The Measurement of Persistence and Hysteresis in Aggregate Unemployment.

Ossama Mikhail* Curtis J. Eberwein† Jagdish Handa‡

October 27, 2003

Abstract

There exists no consensus regarding the definition and the measure of persistence. We aim to spark research interests to address the lack of a standard definition. This paper reviews this issue and proposes an informal definition to unemployment persistence.

JEL classification: B41; E24; E32

Keywords: Hysteresis, Persistence, Business Cycle Fluctuations, Unemployment.

*Corresponding Author. Department of Economics, College of Business Administration, University of Central Florida. E-mail: omikhail@bus.ucf.edu. I am grateful to the McGill Major Fellowship for financial support and the University of Central Florida seminar participants.

†Center for Human Resource Research, Ohio State University. E-mail: ceberw@hotmail.com

‡Department of Economics, McGill University. E-mail: Jagdish.Handa@mcgill.ca

1 INTRODUCTION

"Cycles are characterized by coordinate movements across sectors as well as *persistence* of shocks." [Our emphasis] Engle and Issler (1995, p. 84).

Measuring unemployment persistence is of concern to macroeconomic policy makers since whenever evidence of persistence - however defined - is found, there exists the possibility of some room to decrease the unemployment rate without changing any structure in the organization of the labor market. How fast can the unemployment rate be decreased depends on the persistence mechanism. Therefore, it has been the aim of many to address, to uncover and to identify the type of this mechanism that governs unemployment fluctuations.

Persistence in unemployment is said to occur if a level higher (lower) than the natural (long-run normal) rate of unemployment is accompanied the following year by a level that is also above (below) the natural rate. Each year, unemployment returns about one third of the way to its normal level after a shock displaces it (Hall 1998, 34). Traditionally, one measures this persistence is by the first-order auto-regression coefficient (Heijdra and Van Der Ploeg 2002, 163).

Riddell (1986, p. 126) asked the question "What is the cause of this persistence?" Supplying reasons, highlighting the consequences and proposing solutions to it has been (and still is) the concern of many researchers. Ever since the comments and discussion by Sims, Solow, Gordon and Hall (1975), there has been a growing interest in understanding and modeling unemployment persistence.

Further, since disinflationary policies pursued by the central bank tend to raise the unemployment rate beyond its natural rate, the costs of such policies depend on the persistence mechanism in unemployment. These policies - generally guided by the behavior of the unem-

ployment rate - will prove very costly in terms of lost output and persistent unemployment.

Hysteresis in unemployment is said to occur if the short-run deviations of unemployment from its natural rate change the actual natural rate. If hysteresis is present, persistently high (low) short-run unemployment will raise (lower) the natural rate.

A consistent and puzzling aspect of this empirical-research interest is that, there does not currently exist a consensus on the definition of 'persistence' and 'hysteresis' in unemployment. Different authors use different definitions for these terms and some contributions confuse 'hysteresis' with 'persistence'. This paper examines the definitions of these terms, their measurement in the literature and their consequences.

Section 2 presents the origin [history] of persistence and hysteresis and explains their role in economics. Section 3 presents their consequences. Section 4 reviews the proposed theories put forth to explain them. Section 5 briefly reviews a selection of articles which test for them. Finally, Section 6 proposes a definition for unemployment persistence.

2 ORIGIN AND ROLE

The origin of the word '*hysteresis*' is the Greek word $\upsilon\sigma\tau\epsilon\rho\iota\alpha$ which means 'to come later'. The use of the term 'hysteresis' was first introduced in the natural sciences. In physics, the term can be traced back to the German physicist Kohlrausch in 1866 and the Scottish physicist-engineer Ewing in 1881. The usage of the word 'hysteresis' can be found in many sciences. For example,[1] in biophysics, the vibration of biological membranes may follow a hysteresis loop, such as blood arteries subjected to interior frictions. In thermodynamics, the term 'chemical hysteresis' refers to a certain behavior of gas and fluids. In

electric engineering, the 'hysteresis-loop' refers to the electromagnetic features of ferric metals when magnetized and demagnetized. The residual magnetism is called 'remanence'.[2] The Merriam-Webster dictionary provides the following definitions:

> **Hysteresis**: Main Entry: hys·ter·e·sis, Etymology: New Latin, from Greek hysterEsis shortcoming, from hysterein to be late, fall short, from hysteros later, Date: 1881, : a retardation of an effect when the forces acting upon a body are changed (as if from viscosity or internal friction); *especially* : a lagging in the values of resulting magnetization in a magnetic material (as iron) due to a changing magnetizing force.
>
> **Persistent**: Main Entry: per·sis·tent, Etymology: Latin persistent-, persistens, present participle of persistere, Date: 1826, 1 : existing for a long or longer than usual time or continuously: as a : retained beyond the usual period <a persistent leaf> b : continuing without change in function or structure <persistent gills> c : effective in the open for an appreciable time usually through slow volatilizing <mustard gas is persistent> d : degraded only slowly by the environment <persistent pesticides> e : remaining infective for a relatively long time in a vector after an initial period of incubation <persistent viruses>, 2 a : continuing or inclined to persist in a course b : continuing to exist in spite of interference or treatment <a persistent cough>.

The basic principle of hysteresis was well recognized by economists - such as Frisch, Kaldor and Schumpter[3] - well before its revival in recent economic literature. In economics, two major fields which have provided fertile ground for the empirical investigation of these concepts. The fields are international trade and labor economics (with reference to aggregate unemployment). This paper focuses on the latter. The references on the former can be found in Baldwin (1988; 1990).[4]

In labor economics, the seminal work of Blanchard and Summers (1986) inspired a renewed interest in unemployment hysteresis. Often using a blurred definition of hysteresis, many researchers focused on the modeling and testing of hysteresis in European unemployment during the 1980s to explain the stagnant and relatively high OECD unemployment

rates.

Two vague ideas revolve around the use of 'hysteresis' in economics. The first is the path dependence property and the second is the permanent effect of transitory shocks. The former implies that the equilibrium state of the system depends on the transition towards it while the latter underlines the persistent effects of a shock to the system. The latter property is a major source of confusion between what is known as the 'unit root persistence in discrete time'[5] and 'persistence'.

In the natural sciences, 'hysteresis' is generally defined as a particular type of the response of a non-linear system when one modifies the value of the input: the system is said to exhibit the remanence property when there is a permanent effect on output after the value of the input has been modified and brought back to its initial position. Briefly, hysteresis occurs in non-linear models that exhibit multiplicity of equilibria and the remanence property. On the other hand, 'unit root persistence' lacks the remanence effect with asymmetric persistence and occur mainly in linear models. The occurrence of hysteresis in unemployment implies the non-uniqueness and the path-dependence of the natural rate.

Two forms of hysteresis are well documented: the weak form at the micro (individual agent) level and the strong form (aggregation of a large number of heterogeneous[6] agents) at the macro level. The path dependence property, used by Blinder (1988), was described as (in the hysteresis section) "*... for these (models) bring Keynesian economics* [in which the economy can get stuck in low level production] *with a vengeance*"[7] [our emphasis]. Also, it revives the Phillips curve trade-off (between inflation and unemployment) not in levels but in first differences.

3 IMPLICATIONS for POLICY ANALYSIS

The concept of the natural rate of unemployment - since its introduction by Friedman in an analogy to Wicksell's concept of the natural rate of interest and its formulation by Phelps - applies the doctrine of monetary neutrality to the unemployment level. Monetary policies are said to be neutral if they only affect nominal variables and have a transient effect on the unemployment rate which converges sooner or later to its natural level. Such monetary neutrality is usually taken to occur only in the long run but not in the short run. As Friedman put it " It [the natural rate] is the level that would be ground out by the Walrasian system of general equilibrium equations." In the early 1950's and through the 1960's and 1970's, the Phillips curve became the major policy trade-off between inflation and unemployment.[8] However, the experience of stagflation in the 1970's cast some doubts on the usefulness of the Phillips Curve and the natural rate of unemployment hypothesis as a policy tool and a policy goal. Many voices suggested correcting these hypotheses to explain what happened and a few went even further to discard the hypothesis (Blanchard et al., 1988; Goodinson et al., 1994). Hysteresis was adopted to explain the behavior of high unemployment even when the initial shock (supply shock) to the economy was removed. Hysteresis is an explanation of how the natural rate is affected by the disequilibrium path of the economy, and is contrary to both the Phillips Curve and the natural rate of unemployment hypothesis. Given hysteresis, the NAIRU would be unstable.

Hysteresis is not consistent with the natural rate hypothesis or within the classical doctrine of neutrality. When hysteresis is present, the short-run adjustment of the economy can take place over a very long period. The natural rate proponents tried to amend hysteresis

by postulating that the natural rate will be a strong attractor for actual unemployment in the long-run. However, the debate still goes on. A survey of the seminal contributions to the natural rate[9] hypothesis is presented later.

4 FACTORS AND THEORIES

The high unemployment rate in Europe and in Canada in the 1990s can be explained by labor market rigidities that cause high costs of adjustment for firms. To investigate such an explanation, the empirical agenda would rely on pin-pointing the factors that have caused wage and price equations to shift. The increase in unemployment could be due to the increase in unemployment insurance benefits measured by a generosity index or due to hysteresis. The debate on this is still open. If the actual unemployment rate is high because it is high relative to its natural rate, one should observe a decrease in inflation rates (a recessionary gap in aggregate demand / aggregate supply analysis); otherwise, one's intuition tends to suspect that the natural rate itself is high.

This section reviews the proposed factors in the literature that cause hysteresis and the theories that explain it. The factors can be classified into the following categories: 1) aggregate variables where long periods of low growth and investment decrease the potential of the economy, 2) human capital where a long spell of unemployment leads to deterioration of skills and work ethic and 3) the price mechanism where the wage-formation process, in wage bargaining context, is responsible for hysteresis. Correspondingly, the theories that explain hysteresis are:

1) Duration theory. This is concerned with the negative effects of unemployment du-

ration on the labor demand and the labor supply of the unemployed. The human capital theory explains it as follows. The longer an unemployment duration is, the less likely is an unemployed worker to be offered a job because firms hold the belief that the long-term unemployed are low-quality workers. In other words, if firms are using unemployment experience as a screening device, then unemployed persons with long unemployment durations are perceived as less promising candidates. Also, the longer the unemployment duration, the more discouraged the worker will become and the more likely the agent is to drop out of the labor force.

2) Insider-outsider theory. This is concerned with the loss of the influence on wage formation by the long-term unemployed. The so-called insiders (incumbent workers) possess market power in determining wages independently of the unemployment in the economy. The market power of the insiders is due to high labor turnover costs, which make it costly for firms to replace an insider by an outsider (an unemployed worker). This allows unions to influence wage determination. Insider-Outsider models are based not on human capital but on the differentiation between insiders and outsiders in a wage bargaining context (see Blanchard et al. 1986 for an exposition).

3) The capital stock theory. An adverse demand shock leads to a reduction in firms' capital stock. Firms may close plants or scrap capital (firms reaching the shut down point on their respective marginal cost function where, given the price, the marginal cost is lower than the average variable cost). This will cause unemployment to persist because firms can not suddenly open their plants, once the shock is removed and product demand increases.

4) Sectoral shifts as a mechanism for generating unemployment persistence (Lilien 1982). Regarding these shifts, Brainard and Cutler (1993, p. 222) provided a definition for real-

location shocks and aggregate shocks "Reallocation shocks are defined as changes in tastes or technologies that cause changes in the sectoral pattern of returns that are sufficiently large and persistent to induce shifts in the equilibrium distribution of capital among sectors. Aggregate shocks are defined as transitory shocks that have no lasting effects on the distribution of capital profitability across sectors." The sectoral shift hypothesis refers to those inter-sectoral shocks that are the primary cause of fluctuations in the aggregate unemployment rate. This sectoral view argues that aggregate monetary and fiscal policies (demand policies) are not appropriate cures for a high level of unemployment. Instead, the economy is in need of a supply-side policy to ease the transition of ex-workers across the sectors. The intuition is that a change in sectoral labor demand implies labor reallocation across sectors from the low demand one to the higher one. The consequence of a sectoral shift on economic theorizing is that most unemployment fluctuations are induced by these structural shifts within the economy and are better described as fluctuations of the natural rate itself.

5 EVIDENCE IN THE LABOR MARKET

In most textbook cases, hysteresis/persistence in a time series y_t is tested through the estimation of the following equation for a variable y_t,

$$\Delta \ln y_t = a + b\left[\ln y_{t-1} - (\alpha + \beta(t-1))\right] + \varepsilon_t \tag{1}$$

where t denotes the trend and Δ refers to the first difference linear operator. If y_t reverts toward its trend, then b is negative and non-zero. If it does not, then b is zero. Rewrite

equation (1) as in Romer (1996, p. 176),

$$\Delta \ln y_t = \alpha' + \beta' t + b \ln y_{t-1} + \varepsilon_t \tag{2}$$

where $\alpha' \equiv a - b\alpha + b\beta$ and $\beta' \equiv -b\beta$. As adopted in the literature, the usual hysteresis/persistence test is $H_0 : b = 0$ (permanent shock where y does not revert to trend and has a unit root). Note that testing $H_0 : b < 0$ is equivalent to testing for trend reversion (i.e., if the variable fluctuates around a deterministic trend).[10]

Many papers tested whether hysteresis is present in Canada, the U.S.A. and in many European countries. A selective review of the literature follows and for each the definition used is reported. Gordon (1989) used a simple version of a reduced-form equation. Formally, the underlying model was

$$\pi_t = \alpha \pi_{t-1} + \beta(U_t - U_t^*) \tag{3}$$

where π is the inflation rate, U is the level of unemployment and U^* is the natural rate of unemployment (or the NAIRU) obtained for the steady-state $\pi_t = \pi_{t-1}$. To add hysteresis, the model was amended by the equation,

$$U_t^* = \eta U_{t-1} + \gamma Z_t \tag{4}$$

Inserting the latter equation in the former one yields,

$$\pi_t = \alpha \pi_{t-1} + \beta(1 - \eta) U_t + \beta \eta \Delta U_t - \beta \gamma Z_t \tag{5}$$

where Δ denotes the difference operator and Z_t refers to a set of structural variables. Gordon defined full hysteresis as the case of $\eta = 1$, and persistence as $\eta < 1$. This study concluded that no evidence of full hysteresis was found in five countries (France, Germany, USA, Japan and U.K.) for the time period 1873-1986.

Fortin (1989; 1991) tested for the presence of hysteresis in Canadian data covering the period from 1957 to 1990. By adding and modeling expected inflation, Fortin was able to undertake a more accurate test for hysteresis. The Phillips curve tested in the form,

$$\pi_t = \alpha_1 \pi_{t-1} + \alpha_2 \pi_t^e + \beta[(1-\eta)U_t + \eta \Delta U_t] - \beta\gamma Z_t \tag{6}$$

where π_t^e denotes expected inflation. Fortin defined positive hysteresis as $\eta < 0$ and negative hysteresis as $\eta > 0$. The cases of $\eta = 0$ and $\eta = 1$ are no hysteresis and full hysteresis, respectively. Fortin (1991) reported the presence of negative hysteresis for the data from 1957 to 1972. Positive hysteresis was detected for the data covering the period from 1973 to 1990. Full hysteresis was not rejected for the latter period. Fortin pointed to the Canadian unemployment insurance benefits, productivity slowdown, and union density as possible sources for hysteresis.

Graafland (1991) reported that the labor market in the Netherlands in the 1980s was characterized by a high and persistent level of unemployment. The long-term unemployed made up more than 50 percent of total unemployment. This study investigated the relevance of the duration and insider-outsider theories in explaining hysteresis in the Netherlands. It used a small macro labor market model - consisting of four equations (Graafland 1991, p. 157) describing the dynamics of wages, employment, long-term unemployment and vacancies - and

estimated it using 2SLS for 1960-1987. The endogenous variables were: number of vacancies, real wage (deflated by consumer prices), labor demand (employment plus vacancies), long-term employment (over one year), actual employment and short-term unemployment. The exogenous variables were: the ratio of the value added prices of firms to consumer prices, labor productivity, the rates of income taxes and social transfers (as a fraction of wage costs), the labor force, the replacement ratios of short-term and long-term unemployed, the real value added of firms and a time trend. This study found evidence of duration effects after 1982 in the data. Lopez et al. (1996) reported that monthly unemployment in Spain was consistent with an insider-outsider model and hysteresis.[11] The data in this study was monthly, from 1977:6 to 1994:10.

Measuring shock persistence in time series can be divided into two major approaches. The first is the 'unit root' approach[12] presented by Nelson and Plosser (1982). Such an approach was heavily criticized regarding the low power of unit root tests and the failure to test for structural breaks. Most importantly, using Bayesian analysis, DeJong and Whiteman (1991) reversed the Nelson and Plosser results. The second approach is to use the Beveridge-Nelson decomposition[13] to assess the relative importance of the transitory and the permanent component in the time series. In empirical terms, it amounts to estimating an unrestricted low-order ARIMA.

Nott (1996) did not find evidence of hysteresis in Canadian data. Yet, a non-linear Phillips curve was not rejected. The method followed Fortin (1991) in testing for the presence of hysteresis by estimating a linear Phillips curve equation. The data covered the period from 1954 to 1995. Nott's results contradicted Fortin's findings of hysteresis and showed how sensitive the latter's results were to the sample period used.

Jones (1995) investigated the hysteresis hypothesis in Canadian data at the microeconomic and macroeconomic level. Hysteresis was defined as unit root in the unemployment series. He concluded that the overall picture is not one of hysteresis, but did not rule out the presence of considerable persistence (dependence) in unemployment rates.

Wilkinson (1997) investigated the hysteresis hypothesis in Canadian data using the Labor Market Activity Survey (LMAS). Defining hysteresis as irreversibility in the change of the unemployment rate and by testing evidence of negative duration dependence in unemployment spells, the study concluded that there is evidence of hysteresis at the micro level of the data. Wilkinson attributed the evidence of hysteresis to the loss of skills hypothesis of human capital (the human capital view is in section 4). The intuition is that prolonged periods of unemployment erode the skill level of the unemployed which decreases the probability of exiting the unemployment spell and finding a job. Therefore, unemployment spells will exhibit negative duration dependence.[14] Using the LMAS data, single-risk[15] hazard rates were estimated, then aggregated to estimate hysteresis at the macro level. The study concluded that hysteresis accounts for three percents to eight percents of the Canadian unemployment rate. This small upperbound points to the difficulty of estimating hysteresis in the aggregate data.

However, Heckman and Singer (1984) argued that negative duration dependence of exit rates in the data is by no means a signal of persistence. They examined econometrically the negative duration dependence view and showed that the existence of two types of jobs, good and bad (i.e., using the dual labor market theory), creates unobserved heterogeneity in aggregate unemployment data. This heterogeneity will always bias the estimated hazards towards negative duration dependence. Therefore, negative duration dependence might be a

signal of unobserved heterogeneity and not of persistence in the data. Recently, Coate and Morris (1999) studied why might economic policies persist wherein they defined persistence as non-steady state reversion.

Hence, while there is no consensus on the definition of hysteresis, empirical evidence of the existence of hysteresis (each author with a distinct definition) is mounting.

6 CONCLUSIONS

For a practical definition of unemployment persistence in dealing with the data, we suggest a two-period definition. 'Unemployment persistence' be taken to occur if the 'effect of a shock is felt for a minimum period of two periods'. Locking the definition of persistence to the commonly used first order auto-regressive coefficient emphasizes a deficiency in any definition. Questions without answers arise: How high should the estimated coefficient be for the series to be considered as persistence. What are the (lower/higher) boundaries for the estimated coefficient to be considered as a sign for persistence? Given that Amble et al. (1994) showed that it is impossible to assimilate zero-root dynamics to hysteresis, we adopt the two-period definition that is proposed in this paper. This definition unleashes a set of explorations into the decomposition and identification of the time series process itself.

Document Word Count (including References): 3938.

Date: October 27, 2003.

Notes

[1]See Wolfgang (1990) for the source of the definitions.

[2]A term frequently used in economic context.

[3]See Cross and Allen (1988).

[4]See Wolfgang (1990, pp. 19-34) for the complete set of references.

[5]A special case of the 'zero root dynamics' in physics.

[6]Called 'hysteron'.

[7]Also, from the conclusion section "... and hysteresis seems to characterize some economies some of the time, not all economies all the time ...".

[8]For a survey of the evolution of the natural rate hypothesis, see Goodinson and Frohlich (1994).

[9]Note that the mechanics of measuring the natural rate of unemployment is not of interest here.

[10]See Nickell (1985, p. 119).

[11]Hysteresis is defined as in Blanchard and Summers (1986).

[12]Nelson and Plosser (1982) were the first to consider persistence of the fluctuations in aggregate variables. In general, if the fluctuations of the variable are around a deterministic trend, then the variable growth will be less (more) than normal when it is above (below) trend.

[13]The Beveridge-Nelson decomposition states that the first difference of an integrated process of order one, can be decomposed into a sum of a random walk, an initial condition and a stationary process.

[14]See Kiefer (1988, p. 652), and Lancaster (1990, p. 9, figure 1.1.(b), p. 10 and p. 39).

[15]Single-risk hazard rates occurs when no distinction between transition to work or transition to out of the labour force is made.

References

[1] Amable, Bruno. Jérôme Henry and Richard Topol. (1994) "Strong Hysteresis versus Zero-Root Dynamics," *Economics Letters* 44: 43-47.

[2] Bladwin, Richard E. (1988) "Hysteresis in Import Prices: The Beachhead Effect," *American Economic Review* 78: 773-785.

[3] Baldwin, Richard E. (1990) "Hysteresis in Trade," Studies in Empirical Economics; *Hysteresis Effects in Economic Models*. (Ed.) Wolfgang Franz, Physica Springer; New York.

[4] Blanchard, Olivier Jean. and Summers, Lawrence H. (1986) "Hysteresis and the European Unemployment Problem," in S. Fischer (Ed.), *NBER Macroeconomics Annual 1986*, Cambridge MA (MIT Press): pp. 15-78.

[5] Blanchard, Olivier Jean. and Summers, Lawrence H. (1988) "Beyond the Natural Rate Hypothesis (in Why is Unemployment So High in Europe?)," *The American Economic Review*, Papers and Proceedings of the One-Hundredth Annual Meeting of the American Economic Association 78 (2): 182-187.

[6] Blinder, Alan S. (1988) "The Fall and Rise of Keynesian Economics," *Economic Record* 64 (187): 278-294.

[7] Brainard, Lael S. and Cutler, David M. (1993) "Sectoral Shifts and Cyclical Unemployment Reconsidered," *The Quarterly Journal of Economics* 108 (1): 219-243.

[8] Coate, Stephen. and Stephen Morris. (1999) "Policy Persistence," *The American Economic Review* 89: 1327-1336.

[9] Cross, Rod. and Allan, Andrew. (1988) "On the History of Hysteresis," *Unemployment, Hysteresis and the Natural Rate Hypothesis*, (Ed.) Rod Cross, Blackwell Publishing, Oxford and New York, pp. 26-38.

[10] DeJong, David N. Ingram, B.F. and Whiteman, C.H. (1996) "A Bayesian Approach to Calibration," *Journal of Business and Economic Statistics* 14 (1): 1-9.

[11] Engel, Robert F. and Issler, Joa̋o Victor. (1995) "Estimating Common Sectoral Cycles," *Journal of Monetary Economics* 35: 83-113.

[12] Fortin, Pierre. (1989) "How 'Natural' is Canada's High Unemployment Rate?," *European Economic Review* 33: 89-110.

[13] Fortin, Pierre. (1991) "The Phillips Curve, Macroeconomic Policy and the Welfare of Canadians," *Canadian Journal of Economics* 24 (November): 774-803.

[14] Goodinson, Steven and Frohlich, Jonah. (1994) "A Survey of the Natural Rate of Unemployment," *McGill Journal of Political Economy*, McGill University Press, 81-110.

[15] Gordon, Robert J. (1989) "Hysteresis in History: Was There Ever a Phillips Curve?," *American Economic Review*, Papers and Proceedings 79 (2): 220-225.

[16] Graafland, J.J. (1991) "On the Causes of Hysteresis in Long Term Unemployment in the Netherlands," *Oxford Bulletin of Economics and Statistics* 53 (2): 155-170.

[17] Hall, Robert E. (1998) "Labor-Market Frictions and Unemployment Fluctuations," *National Bureau of Economic Research,* Working Paper Series no. 6501.

[18] Heckman, James J. and Singer B. (1984) "Econometric Duration Analysis," *Journal of Econometrics* 24: 63-132.

[19] Jones, Stephen R.G. (1995) *The Persistence of Unemployment.* McGill Queen's University Press, Canada.

[20] Kiefer, Nicholas M. (1988) "Economic Duration Data and Hazard Functions," *Journal of Economic Literature*, XXVI (June): 646-679.

[21] Lancaster, Tony. (1990) *The Econometric Analysis of Transition Data.* Cambridge University Press; Cambridge, U.K.

[22] Langot, François. (1996) "Do We Need a Hysteresis Model to Explain the Unemployment Persistence?," *Annales d'Économie et de Statistiques* 44: 30-57.

[23] Lilien, David M. (1982) "Sectoral Shifts and Cyclical Unemployment," *Journal of Political Economy*, 90 (4): 777-793.

[24] Lopez, Humberto. Ortega, Eva and Ubide, Angel. (1996) "Explaining the Dynamics of Spanish Unemployment," *Working Papers in Economics*, no. 96/14, European University Institute (EUI).

[25] Nelson, Charles R. and Plosser, Charles I. (1982) "Trends and Random Walks in Macroeconomic Time Series: Some Evidence and Implications," *Journal of Monetary Economics*, 10: 139-162.

[26] Nickell, Stephen. (1985) "Error Correction, Partial Adjustment and All That: An Expository Note," *Oxford Bulletin of Economics and Statistics*, 47 (2): 119-129.

[27] Nott, Loretta. (1996) "Hysteresis in the Canadian labour market: Evidence from the 1990s," *Research Report* no. 9605, Department of Economics, University of Western Ontario.

[28] Riddell, Graig W. (1986) "Dealing with Inflation and Unemployment in Canada," *Royal Commission on The Economic Union and Development Prospects for Canada,* University of Toronto Press, Toronto.

[29] Romer, David. (1996) *Advanced Macroeconomics.* McGraw-Hill Advanced Series of Economics, The McGraw-Hill Companies, Inc.; New York.

[30] Sims, Christopher. Robert Solow. R. A. Gordon and Robert Hall (1975) "The Rigidity of Wages and the Persistence of Unemployment. Comments and Discussion," *Brookings Papers on Economic Activity* 75: 336-349.

[31] Wilkinson, Gordon. (1997) "Micro-Approach to Hysteresis in Unemployment," *Working Papers*, Bank of Canada, no. 97-12.

[32] Wolfgang, Franz. (1990) *Hysteresis effects in economic models*. Studies in Empirical Economics, Physica-Verlag Heidelberg.