjustment costs for physical capital are quite limited (costs of investment, depreciation, and obsolescence), whereas the adjustment costs for labor are diverse and the associated, diverse adjustment processes interact with one another.

The hysteresis view (on the one hand) can only explain the changes in unemployment over time, while the frictionless equilibrium and prolonged adjustment views (on the other) can explain the evolution of unemployment. Nevertheless, the frictionless equilibrium and prolonged adjustment views are mutually exclusive. Clearly, the short-run and long-run states of labor market activity are either compartmentalized, or not.

The NRU and CRT models of the frictionless equilibrium and prolonged adjustment views, respectively, have quite different policy implications. The former focuses attention on policies that affect the long-term structure of the labor market, i.e. the labor demands and supplies once the adjustment processes have been completed. From this vantage point, various authors have suggested that European unemployment could be reduced through declines in taxes on employers and employees, in real interest rates, and in the duration and generosity of unemployment benefits. The prolonged adjustment view, by contrast, stresses the importance of the interaction between the lagged adjustment processes and growth drivers in determining the trajectory of the unemployment rate. For example, policies promoting R&D to increase productivity, or policies that shift upward the time path of capital stock can reduce unemployment.[4]

The remaining of the paper is structured as follows. In Section 2 we outline the problems faced by the mainstream accounts of the labor market performance in the OECD countries, and explain the insights brought by the prolonged adjustment view. In Section 3 we present the frictionless equilibrium view. This establishes the framework whereby, in Section 4, we explain the prolonged adjustment and hysteresis views. Section 5 concludes.

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[4] See Henry et al. (2000), Karanassou and Snower (2004), Bande and Karanassou (2006), and Karanassou et al. (2006).

2 The pitfalls of the conventional views

2.1 The diversity of experience

Over the past forty years, different areas of the OECD have experienced strikingly different changes in employment and unemployment. Table 1 illustrates the diversity by contrasting the European Union (EU)[5] and the US.

Employment in the US has risen much more rapidly than in the EU. Between 1970 and 1990 American employment increased by more than 40 million, almost three times as much as the European. In the 1990s it rose by 18 million in the US and 16 in the EU, but 7.5 million of the latter were due to the German unification. Employment growth rates in the EU have reached similar values than the US only after the end of the US roaring 1990s: they were below 1% in both areas in 2000–2005.

It is of course also true that the labor force has grown faster in the US than in the EU. Thus some of the extra employment creation in the US just absorbed the extra people looking for work. But that cannot be the whole story. Labor demand does not simply rise to meet the increasing labor supply. If that were the case, then unemployment would remain constant. As we can see, however, the EU unemployment rate has edged upwards relentlessly over the last decades—2.4% in 1970, 5.3% in 1980, 7.2% in 1990, 7.6% in 2000 and 7.9% in 2005—whereas the US unemployment rate has remained roughly unchanged on average -around 5.0%, with the exceptional peak in the aftermath of the oil price shocks-.

Within the EU, there is yet more diversity. As shown in Table 2, some countries have recently experienced significant declines in unemployment

Table 1 The diversity of labor market experiences: US vs. EU

	Levels					Differences			
	1970	1980	1990	2000	2005	1970–1980	1980–1990	2000–1990	2005–2000
L_{US}	82.8	107.0	125.9	142.6	149.3	24.2	18.9	16.7	6.7
N_{US}	78.7	99.3	118.8	136.9	141.7	20.6	19.5	18.1	4.8
U_{US}	4.1	7.7	7.1	5.7	7.6	3.5	−0.6	−1.4	1.9
u_{US}	5.0	7.2	5.6	4.0	5.1	2.2	−1.6	−1.6	1.1
L_{EU}	136.0	145.9	158.8	177.0	185.4	9.9	12.9	18.2	8.4
N_{EU}	132.8	138.2	147.3	163.6	170.9	5.4	9.1	16.4	7.2
U_{EU}	3.3	7.7	11.5	13.4	14.6	4.5	3.8	1.9	1.2
u_{EU}	2.4	5.3	7.2	7.6	7.9	2.9	1.9	0.3	0.3

Labor force (L), employment (N) and unemployment (U) expressed in millions; unemployment rate (u) expressed in percentage points. Source: OECD, Economic Outlook n°79.

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[5] The EU comprises the following 15 countries: Austria, Belgium, Germany, Denmark, Finland, France, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden and UK.

Table 2 The diversity of labor market experiences within the EU

	u					ΔN			
	1970	1980	1990	2000	2005	1970–1980	1980–1990	1990–2000	2000–2005
Denmark	1.0	5.3	7.2	4.3	4.8	0.6	0.6	0.4	0.0
Ireland	6.0	7.5	13.1	4.3	4.4	0.9	0.1	3.7	2.9
The Netherlands	0.8	3.7	5.4	2.8	5.0	0.7	1.1	1.9	0.0
Spain	2.4	9.3	12.1	10.8	9.2	–0.4	0.9	1.9	4.0
UK	3.5	6.8	7.1	5.5	4.8	0.1	0.7	0.2	0.9
France	2.6	6.5	8.9	9.4	9.9	0.5	0.3	0.8	0.5
Germany	0.4	1.7	4.5	6.9	9.1	0.3	1.0	0.2	–0.2
Italy	4.0	5.6	9.1	10.2	7.8	0.7	0.1	– 0.1	1.3

u expressed in percentage points, ΔN in growth rates. Source: OECD, Economic Outlook n°79.

rates. For example, from 7.2% in 1990 to 4.8% in 2005 in Denmark, from 13.1 to 4.4% in Ireland, from 5.4 to 5.0% in The Netherlands, from 12.1 to 9.2% in Spain, and from 7.1 to 4.8% in the UK. Others, in contrast, have not: the rate of unemployment in France has risen from 8.9% in 1990 to 9.9% in 2005, in Germany[6] it has doubled from 4.5 to 9.1%, whereas in Italy it rose until the end of the 1990s and has mildly decreased afterwards.

The countries that have been successful at pushing unemployment down have generally done so through relatively strong growth of employment. In other words, their decline in unemployment appears to have been a genuine achievement, rather than testimony to new ways of hiding unemployment (e.g. by using government training programs to remove people from the unemployment statistics). Furthermore, the unemployment drop has been generally achieved without any disproportionate increase in inflation. On the contrary, employment has grown at low rates in France, Italy and Germany. In France employment rose by just 3.0 million employees in 25 years (from 21.8 million in 1980 to 24.8 in 2005); in Italy it hardly grew in the 1980s and 1990s (20.7 millions in 1980, 20.9 in 2000); in the unified Germany it went from 38.1 million in 1991 to 38.8 in 2005.

2.2 Problems with compartmentalization

How can we account for these differing experiences? A lot hinges on our interpretation of the events—not only our understanding of labor market activity, but also our approach to labor market policy.

Current macroeconomic theory, in its standard, mainstream expositions,[7] is thoroughly compartmentalized: the short-run deals with business cycles and

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[6] Before 1991 these data correspond to Western Germany; 1991 onwards to the unified Germany. The annual growth rate of employment in the 1990s corresponds to period 1992–2000.

[7] See, for example, the textbooks by Blanchard and Fischer (1989) and Romer (2006).

the long-run deals with growth. This compartmentalization has been part of the conventional wisdom of macroeconomics for the past fifty years at least. Its beginnings, arguably, are to be found in Samuelson's "neoclassical synthesis," which distinguishes between the short-run business fluctuations that were the focus of much macroeconomic analysis at the time, and the market-clearing equilibrium that was the context of most microeconomic analysis. The implicit assumption underlying this compartmentalization is that market frictions, generated by costs of price and quantity adjustment, apply only to the "short-run," and thus their implications—non-clearing markets, imperfect adjustment of employment and production to shocks, etc.—are short-run phenomena as well. They do not apply to the "long-run," the time span relevant for the analysis of capital accumulation, technological change, and other aspects of economic growth.

Applied to labor markets, this compartmentalization encourages the belief that unemployment may be decomposed into two components: a long-run equilibrium rate and short-run variations around it. The long-run equilibrium rate is often called "structural" and the short-run variations are denoted as "cyclical," and these two components are regarded as largely independent of one another. This approach is often identified with the natural rate theory, which—in most of its conventional formulations—regards movements in unemployment as fluctuations around a reasonably stable natural rate.

At first sight, this compartmentalization of unemployment into a structural (natural rate) component and a cyclical component appears to fit the US experience well. As well known, the US unemployment rate has been trendless over the past four decades, and the temporary episodes of high unemployment (in the mid-1970s, early 1980s, and early 1990s) have coincided with major international recessions. Thus it seems reasonable to suppose, as a first approximation, that the US structural unemployment rate has remained essentially stable, somewhere between 5 and 6%, and that the fluctuations of unemployment around this level were cyclical in nature.

The compartmentalization hypothesis also appears to fit the European experience in the 1950s and 1960s quite well. Once again, the picture is one of a stable, low long-run unemployment rate interrupted by temporary blips, associated with recessions. European unemployment begun to drift upwards in the 1970s, but even then the compartmentalization story can be given some plausibility. After all, in that decade many European countries experienced some significant changes in the structure of their labor markets. Union power was increasing, both in terms of union density and the coverage of union wage agreements. Unions helped push up wages, thereby may have discouraged employment. The proportion of women and young people in the labor force rose, as it became increasingly acceptable for women to work and the postwar baby boom generation came of working age. These groups are associated with higher unemployment rates than the prime-age males. Job security legislation became more stringent in many European countries, giving established employees more market power to drive up their wages. Unemployment benefits and other welfare state entitlement became increasingly generous, making it less onerous for people to remain unemployed. For all these reasons, it could be argued that the structural unemployment rate in Europe must have risen in the 1970s. So although the steep rise in the EU unemployment rate in the mid-1970s was certainly associated with the recession at that time, the rest of the upward drift in unemployment could well have been structural.

But the further climb of European unemployment during the 1980s and 1990s has been unkind to the compartmentalization hypothesis. In the beginning of the 1980s Europe was in recession, but even though the recession ended in mid-1982, the European unemployment during rate kept rising till 1986, before plateauing at a level that was about twice as high as in 1980. It was not until 1989 that the unemployment rate started to fall significantly, and by 1991, in response to another recession, it rose again. This recession ended in 1992, but the European unemployment rate continued to rise until 1994, before plateauing at a level that was more than two percentage points higher than the previous peak of the 1980s. This relentless upward ratchet is difficult to square with the compartmentalization story. Oswald (1998, p. 1) points out that "despite conventional wisdom, high unemployment does not appear to be primarily the result of things like overly generous benefits, trade union power, taxes, or wage 'inflexibility'."

Given that inflation rates were low and stable over much of the 1980s and 1990s, the long climb of European unemployment clearly cannot be explained in terms of temporary errors in inflation expectations, intertemporal substitution of leisure for labor, or cyclical swings. True, cyclical downturns initiate each step in the ratchet—the prolonged increases in European unemployment in the 1970s, 1980s, and 1990s were each initiated by a recession—but what is difficult to explain is why unemployment kept rising and remained high for so long after the recessions were over. If the compartmentalization story is to work, we must argue that most of the upward movement in unemployment during the 1980s and 1990s—like that of the 1970s—must have been due to increases in the structural unemployment rate. The difficulty is to figure out where these structural increases came from. In most European countries, the period since the early 1980s has been characterized by deregulation, privatization, decline in union density, and partial dismantling of job protection. Under these circumstances one would have expected the structural unemployment to have fallen, if anything. On the other hand, rising interest rates, tax rates, and unemployment benefits[8], may all have played a role in driving the European NRU upwards, but the timing of these factors does not always mesh well with the timing of the unemployment increases.[9] According to Blanchard and

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[8] See, for example, Phelps (1994) and Layard et al. (1991) for explanations along these lines.

[9] For instance, the major rises in European unemployment benefits occurred predominantly in the 1960s and early 1970s, and thus extremely long and powerful lagged responses are necessary to explain the rising unemployment since the 1980s on this basis. See, for example, Grubb (1994) and Lindbeck (1994).

Wolfers (2000, p. C2), "Explanations (of high unemployment) based solely on institutions also run however into a major empirical problem: many of these institutions were already present when unemployment was low....Thus, while labour market institutions can potentially explain cross country differences today, they do not appear able to explain the general evolution of unemployment over time."

On this account, a growing number of economists, commentators, and policy makers have suggested that the cyclical and structural components of unemployment are interdependent—so interdependent, in fact, as to make their interactions more significant than the distinction between them. The oft-quoted observation that cyclical unemployment in Europe "turns into" structural unemployment is a reflection of this idea.

In that event, however, the compartmentalization hypothesis breaks down. The sharp distinction between a "short-run" and a "long-run" prevalent in the unemployment literature cannot be maintained. Instead, we must turn to the hysteresis view, where the short and long-runs are identical, or to the prolonged adjustment view, where the short, medium, and long-runs are intimately interrelated, merging with one another along an intertemporal continuum.

2.3 Problems with hysteresis

In the hysteresis view, there is no compartmentalization between cyclical and structural unemployment at all. Every cyclical fluctuation becomes engraved in stone.

One difficulty with this theory is that hysteresis combined with random labor market shocks implies that unemployment follows a random walk, so that the unemployment rate hits 0 or 100% with certainty within a finite time period. As an empirical fact, however, unemployment rates tend to remain within a relatively narrow band, lying approximately between 2 and 15%.

Another difficulty is that while temporary labor market shocks (such as temporary increases in oil prices or interest rates) lead to permanent increases in the unemployment rate, permanent shocks (such as a productivity rise or an increase in the working-age population) make the unemployment rate explode. The reason is that each permanent shock is equivalent to an unending sequence of temporary shocks, all in the same direction. Thus a permanent increase in labor demand (due, say, to a permanent productivity rise) is the same as an unending succession of temporary increases in labor demand, of equal magnitude. So if each temporary increase in labor demand leads to a permanent fall in unemployment, then a permanent labor demand rise must cause unemployment to fall without limit (until it reaches zero). Similarly, a permanent shock in the opposite direction must cause unemployment to rise without limit (until it reaches 100%). But of course neither of these alternative predicted patterns is ever encountered in practice.

Thus it is scarcely surprising that the hysteresis literature focuses exclusively on temporary shocks and ignores permanent shocks.

2.4 Insights with prolonged adjustments

The prolonged adjustment perspective overcomes the pitfalls of the conventional views. It is an interactive dynamics approach with the following salient features.

First, it relies on dynamic multi-equation systems with spillover effects to analyze the trajectory of the unemployment rate. This is in contrast with some prominent contributions of the frictionless equilibrium view (Blanchard and Wolfers 2000, and Nickell et al. 2005) that rely on the estimation of single-equation unemployment rate models. In the context of autoregressive multi-equation models, movements in unemployment can be viewed as "chain reactions" of responses to labor market shocks—hence the epithet 'chain reaction theory' of this approach—working their way through systems of interacting lagged adjustment processes.[10] These labor market frictions make current decision variables of labor market participants depend both on past and future labor market conditions. In the simple model below we focus on the role of training costs. It is also important to note that the various lagged adjustment processes interact with one another and these interactions entail the need of analyzing them as a system.[11]

Second, it recognizes the diverse dynamic features of economic disturbances and explicitly distinguishes between temporary and permanent shocks: the concepts of unemployment persistence and unemployment responsiveness, explained below, are defined to measure the after-effects of such diverse shocks. For a given system of adjustment processes, shocks with different dynamic features have nontrivial different dynamic implications. Note that, by default, the frictionless equilibrium and hysteresis approaches focus exclusively on temporary shocks.

Third, in contrast to the frictionless equilibrium and hysteresis approaches, the chain reaction approach focuses explicitly on frictional growth. In the presence of economic growth in the labor market—technological change and capital accumulation leading to a steady rise in labor demand and population growth leading to a steady rise in labor supply—the adjustment processes never have a chance to work themselves out entirely. Employment and unemployment are continually chasing after their moving, frictionless targets, but since the adjustment processes never work themselves out entirely, the frictionless targets are never reached. This is important because, under frictional growth, the steady state levels of labor market activities are determined through the interaction between economic growth and the

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[10] Labor market adjustment processes are diverse and with well-known microfoundations from the theoretical literature. There are, for example, (1) employment adjustments effects (see Nickell 1978; Berndt and Fuss 1986; Lindbeck and Snower 1988); (2) insider membership effects (see Blanchard and Summers 1986; Lindbeck and Snower 1987a,b); (3) wage/price staggering (see Taylor 1979, 1980); (4) unemployment adjustment effects (see Layard and Bean 1989); and (5) labor force adjustment effects (see French 2005; Flodén 2006).

[11] In fact they may well be complementary (so that their joint effects are stronger than the sum of their individual effects) or substitutable (so that their joint effects are weaker).

adjustment processes. In particular, the equilibrium levels of employment and unemployment depend on how far these levels keep lagging behind their moving (frictionless) targets. As a consequence, the NRU is not a reference point for actual unemployment in models with frictional growth.[12] This underplays the key role in policy making that the frictionless approach has assigned to the NRU.

Fourth, the growth drivers play a significant role in explaining employment and unemployment movements. It follows that policies fostering growth are relevant for the labor market performance. For example, Karanassou et al. (2003, 2004) find that the rise in working-age population and the decline in capital formation is crucial in understanding the EU unemployment experience of the 1970s and 1980s, while Bande and Karanassou (2006) assert the importance of capital stock in explaining the Spanish labor market performance. It is worth noting that the role of capital accumulation is being increasingly acknowledged in the literature (see, among others, Rowthorn 1999; Karanassou and Snower 2004; Kauppi et al. 2004; Kapadia 2005; Blanchard 2005, 2006).

Next, to explain the prolonged adjustment view we depart from a simple static labor market model which is first used to characterize the frictionless equilibrium view.[13]

3 The frictionless equilibrium view

In what follows we consider a static frictionless equilibrium model that reflects the view of basic microeconomic theory, where labor is considered the variable factor that adjusts in the short-run, and capital is the fixed factor that is constant in the short-run but adjusts in the long-run. In short, basic micro theory ignores labor market adjustment costs and thereby focuses on the frictionless equilibrium of this market. In this equilibrium, there is no tendency for the participants in the labor market to change their behavior, given the exogenous variables they face in each period of time. In this static view of labor market activity, there are no labor market adjustment costs, and thus the associated labor market equilibrium is a frictionless equilibrium.

Our model consists of three building blocks: first, *a labor demand function*, which specifies how much labor all firms are willing to employ, given the real wage and other variables; second, *a labor supply function*, which describes how much labor all households are willing to provide, given the real wage and other variables; third, *a wage setting function*, which indicates the real wage that is set, given the employment level and other variables. The labor demand function is derived from the profit-maximizing employment decisions of the firms. The labor supply function is derived from the individual decisions of households.

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[12] See Karanassou and Snower (1997) and Karanassou et al. (2006).

[13] Recall that, in addition to a static labor market model, the frictionless equilibrium view is also manifested in dynamic single-equation unemployment rate models.

The wage setting function may be the outcome of wage bargaining, union decisions, efficiency wage considerations by firms, and so on.

3.1 Labor demand

Consider a labor market containing a fixed number F of identical firms with monopoly power in the product market. The ith firm has a production function of the form

$$q_{i,t}^{S} = A n_{i,t}^{\alpha} k_{i,t}^{1-\alpha}, \tag{1}$$

where $q_{i,t}^{S}$ is output supplied, $n_{i,t}$ is employment, $k_{i,t}$ is capital stock, A is a positive constant, and $0 < \alpha < 1$. Each firm faces a product demand function of the form

$$q_{i,t}^{D} = \left(\frac{\mathsf{P}_{i,t}}{\mathsf{P}_t}\right)^{-\eta} \frac{y_t}{F}, \tag{2}$$

where y_t stands for aggregate real product demand, $\mathsf{P}_{i,t}$ is the price charged by firm i, P_t is the aggregate price level, and η is the price elasticity of product demand (a positive constant). All firms are assumed to face symmetric production and cost conditions.

Each firm set its employment at the profit maximizing level, at which the marginal revenue from producing an extra unit of output is equal to the corresponding marginal cost (for a given capital stock). The marginal revenue is $MR_{i,t} = \mathsf{P}_{i,t}\left(1 - \frac{1}{\eta}\right)$. The marginal cost is $MC_{i,t} = \mathsf{W}_{i,t}\left(\frac{\partial n_{i,t}}{\partial q_{i,t}}\right)$, where $\mathsf{W}_{i,t}$ is the nominal wage paid by the firm, $\frac{\partial n_{i,t}}{\partial q_{i,t}}$ is the marginal labor requirement (the inverse of the marginal product of labor). By the production function 1, the marginal labor requirement is $\frac{\partial n_{i,t}}{\partial q_{i,t}} = \frac{1}{A\alpha}\left(\frac{n_{i,t}}{k_{i,t}}\right)^{1-\alpha}$. Setting the marginal revenue equal to the marginal cost, we obtain the firm's labor demand function:

$$n_{i,t} = A_n \left(\frac{\mathsf{W}_{i,t}}{\mathsf{P}_{i,t}}\right)^{-\frac{1}{1-\alpha}} k_{i,t},$$

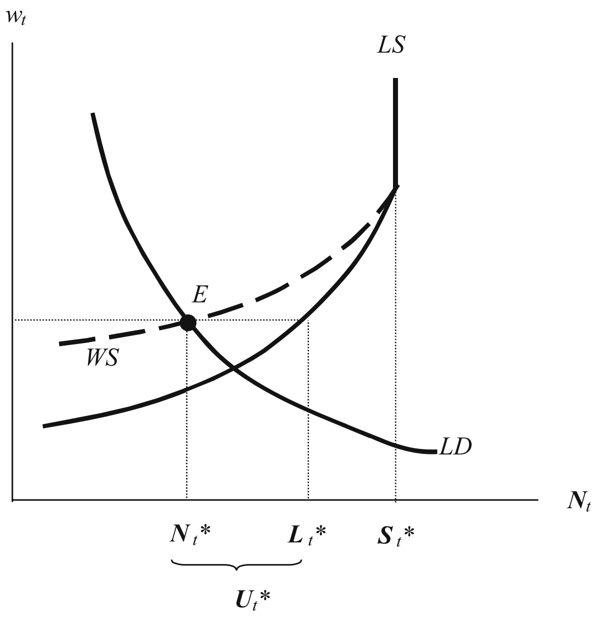
where $A_n = \left[A\alpha\left(1 - \frac{1}{\eta}\right)\right]^{\frac{1}{1-\alpha}}$.

In the labor market equilibrium, $\mathsf{P}_{i,t} = \mathsf{P}_t$ and $\mathsf{W}_{i,t} = \mathsf{W}_t$, due to symmetry across firms. Define aggregate employment as $\mathbf{N}_t = F n_{i,t}$, the aggregate capital stock as $\mathbf{K}_t = F k_{i,t}$ (recalling that there is a fixed number F of identical firms), and the aggregate real wage as $\mathsf{w}_t = \mathsf{W}_t/\mathsf{P}_t$. Aggregating across firms, we obtain the aggregate employment function:

$$\mathbf{N}_t = A_n \mathsf{w}_t^{-\frac{1}{1-\alpha}} \mathbf{K}_t. \tag{3}$$

This labor demand function is pictured in Fig. 1 below.

Fig. 1 The frictionless labor market equilibrium



3.2 Labor supply

For simplicity, we assume the available work is divided equally among all workers in the economy. Let $\mathbf{S}_t$ be the number of workers at time t. Furthermore, let the disutility of work rise with the amount of work done. Specifically, let us express the disutility of work of a representative worker as[14] $e_t = (\mathbf{N}_t/\mathbf{S}_t)^{1/b}$, where $\mathbf{N}_t$ is aggregate employment.

The reservation wage is defined as the wage at which a worker is indifferent between employment and unemployment. Thus the reservation wage is

$$\mathsf{r}_t = (\mathbf{N}_t/\mathbf{S}_t)^{1/b} . \tag{4}$$

Equation 4 may also be interpreted as a labor supply curve:

$$\mathbf{L}_t = \mathbf{S}_t \mathsf{w}_t^b , \tag{5}$$

i.e. at the wage w_t, the amount of labor the workers are willing to supply is $\mathbf{L}_t$. This labor supply curve is pictured in Fig. 1 above.

3.3 Wage determination

Let the wage be the outcome of a bargaining process between the employers and their employees, and the relative bargaining strengths of the bargaining

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[14] Since work is divided equally among all workers, an increase in aggregate employment $\mathbf{N}_t$ means more work done by each worker.

parties could be anywhere between complete monopsony power for the employers and complete monopoly power for the employees. This approach turns out to be quite general. When employers have complete monopsony power (viz., the employees exert no influence on the wage), then our model can easily be modified to encompass the standard models in which the wage depends on the reservation wage, but may be set beneath the reservation wage (as in the standard monopsony models) or above it (as in the efficiency wage models). In a perfectly competitive labor market, the wage is equal to the reservation wage and the wage setting function, derived below, coincides with the labor supply curve. When employees have complete monopoly power (viz., the employers have no influence on the wage), our model can be modified to encompass the standard monopoly union models in which the wage depends primarily on productivity, but the wage is above the marginal product of labor. Of course our model can also portray a variety of bargaining outcomes between these extremes.

To fix ideas, suppose that wage determination is given by a Nash bargaining process between each employer and his marginal employee. Then the wage may be specified as a convex combination between two terms: (1) an "employee power" term, specifying the wage that the employee would receive if she had complete bargaining power, and (2) an "employer power" term, showing the wage that would arise if the employer had complete power. For simplicity, suppose that the fall-back positions of the bargaining parties are zero. Then the employee power term is the marginal revenue product of labor (i.e. if the employee had complete power, then she would capture all the revenue from her employment activity), and the employer power term is the reservation wage (i.e. if the employers had complete power, then she would drive the wage down to the minimum level the worker was prepared to accept).

Recall that the firm's real marginal revenue product of labor is $\left(1-\frac{1}{\eta}\right)\frac{\partial q_{i,t}}{\partial n_{i,t}} = \left(1-\frac{1}{\eta}\right) A\alpha \left(k_{i,t}/n_{i,t}\right)^{1-\alpha}$. Since all firms are identical, and since aggregate employment is $\mathbf{N}_t = Fn_{i,t}$ and $\mathbf{K}_t = Fk_{i,t}$, this marginal revenue product may be expressed as $\left(1-\frac{1}{\eta}\right)\frac{\partial q_{i,t}}{\partial n_{i,t}} = \left(1-\frac{1}{\eta}\right) A\alpha \left(\mathbf{K}_t/\mathbf{N}_t\right)^{1-\alpha}$. Furthermore, the reservation wage is given by $\mathsf{r}_t = (\mathbf{N}_t/\mathbf{S}_t)^b$ (Eq. 4). Thus, the negotiated wage may be expressed as follows:

$$\mathsf{w}_t = \mu\left[\left(1-\frac{1}{\eta}\right) A\alpha \left(\mathbf{K}_t/\mathbf{N}_t\right)^{1-\alpha}\right] + (1-\mu)\left(\mathbf{N}_t/\mathbf{S}_t\right)^{1/b} \tag{6}$$

where μ $(0 \le \mu \le 1)$ stands for the bargaining strength of the employee relative to the employer.

Hence, the negotiated wage depends on two variables:

- The capital–employment ratio $(\mathbf{K}_t/\mathbf{N}_t)$: as this ratio increases, the marginal product of labor rises, driving up the negotiated wage (insofar as the employee has bargaining power), and
- The employment rate $(\mathbf{N}_t/\mathbf{S}_t)$: as this ratio increases, the disutility of work rises, driving up the reservation wage and thus also the negotiated wage (in connection with the employer's bargaining power).

In Fig. 1 this wage setting curve is depicted by the dashed line WS, pictured alongside the associated labor supply curve LS. Observe that, unless employers have complete bargaining power ($\mu = 0$), the wage setting curve will be flatter than the labor supply curve. The reason is that when employees have some power, the reservation wage effect is weaker (since $(1 - \mu) < 1$) and an increase in employment also reduces the marginal production of labor. When employment is $\mathbf{N}_t = \mathbf{S}_t$, the reservation wage is equal to the negotiated wage (by Eqs. 4 and 5), and thus there is full employment. Then the wage setting curve and the labor supply curve coincide.

In this figure the bargaining strength of the employer is sufficiently large relative to that of the employee, so that the reservation wage effect dominates the marginal product effect, and thus the wage setting curve slopes upwards.

The equilibrium position of the labor market may be depicted by the intersection of the labor demand curve and the wage setting curve, denoted by point E in Fig. 1. At this point, the employment decisions made by the firms (at the prevailing real wage) are consistent with the wage setting decisions made in bargaining (at the prevailing employment level). The equilibrium real wage is denoted by w_t^* and the equilibrium employment level by $\mathbf{N}_t^*$ in the figure.

The difference between labor supply $\left(\mathbf{L}_t^*\right)$ and labor demand $\left(\mathbf{N}_t^*\right)$ at the equilibrium real wage is the equilibrium unemployment level $\left(\mathbf{U}_t^*\right)$. Since all labor market decisions are assumed to be made in the absence of adjustment costs, this is the frictionless equilibrium view of labor market activity.

3.4 A log linearized model

In what is to follow, it will be convenient to work with a log-linearized version of this labor market model.

Taking logarithms of the labor demand function 3, and letting $N_t = \log(\mathbf{N}_t)$, $K_t = \log(\mathbf{K}_t)$, $w_t = \log(\mathsf{w}_t)$, and introducing an error term $\varepsilon_t \sim i.i.d\left(0, \sigma_\varepsilon^2\right)$ (to be interpreted below), we obtain the following aggregate employment equation:

$$N_t = a - a_w w_t + K_t + \varepsilon_t, \tag{7}$$

where

$$a = \log(A_n), \text{ and } a_w = \frac{1}{1-\alpha}.$$

We assume that the wage setters do not know the realization of the temporary shock ε_t when they determine the wage (although they know the distribution of this shock). Log-linearizing the wage setting curve, we express the log of the negotiated wage as a weighted average of an employee power term (related to the marginal product of labor, which depends on $K_t - N_t$, the log of the capital–employment ratio) and an employer power term (related to the reservation wage, which depends on $N_t - L_t$, the log of the employment rate):

$$\begin{aligned} w_t &= c + c_e \left(K_t - E_{t-1} N_t\right) + c_f \left(E_{t-1} N_t - L_t\right) \\ &= c + c_e K_t - c_f L_t + \left(c_f - c_e\right) E_{t-1} N_t, \end{aligned} \tag{8}$$

where L_t is the log of labor supply, and E_{t-1} is the expectations operator (with expectations conditional on information in period $t-1$), and c_e and c_f are the employee-power and employer-power parameters, respectively (where the subscript e stands from "employee" and the subscript f stands for "firm"). Note that the slope of this wage setting function in the wage-employment space depends on the relative magnitudes of these two parameters.

By the employment Eq. 7 and the wage setting Eq. 8, we obtain the expected equilibrium employment level $E_{t-1} N_t^*$ and the equilibrium real wage w^*, in terms of the equilibrium labor force and capital stock:

$$E_{t-1} N_t^* = a_0 + a_k K_t + \left(1 - a_K\right) L_t^* \tag{9}$$

$$w_t^* = c_0 + c_k \left(K_t - L_t^*\right), \tag{10}$$

where

$$\begin{aligned} & a_0 = a - a_w c_0, \ a_k = 1 - a_w c_0, \\ & c_0 = \frac{c + a\left(c_f - c_e\right)}{1 + a_w \left(c_f - c_e\right)}, \ c_k = \frac{c_f}{1 + a_w \left(c_f - c_e\right).} \end{aligned}$$

By Eq. 5, the labor supply (in logarithms) is

$$L_t = S_t + b w_t, \tag{11}$$

where S_t is the log of the number of workers.

By this labor supply Eq. 11, the equilibrium wage is

$$w_t^* = \frac{c_0}{1 + b c_k} + \frac{c_k}{1 + b c_k} \left(K_t - S_t\right), \tag{12}$$

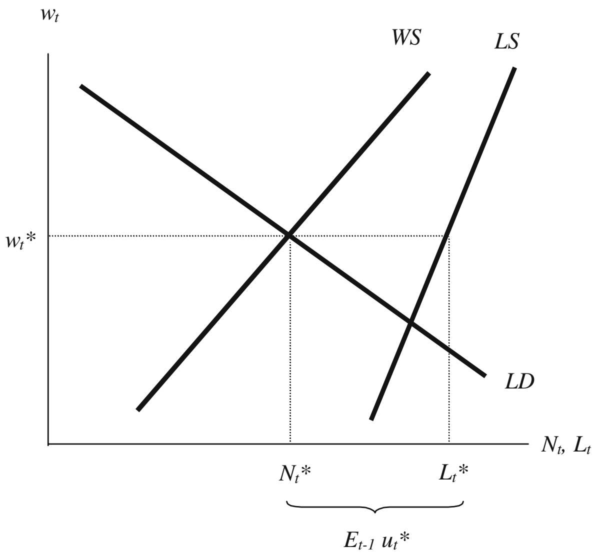
the equilibrium labor force is

$$L_t^* = \frac{b c_0}{1 + b c_k} + \frac{b c_k}{1 + b c_k} K_t + \left(1 - \frac{b c_k}{1 + b c_k}\right) S_t, \tag{13}$$

and the expected equilibrium employment level is

$$\begin{aligned} E_{t-1} N_t^* \ &= \left(a_0 + \frac{\left(1 - a_k\right) b c_0}{1 + b c_k}\right) + \left(a_k + \frac{\left(1 - a_k\right) b c_k}{1 + b c_k}\right) K_t \\ &\quad + \left(1 - a_k - \frac{\left(1 - a_k\right) b c_k}{1 + b c_k}\right) S_t. \end{aligned} \tag{14}$$

Fig. 2 The labor market equilibrium



Finally, the unemployment rate u_t may be approximated as the difference between the log of the labor force L_t and the log of employment N_t :

$$u_t = L_t - N_t. \tag{15}$$

Thus, the expected equilibrium unemployment rate is[15]

$$E_{t-1}u_t = L_t^* - E_{t-1}N_t^*.$$

Substitution of Eqs. 13 and 14 into the above gives

$$E_{t-1}u_t = d_0 - d_k\left(K_t - S_t\right), \tag{16}$$

where

$$d_0 = -a_0 + \frac{a_k b c_0}{1 + b c_k}, \; d_k = a_k\left(1 - \frac{b c_k}{1 + b c_k}\right).$$

The labor market equilibrium is pictured in Fig. 2.

This model provides an underpinning for the simplest formulation of the natural rate hypothesis, whereby the actual unemployment rate (u_t) depends on the natural rate of unemployment (u^n) and a strict white noise error term:

$$u_t = u^n - \epsilon_t, \tag{17}$$

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[15] In much of the frictionless literature, the coefficients of the labor market equations are constrained so that the level of the capital stock cannot affect the long-run equilibrium unemployment rate (see Karanassou and Snower 2004). For our model, the relevant restrictions would be $d_k = 0$, i.e. either $a_k = 0$ or $b = 0$ or $c_f = c_e$.

where $u^n = E_{t-1}u_t$. It can be shown that the above *iid* error term ϵ_t is a linear function of the error term ε_t in Eq. 7. Here the natural rate u^n may be interpreted as the frictionless equilibrium unemployment rate.

The temporary labor demand shocks ε_t give rise to short-run variations in unemployment, whereas permanent shocks—such as changes in the capital stock, the labor force, or the shift parameter of the production function—are responsible for the longer-term changes in the natural rate u^n.

4 The prolonged adjustment view

4.1 Unemployment dynamics

We now take a first step toward the prolonged adjustment view by introducing a single adjustment cost: a training cost that each firm must expend on new recruits in order to make them productive contributors to its production process. We specify the firm's profit-maximizing employment decision in the same way as in the previous section, except that now its marginal cost includes this training cost.

Specifically, let the marginal cost be $MC_{i,t} = \mathsf{W}_{i,t}\left(\frac{\partial n_{i,t}}{\partial q_{i,t}}\right)\xi_{i,t}$, where $\mathsf{W}_{i,t}$ is the nominal wage paid by the firm, $\frac{\partial n_{i,t}}{\partial q_{i,t}}$ is the marginal labor requirement, and the new term is an employment adjustment parameter: $\xi_{i,t} = \left(n_{i,t}/\sigma n_{i,t-1}\right)^{\delta}$, where δ is a training cost coefficient (a positive constant) and σ is the employees' "survival rate," i.e. one minus their separation rate.

For simplicity, we assume that the separation rate is sufficiently high (the survival rate is sufficiently low), so that $n_{i,t} > \sigma n_{i,t-1}$. The employment adjustment parameter may be interpreted in terms of training costs: $n_{i,t}/\sigma n_{i,t-1} = 1 + \left(h_{i,t}/\sigma n_{i,t-1}\right)$, where $h_{i,t}$ is new hires. The training of new hires ($h_{i,t}$) in period t is done by the incumbent employees ($\sigma n_{i,t-1}$) in that period. The greater the ratio of new hires to incumbent employees, the greater the average training cost per employee ($\xi_{i,t}$). When $\delta = 0$ (so that $\xi_{i,t} = 1$), the employment adjustment cost is zero; and when $\delta > 0$ (so that $\xi_{i,t} > 1$), the adjustment cost is positive.

Recall that for the production function 1, the marginal labor requirement is $\frac{\partial n_{i,t}}{\partial q_{i,t}} = \frac{n_{i,t}^{1-\alpha}}{A\alpha}k_{i,t}^{-(1-a)}$, and thus the marginal cost is $MC_{i,t} = \frac{\mathsf{W}_{i,t}}{\alpha A}n_{i,t}^{1-\alpha}k_{i,t}^{-(1-a)}\xi_{i,t}$. Setting this marginal cost equal to the marginal revenue $MR_{i,t} = \mathsf{P}_{i,t}\left(1-\frac{1}{\eta}\right)$, we obtain the following implicit labor demand function of the firm:

$$\frac{\mathsf{W}_{i,t}}{\alpha A}n_{i,t}^{1-\alpha}k_{i,t}^{-(1-a)}\left(\frac{n_{i,t}}{\sigma n_{i,t-1}}\right)^{\delta} = \mathsf{P}_{i,t}\left(1-\frac{1}{\eta}\right). \tag{18}$$

Once again, in the labor market equilibrium, $\mathsf{P}_{i,t} = \mathsf{P}_t$ and $\mathsf{W}_{i,t} = \mathsf{W}_t$ (on account of symmetry). Aggregating across firms, taking logarithms, and introducing the strict white noise error term $\varepsilon_t \sim iid\left(0, \sigma_\varepsilon^2\right)$—to capture supply-side shocks (via technology) or demand-side shocks (via the price elasticity)—we obtain the following aggregate employment equation:

$$N_t = \beta + \beta_n N_{t-1} - \beta_w w_t + \beta_k K_t + \varepsilon_t, \tag{19}$$

where $\beta = \frac{\log\left(1-\frac{1}{\eta}\right)+\log(\alpha A)+\delta\log\sigma}{1+\delta-\alpha}$, $\beta_n = \frac{\delta}{1+\delta-\alpha}$, and $\beta_w = \frac{1}{1+\delta-\alpha}$, $\beta_k = \frac{\beta}{1+\delta-\alpha}$. As in the previous section, N_t, w_t, and K_t denote the logs of aggregate employment, real wage, and aggregate capital stock, respectively.

The parameter β_n will be called the *employment inertia coefficient*. When the employment adjustment cost is zero ($\delta = 0$), the employment inertia coefficient is zero; when the adjustment cost is positive ($\delta > 0$), the employment inertia coefficient is positive as well.

Substituting the labor supply Eq. 11 into the wage setting Eq. 8, we obtain the following wage equation

$$w_t = \left[\frac{c}{1+bc_f} + \frac{c_e}{1+bc_f}K_t - \frac{c_f}{1+bc_f}S_t + \frac{\left(c_f - c_e\right)}{1+bc_f}E_{t-1}N_t\right].$$

Substitution of the above into Eq. 19 gives the following *employment dynamics equation*:

$$N_t = \phi_0 + \phi_n N_{t-1} + \phi_k K_t + \phi_s S_t + \varepsilon_t, \tag{20}$$

where

$$\phi_0 = \frac{\beta\left(1+bc_f\right) - \beta_w c}{1+bc_f+\beta_w\left(c_f-c_e\right)},\ \phi_n = \frac{\beta_n}{1+bc_f+\beta_w\left(c_f-c_e\right)},$$

$$\phi_k = \frac{\beta_k\left(1+bc_f\right) - \beta_w c_e}{1+bc_f+\beta_w\left(c_f-c_e\right)},\ \phi_s = \frac{\beta_w c_f}{1+bc_f+\beta_w\left(c_f-c_e\right)}.$$

Substituting the wage setting Eq. 8 into the labor supply Eq. 11, we obtain the following labor supply equation:

$$L_t = \theta_0 + \theta_n N_t + \theta_k K_t + \theta_s S_t, \tag{21}$$

where

$$\theta_0 = \frac{bc}{1+bc_f},\ \theta_n = \frac{b\left(c_f-c_e\right)}{1+bc_f},\ \theta_k = \frac{bc_e}{1+bc_f},\ \theta_s = \frac{1}{1+bc_f}.$$

Next, let B denote the backshift operator, and rewrite Eqs. 20 and 21 as

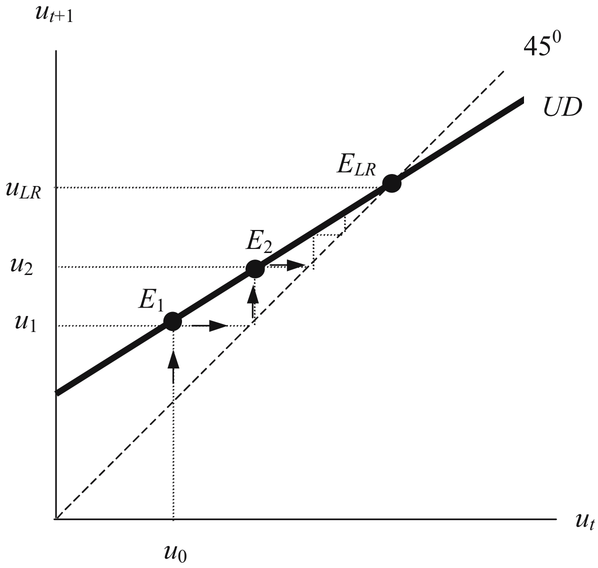
$$\left(1-\phi_n B\right) N_t = \phi_0 + \phi_k K_t + \phi_s S_t + \varepsilon_t, \tag{22}$$

$$\left(1-\phi_n B\right) L_t = \left(1-\phi_n B\right)\left(\theta_0 + \theta_n N_t + \theta_k K_t + \theta_s S_t\right), \tag{23}$$

respectively. Finally, substitute Eqs. 22 and 23 into Eq. 15 to obtain the following *unemployment dynamics equation*:

$$\begin{aligned} u_t &= \left[\theta_0\left(1-\phi_n\right) - \phi_0\left(1-\theta_n\right)\right] + \phi_n u_{t-1} \\ &\quad + \left[\theta_k\left(1-\phi_n B\right) - \phi_k\left(1-\theta_n\right)\right] K_t \\ &\quad + \left[\theta_s\left(1-\phi_n B\right) - \phi_s\left(1-\theta_n\right)\right] S_t - \left(1-\theta_n\right)\varepsilon_t \end{aligned} \tag{24}$$

Fig. 3 Unemployment dynamics



This equation is illustrated by the *UD* line in Fig. 3 (where *UD* stands for "unemployment dynamics"). Here the degree of autocorrelation (ϕ_n) measures *unemployment inertia.*

If the unemployment rate is u_0 in the initial time period $t = 0$, then the period-1 unemployment rate will be u_1, at the period-1 equilibrium point E_1. In period 2 the unemployment rate will be u_2 at the equilibrium point E_2, and so on, until the unemployment rate eventually attains its long-run equilibrium value of u_{LR} at the long-run equilibrium point E_{LR}.

4.2 Unemployment persistence

In the model above, unemployment displays inertia due to the costs of employment adjustment. Under these circumstances, temporary labor market shocks have prolonged after-effects on the unemployment rate.

Suppose, for example, that at time $t = 0$ the labor market is in an initial long-run equilibrium given by point E_0 in Fig. 4. Then, in period 1, a temporary adverse shock occurs, which shifts the unemployment dynamics line upwards from UD_0 to UD_1 for one period. Consequently the unemployment rate rises from u_0 to u_1, corresponding to the period-1 equilibrium point E_1. Thereafter the shock disappears and the unemployment dynamics line shifts back down to UD_0.

So, in period 2 the unemployment rate falls to u_2 (corresponding to equilibrium point E_2). In this way, it continues to fall by smaller and smaller amounts from one period to the next, as it approaches its original equilibrium value of u_0 again.

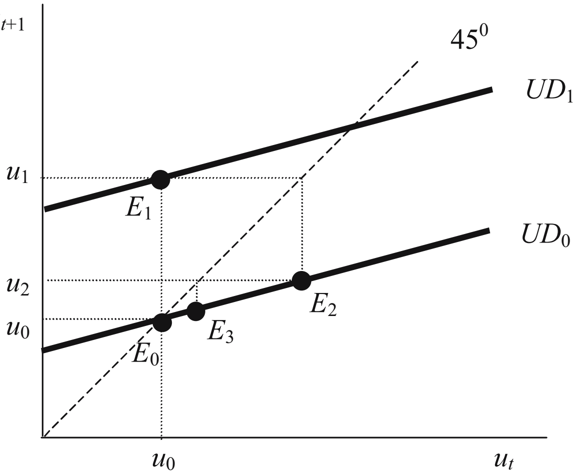


Fig. 4 Unemployment persistence

Thus a temporary shock continues to affect the unemployment rate for a long time after the shock has disappeared. This phenomenon is called *unemployment persistence.*

It is easy to see that the degree of unemployment persistence depends on the slope of the unemployment dynamics line, i.e the unemployment inertia coefficient

$$\phi_n = \frac{\beta_n}{1 + bc_f + \beta_w \left(c_f - c_e\right)} = \frac{\delta}{\left[1 + bc_f + \beta_w \left(c_f - c_e\right)\right](1 - \alpha + \delta)}. \tag{25}$$

Recall that δ is the employment adjustment cost parameter (positive), α is the elasticity of production with respect to employment (positive), b is the wage elasticity of labor supply, β_w is the wage elasticity of labor demand, and c_f (c_e) is the employers' (employees') bargaining power (positive). That is, the unemployment inertia coefficient depends

- Positively on the training cost coefficient (δ),
- Positively on the elasticity of production with respect to employment (α),
- Negatively on the employers' bargaining strength parameter (c_f),
- Positively on the employees' bargaining strength parameter (c_e), and
- Negatively on the wage elasticities of labor demand and supply (β_w and b, respectively) when these are positive.

A stable long-run equilibrium of the labor market exists when $0 < \phi_n < 1$.[16] The greater is the unemployment inertia coefficient ϕ_n, the longer it takes

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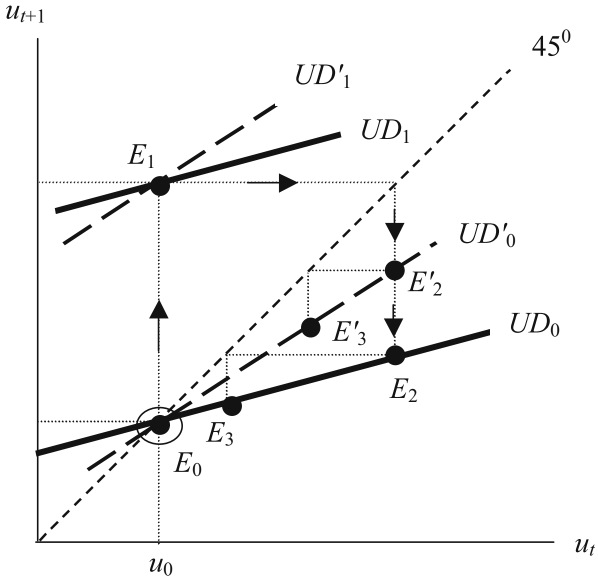
[16] Generally, the AR(1) model is dynamically stable when $|\phi_n| < 1$. However, it is plausible to assume that unemployment is positively autocorrelated.

for unemployment to return into the neighborhood of its original position, for a labor market shock of given magnitude. In other words, the steeper the unemployment dynamics line, the greater is the degree of unemployment persistence. This is illustrated in Fig. 5.

In this figure we compare two economies that are alike in all respects except that one has a higher degree of unemployment persistence than the other. Both economies are initially at the equilibrium point E_0, but one economy has a flat unemployment dynamics line (UD_0) whereas the other has a steep one (UD'_0). Then both economies are hit by a temporary adverse shock of equal magnitude, so that both unemployment dynamics lines shift upward by an equal vertical amount. Thus in period 1 the new equilibrium is at point E_1. Thereafter the shock disappears, so that both unemployment dynamics lines return to their original positions.

The economy with the small unemployment inertia coefficient (the flat unemployment dynamics line UD_0) then proceeds to point E_2 in period 2, point E_3 in period 3, and so on, towards the original equilibrium position E_0. By contrast, the economy with the large inertia coefficient (the steep unemployment dynamics line UD'_0) moves to point E'_2 and then to E'_3, and so on, also towards point E_0. Comparing these two time paths, it is obvious that the economy with the larger unemployment inertia coefficient will take longer to reach any given neighborhood of the initial equilibrium, illustrated by the circle around the initial equilibrium E_0. In short, the greater the unemployment inertia coefficient, the greater is the degree of unemployment persistence.

Fig. 5 Different degrees of unemployment persistence



4.3 The hysteresis view

Now suppose that

$$\alpha = 1 \text{ and } \beta_w \left(c_f - c_e\right) = -bc_f \tag{26}$$

so that the unemployment autocorrelation coefficient is unity, $\phi_n = 1$ (by Eq. 25). Furthermore, suppose that

$$\begin{aligned} 0 = {} & -\phi_0 (1-\theta_n) + [\theta_k (1-B) - \phi_k (1-\theta_n)] K_t \\ & + [\theta_s (1-B) - \phi_s (1-\theta_n)] S_t \end{aligned} \tag{27}$$

Then the unemployment dynamics Eq. 24 becomes:

$$u_t = u_{t-1} - (1-\theta_n)\,\varepsilon_t \tag{28}$$

Thus the current expected unemployment rate is equal to last period's unemployment rate:

$$E_{t-1} u_t = u_{t-1}$$

In other words, the unemployment rate tends to get stuck at wherever it has been, so that last period's unemployment rate is the best predictor of the current unemployment rate. This phenomenon is *hysteresis.*

It is illustrated in Fig. 6. Here we consider an initial unemployment dynamics line for which the realized value of the error term is $\varepsilon_t = 0$, so that

$$u_t = u_{t-1}$$

Thus the initial unemployment dynamics line UD_0 coincides with the 45^0 line. This means that every unemployment rate is a long-run equilibrium. Given that the initial unemployment rate is u_0, the long-run equilibrium is given by

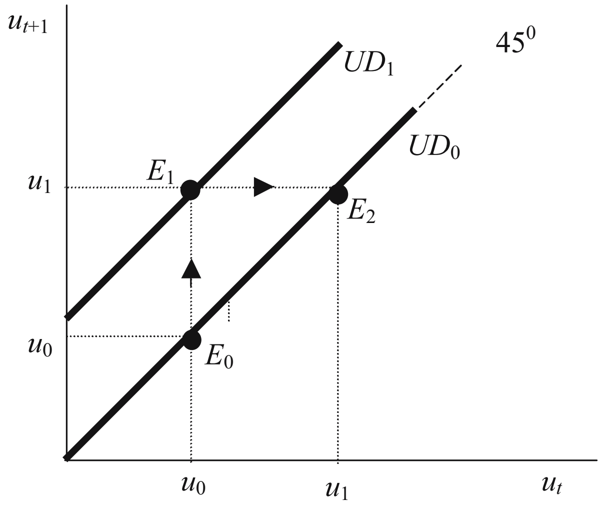


Fig. 6 Hysteresis

point E_0, so that, in the absence of any shocks, there is no tendency for this unemployment rate to change.

Now suppose that there is an adverse temporary shock, lasting for one period. Specifically, in period 1 the unemployment dynamics line shifts from UD_0 to UD_1, and then returns to UD_0 in subsequent periods. In response to this shock, the equilibrium point moves from E_0 to E_1 in period 1, and the unemployment rate rises from u_0 to u_1.

Once the unemployment dynamics line shifts back to UD_0 in period 2, the equilibrium point moves to E_2. In the absence of further shocks, it will remain there. The associated unemployment rate remains at u_1.

In short, in the presence of hysteresis, a temporary labor market shock has permanent after-effects.

The problems with the hysteresis view are immediately apparent from the preceding analysis. First, the condition 26, guaranteeing that the unemployment autocorrelation coefficient is unity, can only hold by accident. For example, there is no reason why the employers' and employees' bargaining power coefficients (c_f and c_e) should bear any particular relation to the wage elasticities of labor demand and supply (β_w and b).

Second, when the unemployment autocorrelation coefficient is unity and the error term ε_t in the unemployment dynamics equation is white noise, the unemployment rate follows a random walk. This has the counterfactual implication that the unemployment rate hits 100 or 0% with certainty in finite time.

And third, the hysteresis view relies on the counterfactual assumption that the unemployment rate is not subject to permanent shocks, since permanent

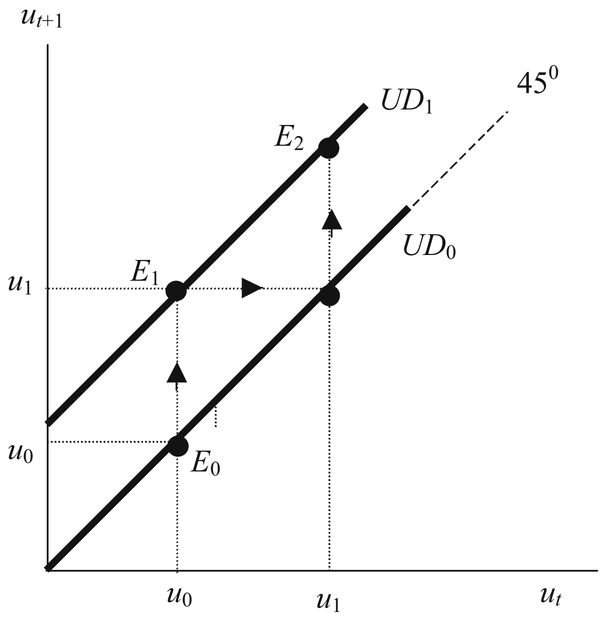


Fig. 7 Effects of a permanent shock under hysteresis

shocks lead to explosive labor market behavior. Suppose, for example, that the economy was initially at the equilibrium point E_0, on the unemployment dynamics line UD_0 in Fig. 6, and then a permanent adverse shock occurred, so that the unemployment dynamics line shifted permanently to UD_1. As result, as shown in Fig. 7, the equilibrium would shift to point E_1 in period 1, and from there to E_2 in period 2, and so on, until the unemployment rate hit 100%.

These deficiencies call the hysteresis view into question.

4.4 Imperfect unemployment responsiveness

We now return to our assumption of dynamic stability where the unemployment inertia coefficient lies between zero and unity: $0 < \phi_n < 1$. Having seen that, under these circumstances, temporary shocks have prolonged aftereffects, we now turn to the unemployment repercussions of *permanent shocks.*

Specifically, suppose that the economy is initially (at time $t = 0$) at the long-run equilibrium point E_0 in Fig. 8. Then a permanent shock occurs in period 1, so that the unemployment dynamics line shifts permanently upwards from UD_0 to UD_1. Thus, in period 1, the economy moves to point E_1, and the associated unemployment rate rises from u_0 to u_1. In the following period, the economy moves to point E_2, and unemployment increases to u_2. The unemployment rate continues to rise gradually in this way, by smaller and smaller amounts in each successive time period, as the economy approaches its new long-term equilibrium E_{LR}.

In short, some of the unemployment effects from a permanent shock are delayed. It can take a long time before the full effects of the shock have

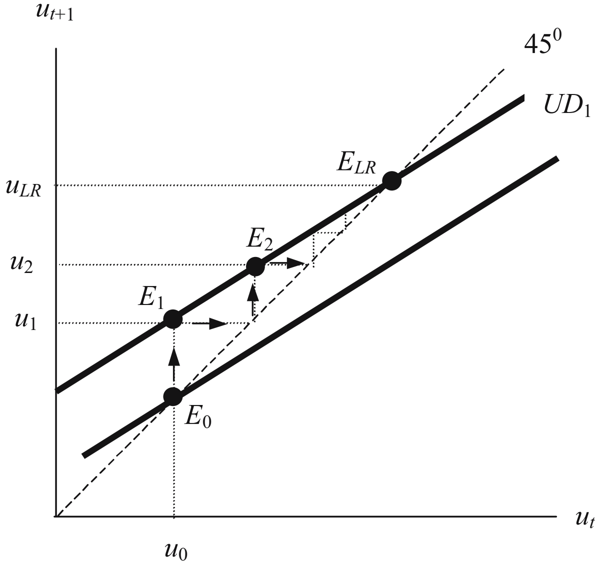


Fig. 8 Imperfect unemployment responsiveness

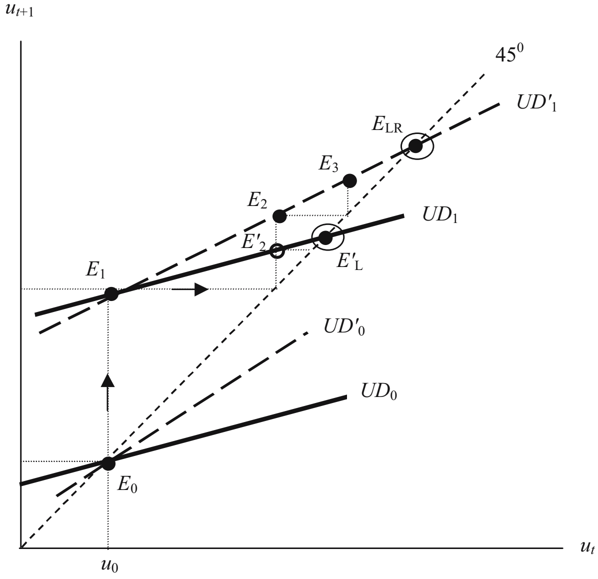
manifested themselves. This phenomenon we call *imperfect unemployment responsiveness.*

The degree of imperfect responsiveness again depends on the size of the unemployment inertia coefficient ϕ_n. The greater this coefficient, the longer it takes for a given fraction of the unemployment effects of a permanent shock to have manifested themselves—or, equivalently, the longer it takes for the unemployment rate to reach a specified neighborhood of its new long-run equilibrium. In other words, the steeper the unemployment dynamics lines, the more *under-responsive* is unemployment. This is shown in Fig. 9.

As in the case of unemployment persistence, we compare two economies that are alike in all respects except that one has a greater unemployment inertia coefficient than the other. Both economies are initially at the equilibrium point E_0, and are then both hit by a permanent shock of equal magnitude. Thus the unemployment dynamics line of one economy shifts from UD_0 to UD_1, whereas the unemployment dynamics line of the other economy shifts from UD'_0 to UD'_1. Thus, in period 1, both economies move to point E_1.

Thereafter, the economy with the relatively large unemployment inertia coefficient proceeds to point E_2 in period 2, point E_3 in period 3, and so on, towards the new long-run equilibrium position E_{LR}. By contrast, the economy with the relatively small inertia coefficient moves to point E'_2, and so on, also towards the long-run equilibrium point E'_{LR}. It is clear that, for the economy with the larger unemployment inertia coefficient, it takes longer to reach any given neighborhood of the new long-run equilibrium. In short, the greater the unemployment inertia coefficient, the greater is the degree of unemployment under-responsiveness.

Fig. 9 Different degrees of imperfect unemployment responsiveness



Observe that, for the unemployment dynamics Eq. 24, the degree of unemployment persistence is related to the degree of unemployment underresponsiveness. The greater the unemployment inertia coefficient, the more prolonged are the after-effects of a temporary shock *and* the more delayed are the after-effects of a permanent shock. However, this relation only holds for first-order unemployment autoregressions. Under more realistic circumstances—such as when there are more than one lagged labor market adjustment process in operation—the unemployment dynamics equation are of higher order, and then persistence and responsiveness are no longer in lockstep. On this account, it will be useful to understand these two phenomena as quite separate by using a chain reaction theory framework.

5 Concluding remarks

Current mainstream macroeconomic theory tends to be compartmentalized into two largely independent areas: (1) short-run business cycles and (2) long-run growth. In macro labor analysis this distinction is central to the natural rate of unemployment and NAIRU theories, in which unemployment is decomposed into two components, "structural" and "cyclical" unemployment. The prolonged adjustment view moves beyond this compartmentalization and shows how short, medium, and long-runs are interrelated, merging with one another along an intertemporal continuum.

It is tempting to understand the prolonged adjustment view as simply occupying an intermediate position between the frictionless equilibrium approach and the hysteresis approach. It is certainly true that, (1) in the frictionless equilibrium approach, cyclical variations in unemployment are independent of structural variations, (2) in the hysteresis approach, all cyclical variations are structural in the sense that all temporary shocks have permanent unemployment effects, and (3), in the chain reaction approach, cyclical unemployment variations can have prolonged after-effects.

But this characterization puts the prolonged adjustment view into a Procrustean bed, focusing our attention primarily on its most trivial, least interesting features. It is like telling a painter that there are three groups of colors: white, black, and the range of tones in between. This is true, but uninformative, since the range of intermediate tones is where most of the action is. Placing the prolonged adjustment view between the frictionless equilibrium and hysteresis views is similarly uninformative, since the prolonged adjustments cover a wide diversity of phenomena, which had best be given explicit, individual attention rather than being sandwiched between the other two views. In explaining the movements of employment and unemployment, it is where most of the action is.

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