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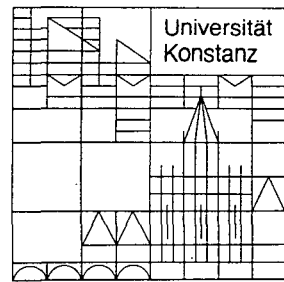
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Wolfgang Franz

**Hysteresis in Economic Relationships:
An Overview**

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**HYSTERESIS IN ECONOMIC RELATIONSHIPS:
AN OVERVIEW**

Wolfgang Franz

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Abstract: This paper provides an overview of the hysteresis phenomenon in economics. After a brief formal statement the origins of this principle are outlined. Hysteresis in economic relationships is then discussed with special reference to industrial economics in an international setting and to labour economics. The paper concludes with an overview of papers to be published in a forthcoming special issue of the journal "Empirical Economics" (1990), for which this survey has been written as an introductory chapter.

Hysteresis in Economic Relationships: An Overview

Wolfgang Franz, University of Konstanz*

*Can the socialist man be created
so as not to show any hysteresis trace
of his bourgeois or peasant past?*

N. Georgescu-Roegen (1971, p.126)

1 Introduction

The hysteresis phenomenon has received renewed attention in economic science. While most of the theoretical work on hysteresis has been done within the context of an explanation of the persistence of European unemployment, there are other studies which investigate to what extent hysteresis is present in international trade, consumption, labor migration and the like. As it is often the case with “new ideas”, the origin of the hysteresis debate can be traced back at least some twenty years. The aim of this short paper is to acquaint very briefly the reader with the concept of hysteresis and to present an overview of the papers included in this special issue. Nothing new is offered in this skeleton overview, nor is it intended to give a full and detailed survey about all aspects.

The paper is organized as follows. The next section is devoted to a more formal treatment of hysteresis. Section 3 very briefly describes the origin and the history of the hysteresis debate (in other sciences). Section 4 attempts to give an idea about the role hysteresis is playing in economics. Finally, section 5 presents an overview of the papers included in this volume.

2 Hysteresis – A Formal Statement

In general terms hysteresis is a property of dynamic systems. Hysteretic systems are path-dependent systems. The long-run solution of such a system does not only depend on the long-run values of the exogenous variables (as

*I am grateful for helpful comments to G. Heidbrink, J. Möller, H.J. Ramser, W. Scheremet, and W. Smolny (University of Konstanz).

usually) but also on the initial condition of each state variable. These systems have a long-lasting memory and are therefore "historical" systems. Loosely speaking: Where you get to is determined by how you get there.¹

Focussing only on discrete time linear systems hysteresis is present when there are one or more unit roots in the characteristic equation of the state matrix. Consider firstly the simple, one-dimensional case where a variable X_t is subject to the following law of motion: ²

$$X_t = aX_{t-1} - Z_t , \quad (1)$$

where Z denotes an exogenous variable. If a differs from unity, the steady-state values (denoted by a bar) are:

$$\bar{X} = \frac{\bar{Z}}{(a-1)} . \quad (2)$$

In this case, \bar{X} is unique and independent of the path followed by Z_t , but is solely dependent on the steady-state level \bar{Z} .

If, however, a equals unity the steady-state value of X is not unique. The solution of eq.(1) is now given by:

$$\bar{X}_t = X_0 - \sum_{i=1}^t Z_i , \quad (3)$$

where we are now considering time dependent values of Z rather than its steady state level.³ Any value of the steady-state level of X is possible now, because \bar{X} depends on the timepath of Z . This is the case of hysteresis: Any temporary disturbance to Z will have a permanent effect on X .

In the multi-dimensional case x_t is a k -dimensional vector of state variables in time t and z is the respective vector of exogenous variables.⁴ The k difference equations are then given by:

$$x_{t+1} - x_t = \Phi x_t - z_t \quad (4)$$

or:

$$x_{t+1} = \Phi^* x_t - z_t , \quad (5)$$

where Φ denotes the transition matrix and $\Phi^* = I + \Phi$. If all eigenvalues of Φ^* (in absolute values) are strictly less than one, then the difference equation

¹Buiter (1987), p.24.

²See Wyplosz (1987), pp.124.

³In the latter case, eq.(3) is simply $\bar{X}_t = X_0 - t \cdot \bar{Z}$.

⁴See Möller (1990) for the following considerations.

system (4) or (5) is stable. On the other hand, if at least one eigenvalue exceeds unity, the system diverges. Hysteresis occurs if at least one eigenvalue of Φ^* or Φ equals unity or zero, respectively.

For stable systems, applying the steady state conditions:

$$x_{t+1} = x_t \text{ and } z_t = \bar{z} \quad (6)$$

yield:

$$\Phi \bar{x} = \bar{z} . \quad (7)$$

If Φ is not of full rank, the solution of (7) – if it exists – yields multiple equilibria due to linear dependencies between several single difference equations. It can be shown, however, that multiple equilibria do not necessarily imply indeterminacy of the system: If the stability conditions are satisfied there exists a unique stationary equilibrium for any set of initial conditions.⁵ The solution of the system (7) is given by ⁶:

$$\bar{x} = \Omega_1 x_0 + \Omega_2 \bar{z} , \quad (8)$$

where $\Omega_1 \equiv VQV^{-1}$ and $\Omega_2 \equiv VD^{-1}V^{-1}$. The quadratic matrices V and D are of order k and designed to diagonalize Φ so that $\Phi = VDV^{-1}$ holds. The elements of D are zero except the diagonal which contains the eigenvalues of the transition matrix in declining order.⁷ The elements of the matrix Q are all zero with the exception of the first element which is a unity matrix .

The system (8) reiterates our statement that in the case of hysteresis the steady-state values depend not only on the vector of the exogenous variables, \bar{z} , but also on the initial conditions described by \bar{x}_0 .The non-hysteretic case is obtained for $D^- = D^{-1}$ and all elements of Q being zero so that (8) collapses to the “usual” solution, i.e.,

$$\bar{x} = \Phi^{-1} \bar{z} . \quad (9)$$

The upshot of these considerations can be summarized by the notion that hysteretic systems never forget any shocks even if these have been transitory in nature. They are ultimately responsible for the particular equilibrium (out of many) which the system is approaching.

⁵See Giavazzi and Wyplosz (1985), p.353 who derive this result for a continuous time model.

⁶For a derivation see Möller (1990).

⁷Accordingly D^- is a matrix with zero elements except the i -th diagonal elements which contain the reciprocal non-zero eigenvalues of Φ .

3 Origins and History of the Hysteresis Debate

The use of the term “hysteresis” has its origins in natural sciences. For example, in biophysics the vibration of biological membranes may follow a hysteresis loop. The expansion and contraction path of arteries may also be subject to hysteresis due to interior frictions. Similar considerations can be found in nonequilibrium thermodynamics within the context of “chemical hysteresis” in the behavior of gas and fluids.⁸ Some of these examples bear close relationships to catastrophe theory where a famous example is to establish thresholds for *sudden* behavioral changes of, say, a dog even if the composition of rage and fear is changed only very *smoothly* (the so called “cusp-lines”).⁹

In the context of electric engineering the so-called “hysteresis-loop” is a well-known concept to describe the electromagnetic features of ferric metals during a cycle of magnetization and an adjacent period of demagnetization. *Figure 1* displays a stylized hysteresis loop.¹⁰ Starting in O, the magnetizing force changes the field characteristics to a saturation level (such as B) which is the maximum amount of flux density B that can be forced through a material regardless of the magnetizing force H.¹¹ Hence, a further increase of the flux density would be inconsequential for the magnetism of the field. The presence of hysteresis is responsible for the specific way of return of the system if the magnetizing force is removed. Rather than to move back on the original path the system traces back on the upper part of the loop, i.e., on BC and, if the magnetizing force is reversed, on CD, now reaching minus saturation denoted by D. If the magnetic flux is driven again magnetism reaches plus saturation B on the way DFB. Thus, the complete hysteresis loop is given by BEDFB. The original zero-balance of the magnetizing force is now associated with some residual magnetism left in the material denoted by OC or OG, respectively, depending on whether the magnetizing force is decreased from B or increased from D. This residual magnetism is called “remanence”. If we are in, say, C the removal of the remanence (in order to restore a zero-magnetic field) requires a further decrease of the magnetizing force of OE (or an increase of OF if we are in G). OE and OF are called “coercivity”. The area enclosed by the hysteresis loop indicates the energy loss that will be experienced if the material is cycled in an alternating field. As a consequence of this field-extracted energy the temperature of the cycled material will rise.

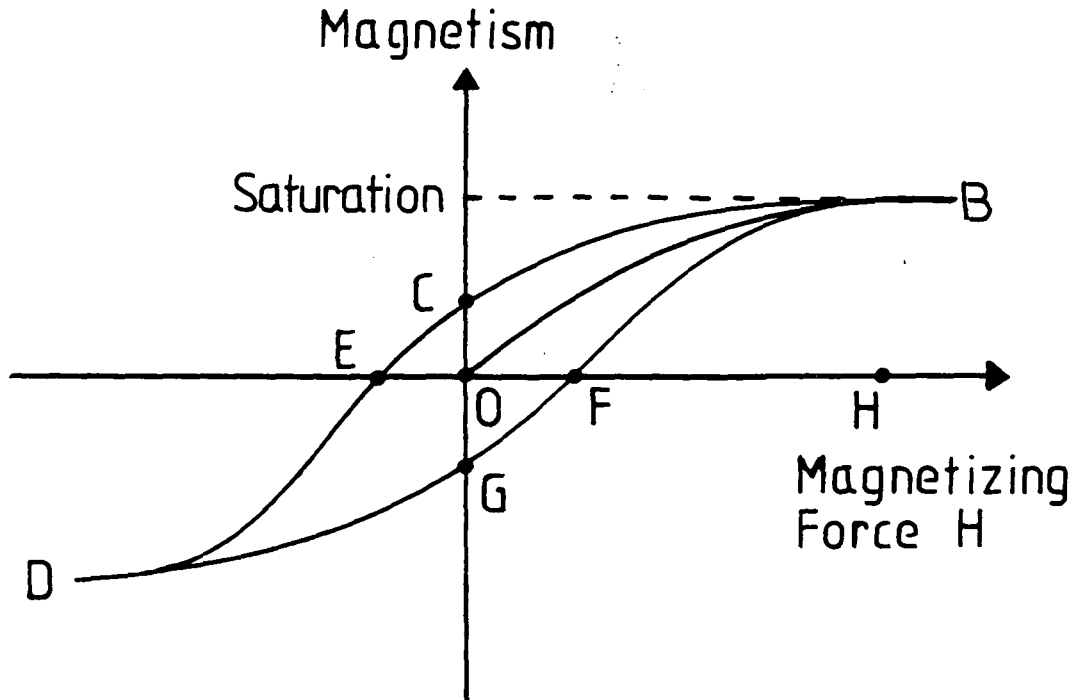
⁸More detailed information about the application of the hysteresis phenomenon in natural sciences can be found in textbooks on biophysics such as Hoppe, Lohmann, Markl and Ziegler (1982) from where the aforementioned examples are taken.

⁹See Zeeman (1976), for example.

¹⁰See Cross and Allan (1988) for a more detailed discussion. Some of the following considerations are also contained in Franz (1989).

¹¹See Burke (1986), pp.63-68 for more details.

Figure 1: Magnetic Hysteresis Loop



While a mathematical treatment of the hysteresis loop is beyond the scope of this introduction,¹² the aforementioned considerations carry over to economics with only slight modifications. As an example, simply replace magnetism by “unemployment” and the magnetizing force by an “adverse supply shock” such as the spurt in some raw material prices in the seventies. In the absence of this shock the economy has frictional unemployment O . A certain shock (OH in figure 1) drives unemployment to OB . Removing the shock completely implies a path of unemployment from B to C with OC now representing higher unemployment even though the original supply conditions (i.e., the original oil prices) are prevailing again. Moreover, in order to restore the pre-shock unemployment level a favourable shock of OE would be necessary. The analogy between magnetism and unemployment driven by supply shocks may not be too far reaching but the similarities are obvious. Especially important is the distinction between hysteresis and irreversibility. In contrast to irreversibility, hysteresis does not mean that the process (magnetism, unemployment) cannot be reversed: In magnetism it costs a reduction of magnetizing forces including coercivity to reach the original equilibrium, while in the labor market exam-

¹²See the detailed mathematical analysis in the book by Krasnosel'skii and Pokrovskii (1989).

ple this can be restored by removing the adverse supply shock including the allowance for a favourable supply shock.

In physics the hysteresis phenomenon may be traced back to the German physicist Kohlrausch in 1866 and the Scottish physicist-engineer Ewing in 1881.¹³ Its explicit use in economics goes back to Samuelson (1965), Georgescu-Roegen (1971), Phelps (1972), and Kemp and Wan (1974).¹⁴ In what follows we discuss these applications in more detail.

4 Hysteresis in Economics

This section is devoted to a brief survey of two major fields in economics in which the hysteresis principle is applied namely in industrial economics with special reference to international trade and in labor economics with special reference to unemployment.

There are other applications of the hysteresis principle which are not reviewed here. For example, in macrodynamics business fluctuations may exhibit hysteresis if an asymmetry of effective demand in ascent and descent is taken into account.¹⁵ While with expansions in output, the expenditures of firms and consumers increase, these expenditures may be reduced less than proportionally with a contraction in output. A related aspect can be found in choice theory where, for example, preferences of consumers change in course of their experiences with consumption, or to quote Georgescu-Roegen: "...in order to determine the equilibrium of the consumer (for a fixed budget and constant prices) we need to know more than his particular hysteresis law. Still worse, this law being expressed by a very complex set function, we can only write it on paper but not determine it in actual practice" (1971, p.126) .

4.1 Industrial Economics in an International Setting

As is evidenced in the survey by Kreps and Spence (1985), there is a long tradition in the area of industrial organization pertaining to the role of history in industrial competition. For example, the "immature" stage of industry competition can affect subsequent behaviour and performance in the "mature" stages by tangible variables such as capacity or levels of technical expertise.¹⁶ Another approach to industry dynamics and the role of history in industry maturity is the question to what extent decision-makers have complete rationality. In the case of limited rationality they may adopt rules of thumb by

¹³Source: Cross and Allan (1988), pp.26-28

¹⁴This does not mean that the basic principle of hysteresis was not recognized before. Economists such as R.Frisch, N.Kaldor, and J.A. Schumpeter have been aware of it; see Cross and Allan (1988), pp.31-35

¹⁵See Goodwin and Punzo (1987), pp.117-124 for more detailed explanations.

¹⁶These aspects are often dealt with by employing the concept of "learning curves".

taking into account previous events and situations.

A more direct and worked-out treatment of hysteresis in industrial organization can be found in the field of international trade. Much of the work concerning hysteresis in international trade is done by Richard Baldwin, Avinash Dixit, and Paul Krugman. A good starting point is the paper by Baldwin on "hysteresis in international trade" in this special issue. The basic point is that foreign firms can enter a domestic market only by incurring once-for-all sunk costs. A *temporary* and sufficiently large rise in the exchange rate would induce *permanent* entries by foreign firms. Due to these sunk costs firms will find it profitable to stay in the domestic market even when the exchange rate returns to former levels.¹⁷ Thus, the economy faces quite a different trade pattern although the exchange rate had fallen and ultimately does not differ from its previous value.¹⁸ These considerations are extended in the paper by Baldwin and Krugman (1989) in several ways. Among other aspects, the behavior of aggregated imports is examined when there are many industries subject to potential foreign entry. This aspect is important in order to ensure that the results of the single-industry case do not get smoothed away in the aggregate. Moreover, that paper explicitly deals with the feedbacks from entry and exit decisions to the exchange rate itself. Special attention to hysteretic effects on import prices is drawn by the papers by Baldwin (1988), and Dixit (1989). The argument is that pricing behaviour is affected by the presence of additional foreign firms.

The aforementioned considerations concerning firm behaviour are not restricted to the analysis of international trade. In a more recent paper by Dumas (1989), a general equilibrium framework of capital formation is introduced. To some extent this capital is "perishable" in the sense that it quickly becomes useless if it is left unused for some time, e.g. marketing capital. As in Dixit (1989), an economy with even small setup costs can exhibit a non-negligible hysteresis phenomenon. If the economy with a given distribution of "regular" and "perishable" capital is subject to random productivity shocks there can exist a bifurcating equilibrium in which the economy can equally well embark on a path of sustained positive or negative growth. It all depends on the actual capital mix the economy has been able to achieve.

In a paper by Kemp and Wan Jr. (1974) possible multiplicity of long-run equilibria due to different costs and speeds of adjustments are investigated. While much of the literature focuses on the behaviour of an individual firm which chooses consciously the speed of adjustment, the authors deal with the question as to what extent a whole economy of rationally adjusting firms is affected. The main conclusion of the paper is that if adjustment costs depend on the speed of adjustment "then under positive time preference the position of long-run equilibrium depends crucially on initial conditions – a dramatic example of hysteresis" (p.222). The basic assumption which creates hystere-

¹⁷See also the study by Fuhrmann (1989).

¹⁸See also the paper by Bean (1987) for the U.K.

sis is that at the origin the derivative of the cost-of-adjustment function is discontinuous. Moreover, on the basis of special examples, the possibility of interindustrial wage and marginal productivity differences and, thus, of the path-dependency of long-run equilibria is established.

4.2 Labor Economics

The bulk of recent papers concerned with the hysteresis phenomenon focussed on the persistence of high unemployment in Europe during the 1980s which poses some puzzles for theoretical and empirical macroeconomics. The analytical problems are evidenced by estimates of the “non accelerating inflation rate of unemployment” (NAIRU) which follow the actual path of unemployment rather closely. To put it in R.Solow’s words: “A natural rate that hops around from one triennium to another under the influence of unspecified forces, *including past unemployment rates*, is not ‘natural’ at all.” [Solow (1986), p.533].

It goes without saying, that the analysis of hysteresis in labor economics has forerunners. In 1972 E.Phelps noted that the “natural unemployment rate at any future date will depend upon the course of history in the interim. Such a property is sometimes called hysteresis” [Phelps (1972), p.xxiii]. His example refers to unemployment attributable to the relative size of union wages. An abnormal increase in aggregate demand leads to higher employment of workers not previously belonging to the union even in firms with a union shop. As a consequence, if the union aims to maintain employment of its enlarged membership, it cannot afford to raise the wage rate as much as without this enlargement. Hence, unemployment due to higher union wages is reduced.¹⁹

As a next landmark, the paper by Hargreaves Heap (1980) should be singled out. The basic point is that the natural rate instead of being at a “level that would be ground out by the Walrasian system of general equilibrium equation” [Friedman (1968), p.5] is path dependent where the difference between actual and natural unemployment drives the latter. Several ad hoc-arguments are offered for this dynamic dependence such as a depreciation of human capital, a shortage of capital, and the like (see below for a detailed treatment).²⁰

It seems fair to say that the revival of the hysteresis debate was put forward by a series of papers by Blanchard and Summers (1986a, 1987). Their model takes up one of the arguments outlined in Hargreaves Heap (1980) and is related to the insider-outsider hypothesis of wage determination emphasized by Lindbeck and Snower (1987). Roughly speaking, the mechanism at work is based on the hypothesis that employed union members (insiders) always set wages so as to maintain just their own employment rather than so as to care for the unemployed (outsiders).²¹ Adverse shocks which raise unemployment

¹⁹See Phelps (1972), p.76-78

²⁰Hansen (1990) and Funke (1990) offer comprehensive surveys of different channels through which hysteresis effects may work.

²¹See Ramser (1988) for a critical assessment of the insider-outsider theory.

reduce the number of insiders. The new, smaller group of insiders then forms the basis of the next wage negotiations. The new, larger group of outsiders has no influence on the bargaining process.²² Rather, wages are set so as to maintain the new, lower level of employment.²³ The shocks may be temporary but the new, higher level of unemployment is permanent with no tendency to return to its previous, lower level, i.e., unemployment exhibits hysteresis. Obviously, the empirical relevance of this hypothesis rests basically on two premises:²⁴

- (i) Unions care in fact less about the unemployed outsiders than about the welfare of their employed insiders. In the absence of adequate data which exclusively refer to insider vs. outsider forces, proxies have been used in aggregate time series regressions on wages such as the distinction between short-term and long-term unemployment where the long-term unemployed are viewed as the outsiders. The empirical results are mixed, however. Layard and Nickell (1986) conclude that most if not all of the pressure on wages in the U.K. comes from short-term unemployment, whereas long-term unemployed exert little influence on wages. By and large, this result is confirmed in the study by Coe (1988) on hysteresis effects in wage equations. Nickell and Wadhvani (1989) in an attempt to assess the relative importance of firm-specific factors (i.e., insider forces) in wage determination also find evidence for insider based hysteresis effects which are, however, inversely related to the extent to which firms take national agreements into account. On the other hand, Holmlund and Zetterberg (1989) in a study for five countries find in their wage equations no evidence in favour of the insider-outsider hypothesis that wages are inversely related to the size of the incumbent work force.
- (ii) Unemployed workers cannot find jobs at lower wages outside the unionized sector either because firms do not accept underbidding or because there is no sector that is not covered by collective bargaining. More specifically, employers may refuse to accept such bids due to bowing to social norms according to which underbidding is viewed as an improper form of social behaviour or because the insiders would withdraw cooperation from the underbidders and would "harass" them [Lindbeck and Snower (1988a), p.167]. This view has been effectively criticized on theoretical grounds by Fehr (1990). He shows that given the wage rule assumed by Lindbeck and Snower (1988a) all insiders would be replaced by out-

²²For a similar reasoning see Gottfries and Horn (1988).

²³The assumption that insiders are to be concerned only with their employment prospects has been called in question by Alogoskoufis and Manning (1988). When they confront various other explanations (such as slow adjustment in the firm's hiring and firing decisions, persistence of wage aspirations of insiders, and the like) with the data for various countries, they find no role for insider membership dynamics.

²⁴See Franz (1987), pp.94 for a more detailed treatment.

siders. This result may hold even if the wage determination process is changed.

Another mechanism besides wage bargaining which can possibly generate hysteresis stems from the search process seen both from the employer's and the job applicant's viewpoints. To begin with the first, in a screening process the firm has to identify the unknown productivity of the applicant for the job in question. If firms use unemployment experience itself as a screening device, then unemployed persons with a long duration of unemployment are viewed as the less promising candidates due to their (potential) depreciation of human capital during the long unemployment spell. Indeed, in a recent econometric study about the recruitment behavior of firms Ebmer (1989) finds evidence that hiring chances are largely reduced by long-term unemployment as well as by "unfavourable" characteristics such as age, physical disabilities, and the like. Parenthetically we note that some of the long-term unemployed with unfavourable characteristics may have had these attributes already when being employed. Firms may have been reluctant, however, to fire them bowing to social norms and/or because their fellow workers did the work of these persons in order to help them. In the case of bankruptcy or larger dismissals these persons find themselves in the unemployment pool, of course, with virtually no chance to escape from unemployment.

Turning to the other side of the search process long-term unemployed may reduce their search intensity due to their discouragement as a consequence of being so often rejected by employers.²⁵ Moreover, if skills are acquired not only through on-the-job-training but also through changing jobs, then high unemployment supports a deterioration in skills because it reduces job mobility.²⁶

The third major channel through which hysteresis may affect the economy stresses the role of the capital stock. In a neoclassical setting several studies such as Burda (1988) point out that reductions in the capital stock affect labor demand in the same way as adverse supply shocks do. In these models demand shocks have no impact on employment unless they influence the real exchange rate. On the other hand, in a world characterized by price rigidities demand shocks may have a more direct effect on the supply-side capacity. For example, in the model by van de Klundert and van Schaik (1989) an adverse demand shock leads to a reduction in the capital stock if large firms close plants and/or scrap capital. This decrease of the capital stock gives rise to unemployment which may turn out to be persistent because firms cannot suddenly be reopened and begin production even if product demand increases, i.e., the model exhibits hysteresis.

²⁵On the other hand, long-term unemployed may reduce their reservation wage so that the net effect of the matching process is ambiguous. See Franz and Siebeck (1990) for a theoretical analysis of these aspects within the framework of a theoretical model of the Beveridge curve.

²⁶See Hargreaves Heap (1980), p.614 for this point.

These arguments provide an obvious channel through which hysteresis may affect the NAIRU. The basic idea is that the NAIRU depends on the capital stock.²⁷ The evolution of the capital stock depends not only on factor prices but also on aggregate demand in the goods market. Running the economy, however, at unemployment rates higher than the NAIRU implies a reduction of investment. This will, in turn, eventually increase the NAIRU. Indeed, econometric estimates of the NAIRU for some countries such as Germany come to the conclusion that especially in the 80s the actual unemployment rate exceeded the NAIRU to a non-negligible extent.²⁸ Moreover, in the same country capital utilization is above normal. This does, however, not necessarily mean that a possible expansion would be hampered by a capital shortage as long as there are sufficient substitution possibilities between labor and capital and other measures such as an extension of overtime and shift work.

We conclude this subsection with some empirical evidence on hysteresis recently obtained by Gordon (1989). As in other studies the empirical counterpart of the hysteresis phenomenon is a reduced-form equation where the inflation rate (p) as the dependent variable depends on the *change* in unemployment rather than on the *level* of unemployment (U) as in the natural rate hypothesis put forward by Friedman (1968). This can be illustrated very easily using the simplest possible version:

$$p_t = \alpha \cdot p_{t-1} + \beta \cdot (U_t - U_t^*) \quad (10)$$

The NAIRU (U^*) is obtained for a steady-state situation where $p_t = p_{t-1}$. Hysteresis can arise when the NAIRU depends on the history of unemployment, approximated by U_{t-1} , in addition to other (microeconomic) explanatory variables captured by Z_t :

$$U_t^* = \eta \cdot U_{t-1} + \gamma \cdot Z_t \quad (11)$$

Inserting (11) in (10) and rearranging yields:

$$p_t = \alpha \cdot p_{t-1} + \beta(1 - \eta)U_t + \beta\eta\Delta U_t - \beta\gamma Z_t \quad (12)$$

Full hysteresis occurs if η equals unity, whereas the case $\eta < 1$ is called "persistence".²⁹ For full hysteresis, we obtain a relation between p_t and the change in unemployment, not the level of unemployment. When we then impose the steady-state conditions and $\alpha = 1$, there is no longer a unique NAIRU. In the other extreme case, if η equals zero, we are left with the standard case where the NAIRU amounts to γZ . Due to a lack of reliable unemployment data for the time period prior to World War I, the unemployment variables

²⁷See Sachs (1986) for this argument.

²⁸See Schultze (1987) and Franz (1987), for example.

²⁹See Wyplosz (1987), pp.125-126

are replaced in the study by Gordon with data on detrended log output. As a result for five countries (France, Germany, Japan, U.K., and U.S.) and for the time period 1873–1986 Gordon (1989) concludes that in no country is the hypothesis of *full* hysteresis supported. Only “traces of hysteresis are evident throughout the past century in the form of evidence that prolonged economic slumps have exerted little or no downward pressure on prices in the United States and the United Kingdom” (p.224).³⁰

Given some plausibility of the hysteresis or persistence argument, what are the policy implications with respect to labor market issues? If the NAIRU is high because actual unemployment is high, this characteristic renders the NAIRU as a less straightforward guide for economic policy. For example, one might consider making a distinction between a “contemporaneous” NAIRU (i.e., the NAIRU given the history of unemployment) and the steady-state NAIRU (i.e., the NAIRU sustainable in the long-run equilibrium when endogenous responses of the contemporaneous NAIRU to past unemployment are taken into account) [Franz (1987)]. In the presence of hysteresis the contemporaneous NAIRU falls with decreasing actual unemployment as the result of expansionary demand policies.

Does the existence of hysteresis imply that the economy with high unemployment should *always* expand? As has been shown by Sachs (1986) in a theoretical analysis, the answer crucially depends on the initial state of the economy with respect to the level of inflation. If the initial position of the economy is one of low inflation and a high NAIRU – a description which characterizes the economic situation of some countries in the eighties – then an expansion is warranted. On the other hand, if the inflation rate is high and the unemployment rate is moderate, then the optimal path involves rising unemployment and falling inflation. Hence, there is no general case for an expansion in the presence of hysteresis.³¹ But if, tax cuts are very likely to be effective according to Blanchard and Summers (1986b). A decrease in tax rates shifts aggregate demand, because of a higher deficit, and aggregate supply, because of the reduction of taxes. Due to the dependence of the subsequent level of wages on the number of insiders, these employment gains (resulting from expansionary policies) are likely to be permanent. Moreover, tax cuts can ultimately increase employment and real wages without spurring government budget deficits.

³⁰See Graafland (1989) who finds evidence that labor market developments in Europe are more characterized by hysteresis than in the United States.

³¹See Buiter and Gersovitz (1981) for an analysis of dynamic controllability of systems with hysteresis. The interpretation by Sachs (1986) is examined and partly rejected by Möller (1990).

5 Overview of Papers

How do the contributions written for this special issue fit into the framework outlined in the previous section? All but one of the papers are concerned with labor market issues. This reflects the persistence of high unemployment in Europe during the eighties and the discomfort with the conventional theories of how to explain this phenomenon.

The exception is the paper by Richard Baldwin which deals with hysteresis in international trade. The first draft of this paper was already written in 1986 and, therefore, it represents a major basis of much of the subsequent work on this subject that was surveyed in the previous section. The basic idea is that due to sunk market-entry costs a temporary exchange rate shock can lead to a lasting distortion of comparative advantage.

Is unemployment in Europe plagued by the hysteresis phenomenon? One possible view is that increases in unemployment in Europe over the past decade are attributable to divergences of interests of different groups that cannot be mediated by the marketplace. This is the theme of the paper by Michael Burda which claims that in a democratic model of union wage-setting, monopoly unions can induce hysteresis in the behavior of employment, at least locally. Using unit root tests and Granger causality tests the author concludes that there is little evidence that employment hysteresis constitutes the key difference between the European and the U.S. experiences. On the other hand, trade union membership data from the Federal Republic of Germany provide in this study strong support for the membership hysteresis hypothesis in that country.

As has been documented in the previous section, wage equations may be used to detect the sources of a possible hysteresis effect. David Coe investigates the extent to which wages are determined by insiders, with outsiders having little impact on the wage bargain. Based on a specification which nests alternative models to the wage determination process, the paper presents estimates of wage equations for fifteen industries for fourteen industrialized countries. The results offer support to the insider view of wage determination. Again, hysteresis does not appear to characterize wage formation in the high-unemployment European countries to a greater extent than in North America and Japan.

Rather than to look at wage equations, one can apply other econometric methods to identify possible hysteresis. Albert Jaeger and Martin Parkinson suggest a test for hysteresis in unemployment based on an unobserved components model. Observed unemployment rates are decomposed into a natural rate component and a cyclical component. The impact of lagged cyclical shocks on the current natural component is the measure of hysteresis. The authors find no evidence of hysteresis in U.S. data, whereas German unemployment rates exhibit substantial hysteresis. For both countries, natural rate shocks turn out to be an important impulse mechanism to explain movements in observed unemployment rates.

Another procedure is applied in the paper by Joachim Möller. He focuses on the deterioration of human capital during spells of unemployment. The importance of this aspect has been mentioned in the previous section. In his model the deterioration of human capital during unemployment affects the relation between vacancies and unemployment in a specific way: In the case of labor market slackness the steady state Beveridge curve bends away markedly from the standard u/v -curve. The Beveridge curve may even be upward sloping implying the existence of multiple equilibria. Empirical estimates for Germany reveal that this has been the likely case in that country.

Austria is in many aspects a country which is distinct from other industrialized countries. Since it is included only in the paper by Michael Burda, it seems appropriate to have a closer look. This is done in the contribution by Peter Neudorfer, Karl Pichelmann, and Michael Wagner. Their paper analyses hysteresis or persistence effects on Austrian unemployment data using formal unit root tests and a macroeconometric model of wage-price formation. Their empirical results point towards a considerable amount of persistence in unemployment generated by the rising share of long-term unemployed that has been associated with the increase in overall unemployment in that country.

References

- Alogoskoufis, G.S. and A.Manning** (1988), On the Persistence of Unemployment, *Economic Policy* 7, 428-469.
- Baldwin, R.** (1988), Hysteresis in Import Prices: The Beachhead Effect, *American Economic Review* 78, 773-785.
- Baldwin, R. and P.R.Krugman** (1989), Persistent Trade Effects of Large Exchange Rate Shocks, *Quarterly Journal of Economics* 104, 635-654.
- Bean, C.** (1987), Sterling, Misalignment and British Trade Performance, London School of Economics, Centre for Labour Economics, Discussion Paper No. 288 (July), London.
- Blanchard, O.J. and L.H.Summers** (1986a), Hysteresis and the European Unemployment Problem, in: S.Fischer (ed.), *NBER Macroeconomics Annual 1986*, Cambridge MA (MIT Press), 15-78.
- Blanchard, O.J. and L.H.Summers** (1986b), Fiscal Increasing Returns, Hysteresis, Real Wages and Unemployment, NBER Discussion Paper No. 2034 (October), Cambridge MA.
- Blanchard, O.J. and L.H.Summers** (1987), Hysteresis in Unemployment, *European Economic Review* 31, 288-295.
- Brunello, G.** (1988), Hysteresis and "the Japanese Unemployment Problem": A Preliminary Investigation, mimeo Osaka University.
- Buiter, W.H.** (1987), The Right Combination of Demand and Supply Policies: The Case For a Two Handed Approach, NBER Working Paper No. 2333, Cambridge MA.
- Buiter, W.H. and M.Gersovitz** (1981), Issues in Controllability and the Theory of Economic Policy, *Journal of Public Economics* 15, 33-43.
- Burda, M.** (1988), Is there a Capital Shortage in Europe? , *Weltwirtschaftliches Archiv* 124, 38-57.
- Burke, H.E.** (1986), *Handbook of Magnetic Phenomena*, New York (Van Nostrand Reinhold).
- Coe, D.T.** (1988), Hysteresis Effects in Aggregate Wage Aspirations, in: R.Cross (1988), 284-305.
- Cross, R.** (1987), Hysteresis and Instability in the Natural Rate of Unemployment, *Scandinavian Journal of Economics* 89, 71-89.

- Cross, R., ed.**, (1988), *Unemployment, Hysteresis, and the Natural Rate Hypothesis*, Oxford (Basil Blackwell).
- Cross, R., and A.Allan** (1988), *On the History of Hysteresis*, in: R.Cross (1988), 26–38.
- Dixit, A.** (1989), *Hysteresis, Import Penetration, and Exchange Rate Pass-Through*, *Quarterly Journal of Economics* 104, 205–228.
- Dumas, B.** (1989), *Perishable Investment and Hysteresis in Capital Formation*, NBER Working Paper No. 2930 (April), Cambridge MA.
- Ebmer, R.** (1989), *Some Micro Evidence on Unemployment Persistence*, Paper presented at the 4th Annual Congress of the European Economic Association held in Augsburg.
- Fehr, E.** (1990), *Do Cooperation and Harassment Explain Unvoluntary Unemployment?* *American Economic Review* (forthcoming).
- Franz, W.** (1983), *The Past Decade's Natural Rate and the Dynamics of German Unemployment: A Case Against Demand Policy?*, *European Economic Review* 21, 51–76.
- Franz, W.** (1987), *Hysteresis, Persistence, and the NAIRU : An Empirical Analysis for the Federal Republic of Germany*, in: R.Layard and L.Calmfors (eds.), *The Fight Against Unemployment*, Cambridge MA (MIT Press), 91–122.
- Franz, W.** (1989), *Das Hysteresis Phänomen*, *WiSt-Wirtschaftswissenschaftliches Studium* 18, No. 2, 77–80.
- Franz, W. and K.Siebeck** (1990), *Theoretical Aspects of the Relation between Unemployment and Vacancies*, University of Konstanz, Department of Economics, Discussion Paper, Nr. 102, Konstanz.
- Friedman, M.** (1968), *The Role of Monetary Policy*, *American Economic Review* 58, 1–17.
- Fuhrmann, W.** (1989), *Außenwirtschaftliche Persistenzen und Wechselkurselastizitäten*, *Zeitschrift für Wirtschafts – und Sozialwissenschaften* 109, 585–602.
- Funke, M.** (1990), *Das Hysteresis-Phänomen*, mimeo Berlin.
- Georgescu-Roegen, N.** (1971), *The Entropy Law and the Economic Process*, Cambridge MA (Harvard University Press).

- Giavazzi, F. and C.Wyplosz** (1985), The Zero Root Problem: A Note on the Dynamic Determination of the Stationary Equilibrium in Linear Models, *Review of Economic Studies* 52, 353–357.
- Goodwin, R.M. and L.F.Punzo** (1987), *The Dynamics of a Capitalist Economy*, Oxford (Basil Blackwell).
- Gordon, R.J.** (1989), Hysteresis in History: Was There Ever a Phillips Curve?, *American Economic Review* 79 (Papers and Proceedings), 220–230.
- Gottfries, N. and H.Horn** (1988), Wage Formation and the Persistence of Unemployment, *Economic Journal* 97, 877–884.
- Graafland, J.J.** (1989), Can Hysteresis Explain Different Labour Market-Operations between Europe and the United States?, *Applied Economics* 21, 95–111.
- Hansen, G.** (1990), Die Persistenz der Arbeitslosigkeit. Eine theoretische und empirische Analyse in: G. Nakhaeizadek and K.-H. Vollmer (Hrsg), *Neuere Entwicklungen in der Angewandten Ökonometrie*, Heidelberg (Physica).
- Hargreaves Heap, S.P.** (1980), Choosing the Wrong Natural Rate: Accelerating Inflation or Decelerating Employment and Growth, *Economic Journal* 90, 611–620.
- Holmlund, B. and J.Zetterberg** (1989), Insider Effects in Wage Determination: Evidence from Five Countries, Uppsala University, Department of Economics, Working Paper No. 11/1989, Uppsala
- Hoppe, W., W.Lohmann, H.Markl and H.Ziegler** (1982), *Biophysik*, 2nd. ed, Berlin (Springer).
- Kemp, M.C. and H.Y.Wan Jr.** (1974), Hysteresis of Long-Run Equilibrium from Realistic Adjustment Costs, in: G.Horwich and P.A.Samuelson (eds.), *Trade, Stability, and Macroeconomics*, New York (Academic Press), 221–242.
- Klundert, Th. van de and A. van Schaik** (1989), Unemployment Persistence and Loss of Productive Capacity: A Keynesian Approach, Paper presented at the 4th Annual Congress of the European Economic Association held in Augsburg.
- Krasmosel'skii, M.A. and A.V.Pokrovskii** (1989), *Systems with Hysteresis*, Berlin (Springer).

- Kreps, D.M. and A.M.Spence** (1985), Modelling the Role of History in Industrial Organization and Competition, in: G.R.Feiwel (ed.), Issues in Contemporary Microeconomics and Welfare, London (MacMillan), 340–378.
- Layard, R. and S.Nickell** (1986), The Performance of the British Labour Market, London School of Economics, Centre for Labour Economics, Discussion Paper No. 249 (September), London.
- Lindbeck, A. and D.J.Snowder** (1987), Efficiency Wages Versus Insiders and Outsiders, *European Economic Review* 31, 407–416.
- Lindbeck, A. and D.J.Snowder** (1988a), Cooperation, Harassment, and Involuntary Unemployment: An Insider–Outsider Approach, *American Economic Review* 78, 167–188.
- Lindbeck, A. and D.J.Snowder** (1988b), The Insider–Outsider Theory of Employment and Unemployment, Cambridge MA (MIT Press).
- Möller, J.** (1990), Das Hysteresis Phänomen in Arbeitslosigkeit–Inflations–Modellen: Theorie, Empirische Relevanz und wirtschaftspolitische Konsequenzen, mimeo, Konstanz.
- Nickell, S. and S.Wadhvani** (1989), Insider Forces and Wage Determination, London School of Economics, Centre for Labour Economics, Discussion Paper No. 334 (January), London.
- Phelps, E.S.** (1972), *Inflation Policy and Unemployment Theory*, London (Macmillan).
- Ramser, H.J.** (1988), Lohnbildung und Beschäftigung : Anmerkungen zur Relevanz des Insider–Outsider–Ansatzes, in: Universität Konstanz, Fakultät für Wirtschaftswissenschaften und Statistik (ed.), Zum Gedenken an Harald Gerfin, Konstanz, 55–69.
- Sachs, J.D.** (1986), High Unemployment in Europe: Diagnosis and Policy Implications, NBER Working Paper No. 1830 (February), Cambridge MA.
- Samuelson, P.A.** (1965), Some Notions on Causality and Teleology in Economics; reprinted in: *The Collected Scientific Papers of Paul A.Samuelson*, VolIII, 428–472.
- Schultze, Ch.L.** (1987), Real Wages, Real Wage Aspirations, and Unemployment in Europe, in: R.Z.Lawrence and Ch.L. Schultze (eds.), *Barriers to European Growth. A Transatlantic View*, Washington D.C. (Brookings Institution), 230–291.

- Solow, R.M.** (1986), Unemployment: Getting the Questions Right, *Economics* 53 (Supplement), S23–S34.
- Wyplosz, C.** (1987), Comment on W.Franz: “Hysteresis, Persistence, and the NAIRU. An Empirical Analysis for the Federal Republic of Germany”, in: R.Layard and L.Calmfors (eds.), *The Fight Against Unemployment*, Cambridge (MIT-Press), 123–131.
- Zeeman, E.C.** (1976), Catastrophe Theory, *Scientific American* 234, part 4, 65–83.