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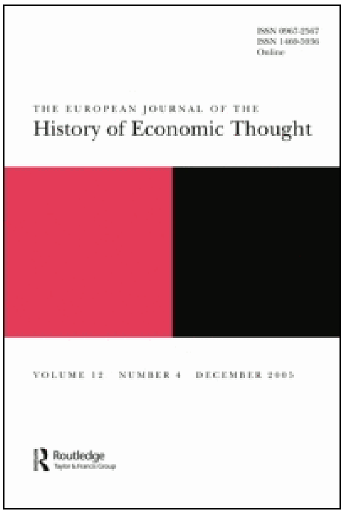

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Peter Rodenburg

1. Introduction

Ever since John Stuart Mills's (1848) *Principles of Political Economy* and John Neville Keynes's (1890) *The Scope and Method of Political Economy*, economic science has been perceived as a deductive science. Particularly since the rise of axiomatized neoclassical microeconomics in the 1870s and the demise of inductive approaches, such as Schmoller's German Historical School, economics became overly deductive in nature. Philosophers of science, however, may argue that induction is able to provide a richer approach to science than deduction, as inductive inference can provide us with novel insights and amplify and generalize our experience. Inductive inference is, therefore, as philosopher Charles Pierce (1931–1966, vol. 2, book 1) puts it, ampliative, whereas with deduction we can never get more out of the arguments (axioms) than we put in.

In 1958, two novel empirical relationships came into being in macroeconomics in an – apparently – inductive way, both of which had a substantial impact on economic thinking: the Phillips curve and the Unemployment–Vacancy (UV) curve (or the Beveridge curve as it was

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named in the 1980s after William Beveridge). The UV curve features the inverse relation between unemployment and vacancies in an economy. Since the UV curve was meant in the first place as a practical measurement device to guide economic policy, its place in economic theory was not immediately clear and the novel features and insights of the UV curve forced economists to rethink macroeconomics and incorporate these insights into (mainstream) economic thinking.

Whereas the history of the Phillips curve, its impact on and its place in economic thought are well documented in the relevant literature,[1] a thorough analysis of the impact of the UV curve on economic thought seems to be missing from the literature. This is even more remarkable since the place and role of the UV curve in economic thinking has changed radically over the decades since its first appearance. The purpose of this paper is therefore to provide such an analysis and to investigate a rare case where – apparent – inductive inference gave rise to novel insights, which puzzled economists and forced them to theorize.

The paper is organized as follows. In order to gain a good understanding of the place and influence of the UV curve, Section 2 will analyse how and why the UV curve came into being in the first place. Section 3 analyses the impact of the UV curve on economic theory. This section discusses the various attempts to incorporate the simultaneous occurrence of unemployment and vacancies in economic theory and to provide a theoretical foundation for the UV relation. It also treats the rivalry with the Phillips curve. Section 4 discusses the stability of the UV curve debate, whereas Section 5 analyses the rise of a new paradigm – search theory and matching models – that relies on the UV curve as an axiom for deduction. Finally, conclusions are drawn in section 6.

2. The birth of the UV curve

The UV curve originated from the work of two British economists, Dow and Dicks-Mireaux (DDM), in 1958.[2] In their seminal paper 'The Excess Demand for Labour: A Study of Conditions in Great Britain, 1946–1956',[3] they sought to establish a measure for excess demand, as they were primarily concerned about inflation in the goods market. In the post-war

1 See, for example, Leeson (2000).

2 At that time, DDM were associated with the National Institute of Economic and Social Research (NIESR) in London, an independent, non-profit organization founded in 1938.

3 A slightly rewritten summary of this article can be found in Dow (1970: 337–43).

period, Keynesianism was the dominant paradigm, and economists held a strong belief in aggregate demand management by the government. However, in the 1950s the British unemployment rate was very low, around 1.5% on average, and, in such a situation, fluctuations in aggregate demand could easily lead to inflation. DDM therefore sought an indicator that could guide Keynesian fiscal policy in such a way that unemployment could be removed if necessary while avoiding inflation. They suggested using data on vacancies and data on unemployment in order to measure excess demand in the labour market as an indicator for the excess demand in the goods market, since the data on unemployment represent excess supply of labour in the labour market, and those on vacancies represent excess demand for labour. The application of this simple idea was possible for Britain since data for both vacancies and unemployment were available. The collection of (trade union) unemployment data had begun in the nineteenth century, while the British Government had collected data on unfilled vacancies from notification at labour exchanges since 1946. By 1958, DDM had available an 11-year time series of both vacancy and unemployment data for Britain. Vacancy data are, however, notorious for their incompleteness for two reasons. First, unlike unemployment, where unemployed workers have a strong financial incentive to register as unemployed, there are no direct financial incentives for firms to report vacancies or penalties for not reporting vacancies. Secondly, unlike unemployment, there are no checks on double-counting where vacancies are advertised at more than one labour exchange, or on undercounting where one vacancy is posted for a number of workers performing the same task. Moreover, firms could be disappointed by the previous mediation of labour exchanges, and look for other ways of hiring workers. William Beveridge (1944: 88) therefore argues that: 'the vacancies notified to the exchanges and not filled by them do not necessarily remain unfilled and cannot be taken as a measure of unsatisfied demand; most of them get filled in other ways'. DDM argue, however, that although there are good reasons to distrust the vacancy numbers, there are also reasons to have a certain confidence in the variation in vacancy numbers. The recording of vacancies might be incomplete, they argue, but the *behaviour* of vacancies shows that vacancy statistics can be considered as rather reliable indicators. This is especially clear when the behaviour of vacancies is compared with that of unemployment (see Figure 1; in panel (b), data are seasonally corrected and the unemployment curve is inverted).

The two curves exhibit a remarkable inverse relationship, which leads DDM to conclude: 'These observations give one a certain confidence in the vacancy statistics' (1958: 2). Thus, although vacancy data are probably incomplete and therefore do not give accurate information about the

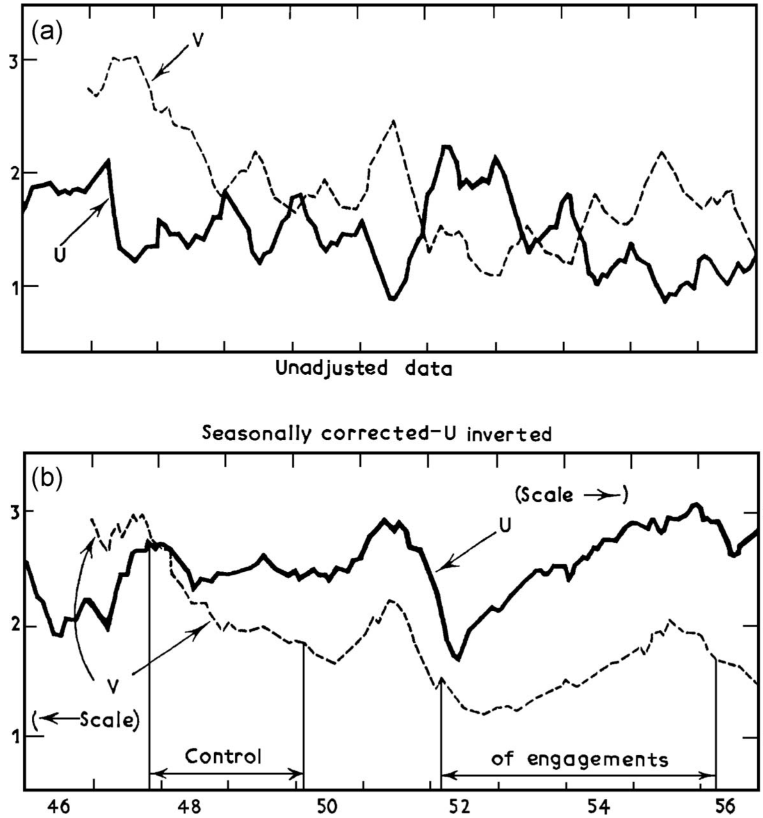

Figure 1 Unemployment and vacancy rates, 1946 to 1956 (percentage, Great Britain)
Source: Dow and Dicks-Mireaux (1958: 3)

absolute number of vacancies, they can be used to give an *ordinal* measure of excess demand rather than a cardinal measure.[4]

4 In addition, DDM employed two tests of unemployment and vacancy data, and found indications that the measurement error of vacancies is fairly stable. First, they compared the effect of seasonal changes on vacancies with the effect of seasonal changes on unemployment. The amplitude of the seasonal variations turned out to be of the same order, suggesting a stable measurement error (DDM 1958: 26). Second, DDM considered changes in notification of vacancies when the statutory regulations for labour exchanges changed. For the period 1946 to 1956, there were two periods when notification of vacancies to labour exchanges was compulsory in the UK: October 1947 to March 1950 and

An important feature that DDM assumed about the behaviour of unemployment is that unemployment below a certain level would be decreasingly sensitive to demand. That is, a further increase in demand should lead to a disproportionately small decline in unemployment rates (and *vice versa* for vacancies). DDM base that assumption on the rationale that when 'demand increases, *u* will decrease continuously [. . .], but since it cannot shrink below zero it must be supposed to become decreasingly sensitive' (DDM 1958: 20). DDM point out, however, that it can also be observed empirically in the downswing of 1952 and the boom of 1955. According to DDM, this feature is better observed when the data are presented in UV space and successive observations are connected (Figure 2).

Following this rationale, DDM derive an idealized UV curve as a rectangular hyperbola (Figure 3). This idealized UV curve has the following

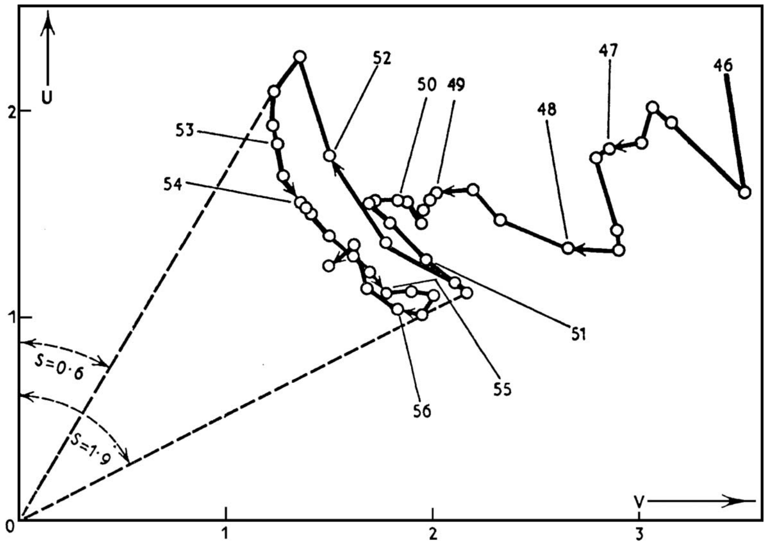

Figure 2 Relation between unemployment and vacancy rates for Great Britain, 1946 to 1956 (seasonally corrected quarterly figures)
Source: Dow and Dicks-Mireaux (1958: 4)

February 1952 to April 1956. However, the change from voluntary to compulsory notification had only a modest effect on the rate of notified vacancies. DDM again interpret this as evidence that the measurement error in measuring vacancies is fairly stable.

features. Firstly, it has an inverse relation between vacancy and unemployment rates. When the economy is in recession (point 1), it experiences high unemployment rates and low vacancies rates; and *vice versa* in an upswing (point 3). Each point on the UV curve represents a different degree of aggregate demand, and, across the various stages of the business cycle, the economy moves along the idealized UV curve. Secondly, the hyperbolic and convex shape of the UV curve represents the feature that a further increase in demand leads to a disproportionately small decline in unemployment rates. This 'increasing insensitivity of unemployment', as DDM called it, clearly resembles the neoclassical idea of decreasing returns to input factors as found in production and utility functions. Later empirical studies estimate this hyperbolic UV relation as $\log v = \beta_0 + \beta_1 \log(1/u) + \varepsilon$. Thirdly, different degrees of *maladjustment* (structural unemployment) correspond to different idealized UV curves, further from or closer to the origin.

The idealized curve does not seem to follow easily from all the observations. The data from 1946 to 1950, for example, do not fit the hyperbolic-shaped UV curve at all (see Figure 2). DDM therefore conclude that the observations from 1946 to 1950 do not lie on the UV curve because of shifts in the level of maladjustment m; that is, *changes* in the kind of labour supplied and that demanded. DDM attribute the causes of maladjustment to skill mismatch, geographical maldistribution, seasonal variations in demand and the effect of turnover of labour between firms. The level of maladjustment m is defined as the level of unemployment where unemployment u equals the 'true number of vacancies' v/s. That is, the vacancy rate v should be corrected for the measurement error or 'statement error' s, due to underestimation or overestimation of vacancies; thus with s defined as:[5]

$$s = \frac{\text{unfilled vacancies reported to labour exchanges}}{\text{true number unfilled vacancies}}$$

At this point there is no excess demand d.

The convenience of the assumption that the UV curve is a rectangular hyperbola is that it relates u, v, s and m in an easy way, which makes it possible to derive either excess demand d or the level of maladjustment m. Given an estimate of s and the level of maladjustment m and observations of u and v, excess demand d can easily be calculated from the relation

5 Maladjustment is then defined as the amount of unemployment at the point where $u = v/s$ (DDM 1958: 20) and is thus measured in terms of the corresponding unemployment rate.

$d = m - u$. Clearly, (changes in) the value of the statement error s could significantly influence the measurement outcomes. For the moment, we will assume s to be unity.

After deriving an idealized UV curve, DDM construct a line of zero excess demand. Under the assumption that employers give correct statements about their vacancies (thus conditional on $s = 1$), this is an upward sloping line through the origin at a 45° angle that separates the areas of excess supply and demand for labour. Each point on that line corresponds to a case where unemployment equals unfilled vacancies. These two constructs enabled DDM to measure excess demand for labour according to the following general principles (DDM 1958: 5–6):

(i) Vacancies and unemployment rates are plotted in a UV space. Vacancies have to be corrected for the degree of overestimating or underestimating to give the real vacancies rate v/s.
(ii) Zero net excess demand is defined as all situations where $u = v/s$, and corresponds to the 45° line through the origin.
(iii) Successive points on the 45° line correspond to different degrees of maladjustment.
(iv) For any given degree of maladjustment, there will be a series of points corresponding to different degrees of demand and lying on a curve convex to the origin. (Thus, for the degree of maladjustment measured by u_2 (Figure 3), there will be points 1, 2, 3, ...).
(v) Excess demand is measured as vacancies less estimated maladjustment.

Thus, for example, at point 3 in Figure 3, the excess demand can be measured as $v_3 - v_2$. For situations of net deficient demand, like point 1, deficient demand is measured as estimated maladjustment less unemployment; that is, $u_1 - u_2$. For the year 1956, for example, DDM find that a vacancy rate of 1.7% was offset by an excess supply of labour of 1.2%, yielding a net excess demand of 0.5%. Therefore, vacancies up to 1.2% refer to the level of maladjustment, since they can be matched by an equal amount of labour.

For assessing the reliability of their measurement procedure, DDM's concern was not the shape or convexity of the UV curve, but ignorance about the statement error s. In particular, they mention three sources of imprecision, all of which seem to relate to ignorance about the statement error s. First, DDM point out that the statement error affects the net zero demand locus, since it should be redefined as $u = v/s$ when the statement error is taken into account (DDM 1958: 20). When s is not unity, the $u = v/s$ locus will have a slope greater or smaller than 45°. Without precise

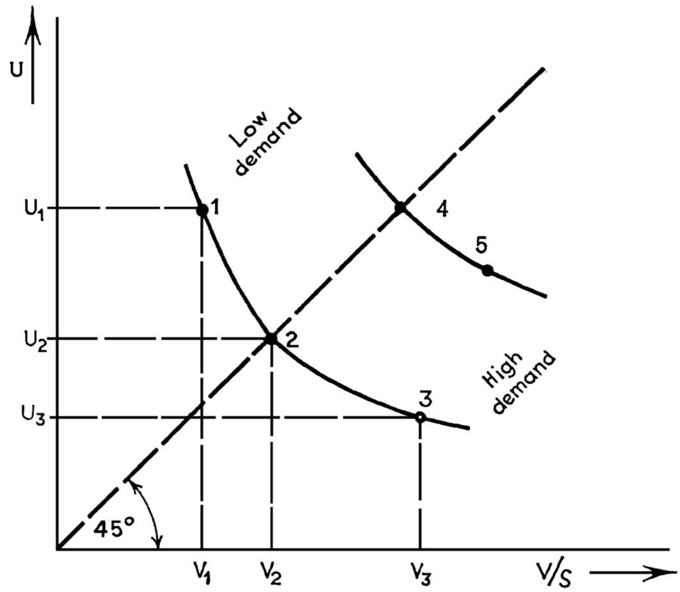

Figure 3 Idealized UV relation (where v/s is the adjusted vacancy rate; see text)
Source: Dow and Dicks-Mireaux (1958: 4)

knowledge about *s*, the intersection of the net zero demand locus and the UV curve cannot be identified exactly. Second, apart from changes in demand, both changes in the statement error and changes in maladjustment affect unemployment and unfilled vacancies. However, if the statement error is unknown, it becomes impossible to distinguish between changes in the statement error and changes in the degree of maladjustment. Finally, the statement error itself might be a function of demand. For example, in times of a slack labour market, employers may not even report vacancies at labour exchanges at all since they are easily filled. The two tests on the vacancy data (see footnote 4) enabled DDM to conclude that the statement error is stable and close to unity. A unity value of *s* implies that the zero net demand line can be considered to have a slope of 45°, and that the statement error is unlikely to be a function of demand (DDM 1958: 28). This consequently enabled them to conclude that the shift in the pre-1950 data was caused by a shift in maladjustment.

DDM's measurement procedure clearly pivots critically around the derivation of the hyperbolic-shaped UV curve. The step from the observations in Figure 2 to the idealized curve in Figure 3 is crucial, and another curve would have induced different measures of excess demand. DDM acknowledge this point (in their appendix) and reckon that other curves would be possible, as they argue (about Figure 2): 'Any curve, of whatever shape, which falls from left to right will preserve the correct ranking of observations', but 'a curve like a rectangular hyperbola seems plausible' (DDM 1958: 22); most probably on grounds of the familiarity with utility and production functions. The UV curve, therefore, seems not to come into existence by entirely inductive inference alone.

3. The impact of the UV curve on economic theory

The UV curve was put forward by DDM as a practical measurement device to guide economic policy. Its place in economic theory was therefore not immediately clear. The UV curve obviously had some attractive features, in the sense that it provided a macro-framework showing that unemployment and vacancies coexist simultaneously in the absence of excess demand, or that some unemployment will exist even at very high levels of demand, but its explanatory power was low since it provided no new insights, other than those that already existed, about what mechanisms caused the simultaneous existence of unemployment and vacancies. More importantly, although the UV curve was empirically supported, there was no theoretical foundation for it.

In retrospect, several effects of the introduction of the UV curve in economics can be distinguished; the most important ones seem to me to be the following four. Firstly, it introduced a method, which later became known as UV analysis, for the decomposition of unemployment into different types for the guidance of economic policy. This was clearly consistent with DDM's purpose of performing measurement for guiding Keynesian policies. Secondly, both the UV curve and the Phillips curve were used to clarify the post-war policy debate on 'full employment' that was instigated by Keynes's *General Theory* and Beveridge's *Full Employment in a Free Society*. Although the empirical and theoretical relation between the UV curve and the Phillips curve was not clear, both curves were interpreted to bear (implicit) contradictory notions of the full employment level of unemployment. Thirdly, the simultaneous coexistence of unemployment and vacancies was at odds with neoclassical notions of market clearing. It was, for example, not clear how this UV curve should be explained in a simple Marshallian supply and demand analysis. The growing awareness that labour markets may not clear as instantaneously as perhaps other markets necessitated a theory of simultaneous coexistence of unemployment and vacancies in equilibrium. Finally, it gave, in the 1980s, a strong impetus and empirical support to new equilibrium theories of labour markets, such as search theory and matching models of unemployment. Important contributions to these theories were made by, among others, economists at the London School of Economics (LSE). The first three issues will be examined in closer detail in this section. The fourth issue – the role and use of the UV curve in search and matching models – turned out to dominate contemporary labour economics, and will be discussed in full in Section 5.

3.1 UV analysis and the decomposition of unemployment

Economists of the NIESR in London, familiar with the UV framework through the work of NIESR-member Dow, made further contributions to the UV-curve framework and applied it to regional studies in their empirical work.[6] In October 1966, the NIESR began a study on regional economic development in Great Britain.[7] The original idea was:

> to provide a measure of the differences of degree of imperfection between the labour markets of the United Kingdom regions: we wanted to be able to say something about the extent to which the regions' different rates of unemployment could be attributed to differences in labour market imperfections, as opposed to differences in effective demand. (Brown 1976: 134)

Therefore, they used an analysis of u and v data for both regions and industries as the framework for these regional studies and called this approach 'UV analysis' (Brown 1976: 134). They identified the level at which unemployment and vacancies are equal for regions or industries as the level of non-demand deficiency unemployment, and considered this a measure of the inefficiency of regional labour markets. The contribution of the NIESR lies in the fact that they further decomposed the non-deficient demand component of unemployment into a structural (u_s) and a frictional (u_f) component of unemployment, so that a classification arose that corresponded to the 'traditional' classification; a division of unemployment into frictional, structural and deficient demand unemployment.

At the sector level, the level of structural unemployment u_s is determined as the difference between excess supply and demand of labour per sector of the economy (industry or region), while the level of frictional unemployment is the minimum of unemployment and vacancies for each sector. At the aggregate level, for example, for a two-industry economy with

6 Members of NIESR in the late 1960s and early 1970s were, among others, Arthur Brown, David Worswick, John Bowers, Paul Cheshire, Edward Webb and Robert Weeden.

7 The results were presented in Brown (1972), Cheshire (1973), Weeden (1973, 1974), and Webb (1974), while the framework is explained in close detail in Cheshire (1973).

unemployment U_1 and U_2 and vacancies V_1 and V_2 in the respective industries, and $V_1 > U_1$ and $V_2 < U_2$, aggregate frictional unemployment is defined as the sum of $u_f^1 + u_f^2 (= U_1 + V_2)$, and aggregate structural unemployment as the minimum of differences between U_i and V_i, thus as $u_s^1 (= V_1 - U_1)$ or $u_s^2 (= U_2 - V_2)$, whichever is the smaller. Demand deficiency unemployment is $(U_1 + U_2) - (V_1 + V_2)$ (Cheshire 1973: 13).

Armstrong and Taylor (1980) suggest decomposing structural unemployment even further into a geographical, an occupational and a simultaneous occupational–geographical component for regional studies. Thirlwall (1969) provides an analytical treatment of this approach. Based on these measures of classes of unemployment, the NIESR (Cheshire 1973) derives a conceptual framework using the simplifying assumption of a fixed level of frictional unemployment. This idea of frictional unemployment as 'frictions within sectors' and structural unemployment as 'frictions between sectors' is often found in labour market studies in the 1970s.

In the 1970s, UV analysis reached the highest stage of its popularity, and most studies date from this era. UV analysis turned out to be a very simple and easy-to-use device for analysing the nature of unemployment. In most studies, unemployment was decomposed into two classes – deficient demand and non-deficient demand – so the UV analysis indicated which part of unemployment was caused by deficient demand and could be removed by Keynesian expansionary policy.

With respect to the use of UV analysis, two aspects are noteworthy. Firstly, UV analysis seems to have been most popular in Europe, most notably in Great Britain, and Japan. For the US, there do not seem to be many studies. This is likely to be attributed to the fact that, in the US, the preferred framework for analysis of unemployment was the Phillips curve and concepts derived from it, such as the natural rate of unemployment. Secondly, UV analysis was particularly popular for regional studies.[8]

3.2 Notions of full employment and the relation with the Phillips curve

Although DDM never made the claim explicit, the UV-curve analysis bears an implicit notion of full employment in terms of equilibrium between *excess* supply and demand for labour, which lies at the intersection of the UV curve and the 45° line. This does not correspond, however, with the neoclassical definition of an equilibrium outcome in terms of equilibrium between total aggregate supply and demand of labour with an implicit reference to an equilibrium wage rate. It is rather more akin to the

8 See, for example, Cheshire (1973), Webb (1974) and Armstrong and Taylor (1980).

definition of full employment of William Beveridge, who expressed full employment in terms of unemployment and vacancies as 'having always more vacant jobs than unemployed men, not slightly fewer jobs' (1944: 18).

The Phillips curve provides other operational definitions of full employment and the way to achieve it.[9] Two important definitions are those of Lipsey and Friedman. Lipsey (1965) defines full employment as the lowest level of unemployment that could be attained given the government's dual policy targets: both an acceptable rate of inflation and an acceptable rate of unemployment. These dual policy targets can be represented as indifference curves from the origin (the dotted lines in Figure 4). Full employment is then derived as the minimum combination of both acceptable inflation and unemployment; that is, where an indifference curve and the Phillips curve coincide (point *a*). Unemployment rates above the level of point *a* (full employment) are considered deficient-demand unemployment (u_d), which the government can reduce by an expansionary fiscal policy. In Lipsey's account, full employment is thus subjectively determined by the government's preferences. In full employment, the remaining unemployment consists of both frictional unemployment (u_f) and structural unemployment (u_s). In Lipsey's account, the government might be able to reduce the level of full employment by the reduction of structural unemployment (u_s). This implies a shift of the Phillips curve to the left until a lower full employment state is realized at a lower indifference curve at

9 The relation between the Phillips curve and the UV curve was formally derived as follows. The UV curve can be written as:

$$v = \gamma \frac{1}{u} \qquad \gamma > 0. \tag{n1}$$

The increase in wages can be written as a function of excess demand for labour: $\Delta w = f(XD)$. With the difference between vacancies and unemployment taken as excess demand, this relation becomes:

$$\Delta w = \alpha(v - u) + \beta. \tag{n2}$$

Substituting Equation (n1) into Equation (n2) then gives:

$$\Delta w = \frac{\alpha\gamma}{u} - \alpha u + \beta. \tag{n3}$$

which is the original 1958 Phillips-curve relation; that is, the relation between wage increases and unemployment.

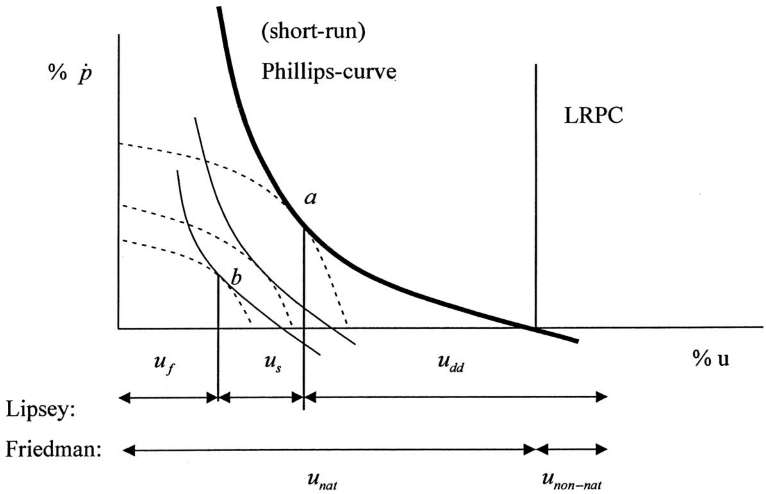

Figure 4 Classification of unemployment according to Lipsey and Friedman
Note: LRPC, long-run Phillips curve
Source: Based on Lipsey (1965)

point *b*. Shifts of the Phillips curve to the left could be brought about by, for example, 'reducing inequalities in excess demand between various labor markets, and reducing the time taken in changing the supply of labor into the form in which it was being demanded' (Lipsey 1965: 213). The trade-off of costs and benefits of policy measures, such as retraining the unemployed, determines the level of reduction of structural unemployment. The level of frictional unemployment, however, is exogenous and therefore unavoidable.

Friedman (1968) provides another operational definition of full employment based on what is now known as the long-run Phillips curve. Friedman (1968) and Phelps (1967) deny the existence of a long-run trade-off between unemployment and inflation. Workers form expectations about future inflation, and, when they realize they will be fooled by decreases in real wages as a consequence of inflation shocks, they will withdraw labour from the market. The long-run Phillips curve is therefore vertical and unemployment cannot be pushed below its 'natural rate' (u_{nat}). Long-run equilibrium in the labour market can only exist when there is equilibrium in both the labour and the financial markets.

Obviously, the different frameworks – UV curve and Phillips curve – bear different and conflicting notions about the nature of equilibrium and full employment. Figure 5 presents the relation between the notions of Lipsey, DDM and Friedman, and their corresponding levels of full employment. It will be clear that in all accounts the exact level of full employment is primarily determined by the position of the empirical UV or Phillips curve.

3.3 The UV curve in a Marshallian framework

The simultaneous existence of unemployment and vacancies seems at odds with the Marshallian supply and demand framework. Hansen (1970) integrates elements of Gordon (1966) and Holt and David (1966) to provide a comprehensive, neoclassical theory of friction in a supply and demand framework, and shows that unemployment and vacancies can coexist in theory. The starting point for Hansen is the division of the labour market into homogeneous and frictionless submarkets, where on each submarket there only exists excess supply or excess demand for labour (in the same way as the NIESR did). Frictions, however, do exist between submarkets, and unemployment can still exist since excess demand in one submarket cannot

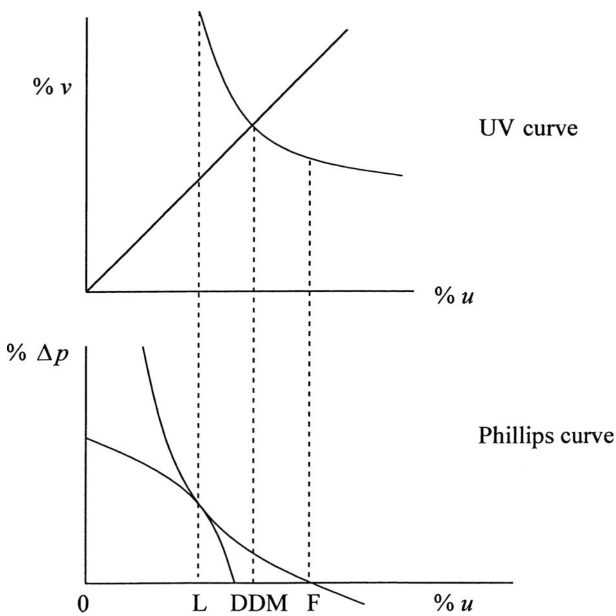

Figure 5 Relation between concepts of full employment in UV-curve and Phillips-curve frameworks
Note: L, Lipsey; F, Friedman
Source: Based on Gordon (1966)

be matched by excess supply in another submarket.[10] Submarkets thus have excess supply or demand and, according to Hansen, this means:

> that actual unemployment is never *on* the supply curve (if the wage rate is below equilibrium) or the demand curve (when below equilibrium), but let us assume, to the left of both the demand and supply curve. (Hansen 1970: 6)

This is represented in Figure 6 in an ordinary wage–labour diagram.[11] If wage w_1 is above the market-clearing level w^*, unemployment arises corresponding to the distance KM, while vacancies exist equal to KL. At the market-clearing wage w^*, vacancies and unemployment are equal and correspond to NO, and, for wages below the market-clearing level w_2, an excess demand occurs with PR vacancies and PQ unemployment. The locus **EE** is referred to as the 'market-clearing path', and it relates the actual quantity of employment to the forces of supply and demand. The shape of the curve is based on the assumption that, as the pressure of demand increases, matching becomes easier. The distance between **EE** and the supply and demand curve thus represents DDM's 'degree of maladjustment' in the economy. Plotting vacancy rates against unemployment rates will yield the ordinary UV curve.

The NIESR presents the same phenomenon by plotting vacancies and unemployment against aggregate demand (Webb 1974; Brown 1976), yielding Figure 7. When demand for labour is low, such as in O, unemployment occurs corresponding to OA. Unemployment falls, according to line AL, when aggregate demand increases. For every new additional vacancy, there are many unemployed workers, and it will be easy to find an unemployed worker who meets the job requirements. However, after a certain point (point M), it will be harder to match and vacancies will exist as well as unemployment. Hence, in full employment (point L), there will exist an equal amount of unemployment and vacancies. When demand for labour further increases, vacancies will increase according to line *VV* and unemployment will fall along line *UU*.

3.4 The name Beveridge curve

As a final impact of the introduction of the UV curve, one might consider the honour it paid to William Beveridge, as the UV curve also became

10 All unemployment is thus structural unemployment since frictional unemployment is absent. Hansen's assumption of markets is akin to the Phelps–Lucas island paradigm, which was invented at about the same time and became a popular tool of analysis in search theory.

11 Bowden (1980) stresses that the real wage rate w / p would be more appropriate.

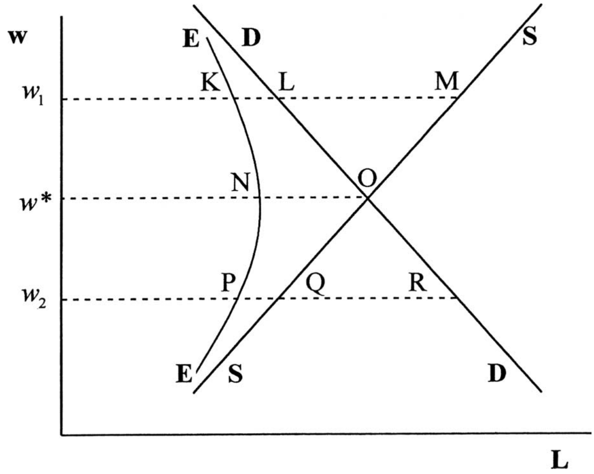

Figure 6 Employment function in an S–D diagram
Source: Based on Hansen (1970: 7)

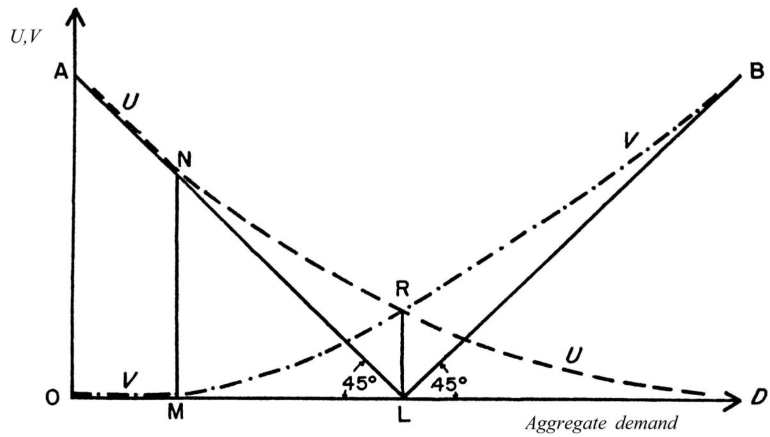

Figure 7 Demand for labour, unemployment and vacancies
Source: Brown (1976: 136)

known in economic theory as the Beveridge curve. The reason for this, as well as the origin, is not entirely clear. Obviously, Beveridge did analyse unemployment and vacancy data extensively, particularly in his 1944 book *Full Employment in a Free Society*. He did not, however, plot a graphical representation of the UV relation and DDM make no explicit reference to

Beveridge. The UV relation is only implied in Beveridge's work, in which he addressed many of the problems that the UV curve helped to analyse, such as mismatch between unemployment and vacancies, both at aggregate level and industry levels, trend versus cyclical changes and measurement problems of vacancies (Yashiv 2008). The name Beveridge curve appears to come into regular use in the 1980s but, after an intensive search, I have not been able to identify the exact origin of the term. This is consistent with Komine, who argues that: 'it is still obscure as to when and by whom the term was coined for the first time, and from what points in Beveridge's sentences he/she drew the idea' (Komine 2007: 5).[12]

4 The UV-curve stability debate

The work of DDM as well as theoretical analyses by Holt and David (1966) and Gordon (1966) inspired a series of empirical studies in the late 1960s and throughout the 1970s, estimating the relation between unemployment and vacancies. Cohen and Solow (1967) found a stable relationship between unemployment and vacancies;[13] however, almost immediately after Cohen and Solow's publication, other empirical studies found supposed 'breakpoints' in the UV curve, suggesting shifts of the curve further from or closer to the origin corresponding to higher or lower levels of structural unemployment. This obviously raised questions about the stability of the UV relation and the usefulness of the UV curve as a structural relation for economic analysis and measurement, and resulted in an enormous amount of empirical studies since the 1970s with an abundance of specifications of the UV curves, all of which incorporate additional variables, dummy variables or lagged variables. The discussion took place roughly speaking following national boundaries. The discussion in the US focused on the behaviour of the Help-Wanted Index[14] – as a proxy for vacancies – in relation to unemployment for US data for the

12 Translated from Japanese into English by Atsushi Komine in e-mail correspondence.

13 Solow's empirical study was motivated by the debate in the early 1960s that became known as the 'structuralist-deficient demand' debate, or, as it was sometimes referred to, the 'structuralist–antistructuralist' debate, on the nature of unemployment in the US. The claim of the structuralists was that the high unemployment in the US in the 1960s (around a 5% level) was caused by an increase in structural unemployment.

14 The Help-Wanted Index of the National Industrial Conference Board is a weighted average of indexes of the number of help-wanted advertisements posted in leading newspapers of 52 cities in the US.

period 1951 to 1966.[15] Cohen and Solow (1970) find a systematic pattern connected with business cycle fluctuations. During downswings, the regression overestimates the Help-Wanted Index and underestimates it in an upswing. This phenomenon, confirmed in almost all later empirical studies, reveals 'counterclockwise' loops in the UV relation (see Figure 8).

The generally accepted explanation was that vacancies respond much faster to changes in aggregate demand than unemployment does. The adjustment process of labour is just more time-consuming than the posting of a vacancy. The finding of these 'counterclockwise loops' was obviously of economic interest and in a certain way even reassuring since they could be related to the 'loops' found in the Phillips curve. However, the loops made precise observation of shifts rather difficult. A more comprehensive discussion focused on the stability of the British UV curve for the period

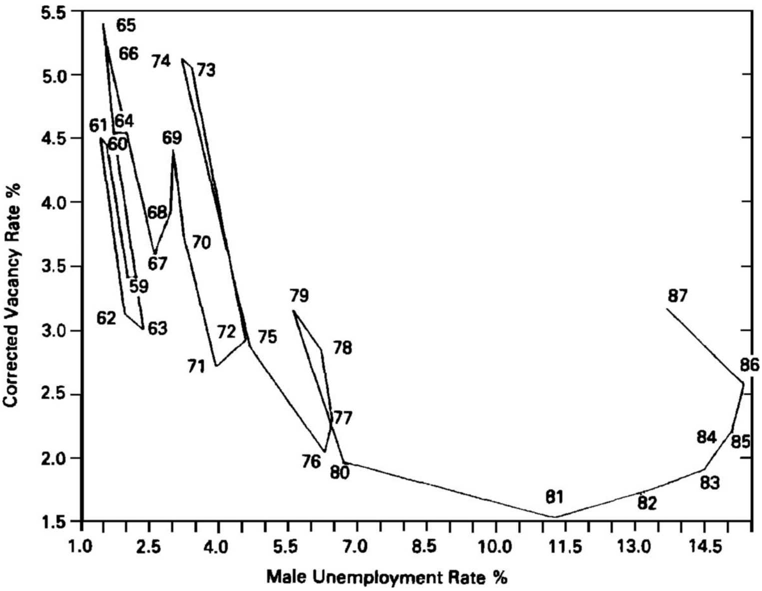

Figure 8 Loops and breakpoints in the empirical UV curve for Great Britain (1959 to 1987) Source: Jackman *et al.* (1989: 378)

15 Cohen and Solow (1967, 1970), Burch and Fabricant (1968, 1971) and Gujarati (1969), all in *The Review of Economics and Statistics.*

Table 1 Supposed causes of shifts of the UV curve

Reference	Cause of shift
Bowers *et al.* (1970)	Combination of factors
Gujarati (1972a)	Redundancy Payment Act (1965), National Insurance Act (1966)
Taylor (1972)	'Labour shake out' (labour dishoarding)
Foster (1973)	Various reasons
Foster (1974)	Increase in 1940s birth rates
Evans (1975)	Increase in structural unemployment
Evans (1977)	Fluctuations in registered unemployment and registered vacancies
Berg (1982)	Increase in female labour supply and geographical spreading of labour force
Budd *et al.* (1987)	Deterioration of human capital (due to long-term unemployment)
Jackman *et al.* (1989)	Decrease in search intensity
Wall and Zoega (2002)	Business cycles

1958 to 1971.[16] These studies all find 'breakpoints' or shifts of the UV curve for the British economy, but disagree about what causes the shifts. Econometric analysis usually provided no or only very little evidence for the alternative hypotheses tested. Table 1 summarizes the main contributions to the discussion and the presumed causes of the shift of the British UV curve. After three decades of testing and specifying the UV curve, Jackman *et al.* (1989: 392) admit that: 'we must remain agnostic as to the causes of the change'.

The economy turns out to be subject to a set of unknown factors that affect the UV curve in three ways simultaneously. Changes in aggregate demand in the economy cause movements along an otherwise stable UV curve, while at the same time shocks or structural changes in the economy (whatever they may be) cause movements of the curve itself. Finally, economic policy aimed to make matching in the labour market more efficient shifts the UV curve inwards deliberately. But although in theory it is clear how these three shocks affect the UV curve, identifying the shocks with empirical methods has proved elusive. As a consequence of these simultaneous movements, the exact shape of the UV curve cannot be estimated and hence classes of unemployment cannot be determined exactly. This bears a resemblance to the identification problem of supply and demand curves in macroeconomics, where price elasticities of supply

16 Bowers *et al.* (1970), Gujarati (1972a, 1972b, 1973), Taylor (1972), Foster (1973), Knight and Wilson (1974), Evans (1975, 1977), Holden and Peel (1975, 1977), Warren (1977), Parikh (1977), and Bewley (1979), almost all in *The Economic Journal* and *Applied Economics*.

and demand cannot be estimated when it is unknown whether price or quantity changes are caused by shifts of the supply or the demand curve. This identification problem could be overcome if economic theory could provide good reasons for a particular shape of the UV curve or could give good reasons for conditions where UV shifts are absent. In that case, it would be possible to estimate the UV curve and trace out its shifts. Unfortunately, however, economic theory – either Keynesian nor neoclassical – is not able to do so, leaving the UV curve underdetermined. In the next section, we will see how neoclassical economists overcame this identification problem and how that changed the role of the UV curve.

5 Search theory: towards flows and microfoundations

In the 1980s, studies using UV analysis became rare. While Armstrong and Taylor still argue that UV analysis 'continues to have considerable potential for further development' (1980: 100), it was almost completely abandoned only a few years later, as Muysken and Meijers's (1988) article 'A Post-Mortem on the UV-analysis' illustrates. Opponents of the UV analysis were found in a neoclassical paradigm that finally took over Keynesian, macroeconomic thinking on unemployment and was labelled as 'search theory', 'flow approach' or 'new microeconomics'. Economists of this new paradigm, like Phelps and Holt, argued that the UV analysis suffered from two flaws: it was a static approach that analysed stocks rather than flows; and it lacked a microeconomic foundation; it was a black box that did not provide any explanation. The new paradigm did address these two issues. Phelps and Holt (1970) sought the microfoundations in the individual search behaviour of agents. Unemployed workers make rational decisions to accept a job offer or reject it when they expect higher payoffs from other future job offers. Unemployment is hence seen as a productive investment.

Characteristic of search theory is that it analyses equilibrium unemployment in terms of flows in and out of unemployment rather than a static difference in stocks as the UV analysis did. Unemployment and vacancy figures alone are not informative about structural unemployment since the duration of unemployment has to be taken into account as well. A reduction of the velocity of circulation in the pool of the unemployed will increase the number of long-term unemployed. Changes in unemployment duration therefore hamper tests of changes in structural unemployment, and hence the UV analysis.[17] The problem of unemployment duration became a central research question in the late 1970s and early 1980s when

17 Burch and Fabricant (1968: 279–80) had already stressed this point in 1968.

unemployment rose sharply and most notably European countries experienced persistent long-term unemployment. This led to the formation of new theories of unemployment such as search theory, matching theory and hysteresis theory.

5.1 Search and matching theory

A particular brand of search theory is matching models, which draw back on the pioneering work of Butters (1977), Hall (1979), Pissarides (1979, 1985), Bowden (1980), Mortensen (1982) and Diamond (1982a, 1982b, 1984).[18] In England, important contributions were made at the LSE by Pissarides, Jackman, Nickell, and Layard, currently at the LSE Centre of Economic Performance. Whereas the contributions of the NIESR were empirical and concerned with the empirical decomposition of unemployment changes, especially at the regional level, the LSE contribution to matching theory was more theoretical.

The key idea of matching models is that the complicated and stochastic process of job searching is captured in one single, well-behaved, aggregate, mathematical function, called the matching function. The idea of a labour market divided into frictionless submarkets is abandoned and replaced by one mathematical function accounting for flows in the labour market in equilibrium. In its most elementary form, the matching function is:

$$M = m(U, V) \tag{1}$$

This function expresses matches between the unemployed and vacancies in a discrete, aggregate way and generates the UV curve. Without explicit reference to the source of friction, the equilibrium outcome is now defined in a small set of variables.

Three assumptions concerning the matching function are usually made. A first, and necessary, assumption is:

- Assumption 1: $M = m\ (U,\ V)$ is non-decreasing in U and V.

This assumption means that there is a non-decreasing 'marginal productivity' of unemployment and vacancies. The second assumption commands the equilibrium relationship:

18 By now, the amount of literature on search and matching theory is enormous. A number of books and survey articles provide excellent overviews, such as Pissarides (2000), Mortensen and Pissarides (1999), Petrongolo and Pissarides (2001) and Rogerson *et al.* (2005).

- Assumption 2: Inflow in employment equals outflow out of employment

Finally, a third, although not necessary, assumption is usually added:

- Assumption 3: $M = m\ (U,\ V)$ is homogeneous of degree one.

This assumption, which states that a 10% increase in both vacancies and unemployment will lead to a 10% increase in matches, is added because of its convenience,[19] but is also supported empirically in a number of studies. It ensures that the efficiency of matching does not depend upon the size of the market, and hence a constant unemployment rate along a balanced growth path in a growing economy is assured. At the same time, it enables us to write the matching function as a function of only one variable, θ the ratio of V/U, which is referred to as the labour market tightness. The matching function is then written:

$$M = m(U, V) = m(1, \theta)U \tag{2}$$

In a UV space, the matching function is stable, convex to the origin and exhibits diminishing returns to the input factors; that is, it corresponds with the empirically found UV curve. The role of the matching function is to provide a framework for analysing flows of the unemployed without bothering about the underlying matching process. How the matches between individual unemployed and unfilled jobs are made is not made explicit, since the matching function only gives an aggregate outcome. The underlying frictions in the labour market and their effect on unemployment are not analysed individually, but the outcome effect as a whole is considered. It is therefore used in a similar way to production and utility functions. For the same reason as for production or utility functions, a Cobb–Douglas type of matching function is often assumed:[20]

$$M = NU^{\alpha}V^{1-\alpha} \tag{3}$$

The economic interpretation of α is as the contribution of the unemployed to the search process. N can be interpreted as a technology parameter.

19 Increasing returns to matching, for example, make analysis much more complicated since multiple equilibria could occur (Petrongolo and Pissarides 2001: 4).

20 Petrongolo and Pissarides (2001) show that the Cobb–Douglas specification of the matching function commands a fair amount of empirical support. There are, however, no compelling theoretical reasons why the matching function should be of the Cobb–Douglas form.

Other matching models incorporate additional variables such as search effectiveness or search intensity. The matching function is then defined as:

$$M = m(cU,\ V) \tag{4}$$

Structural shifts of the UV curve are then explained by changes in the factor *c*, the search effectiveness (see, for example, Layard *et al.* 1991).

After the unemployed and vacancies are brought together by this stochastic matching technology, matching models focus consequently on the division of the outcome of this productive match, often as a bargaining process, where the surplus is divided according to a surplus-sharing rule. Two equilibrium-generating mechanisms are usually explored: the effect of wage adjustments and the effects of labour tightness adjustment. The equilibrium outcome – that is, the values of the variables U, V and W (wage) – is determined by equilibrium conditions and is at the intersection of the stable UV curve and the job creation curve, a straight line with the labour market tightness as slope θ.

It can easily be seen that the role of the UV curve has changed significantly in the search theory approach and that, in turn, the conception and analysis of unemployment changed. The UV curve is derived as an equilibrium outcome rather than empirically estimated, and although later studies revealed empirical support for the Cobb–Douglas type of UV curves, the Cobb–Douglas form was used in the first place for achieving identification. More in general, search theory analyses unemployment consistent with a particular notion of equilibrium, namely equilibrium between flows. When L is the size of the labour force, N the number of employed workers and U the number of unemployed workers, $N + U = L$ holds. With s being the separation rate, the inflow in unemployment is sN, while the outflow is fU with f being the rate of job finding. In equilibrium (i.e. the absence of deficient demand), inflow equals outflow, hence $sN = fU$. Rewriting this equation yields the equilibrium (or non-deficient demand) unemployment rate $u^* = U/L = s/(s + f)$. This level of unemployment is thus expressed in terms of separation and job quit rates, and the UV curve represents this equilibrium relationship.

5.2 Testing device for the 'sectoral shifts' hypothesis

Soon after the introduction of search theory, a debate broke loose in modern macroeconomics – particularly in the USA – on 'sectoral shifts' or 'reallocation shocks' versus 'aggregate disturbances' as unemployment, both in Europe and the US, rose rapidly in the early 1980s. The debate started with the publication of Lilien's (1982) paper where he presents his sectoral shift hypothesis as a cause of high unemployment; that is, the idea that intersectoral (and intrasectoral) labour reallocations affect unemployment at an aggregate level.[21] Idiosyncratic shocks will cause flows of labour from declining sectors to booming sectors. In fact, the debate is about the nature of unemployment and is some renewed version of the structuralist versus deficient demand debate of the 1960s. The issue became how to identify the effects of aggregate demand changes from structural changes (at the level of sectors). In order to test the sectoral shift hypothesis, Lilien used a simple turnover model but soon the UV curve acquired a dominant place in the analysis of the sectoral shift hypothesis. Abraham and Katz (1986, 1987) suggest using U and V data for identifying the nature of shocks. If a sectoral shock will hit the economy and structural unemployment will rise, the UV curve will shift outwards, resulting in a positive U–V co-movement and a positive correlation between vacancies V and Lilien's dispersion index s (variance of the reallocation shocks). Similarly, an aggregate shock will result in a movement along the UV curve, a negative co-movement of U and V and a negative correlation between V and s. In a similar fashion, the UV curve – by then most often referred to as the Beveridge curve – is used by Jackman *et al.* (1989) and Blanchard and Diamond (1989). Jackman *et al.* (1989) use the Beveridge curve to distinguish between demand-side and supply-side changes in unemployment. Finally, Hosios (1994) shows that there are constraints to the use of the Beveridge curve as a diagnostic tool for the determination of the nature of unemployment. His matching model shows that reallocation shocks can generate a negative short-term UV relationship, which makes it impossible to identify whether aggregate shocks or sectoral shocks are driving aggregate unemployment fluctuations. As a consequence of Hosios's work, the current interpretation of the UV curve is that U and V data alone, in isolation, are insufficient to distinguish between the causes of unemployment fluctuations and to test the sectoral shift hypothesis satisfactorily (Gallipoli and Pelloni 2008).

6 Conclusions

In retrospect, it can be concluded that the paradigmatic change in unemployment theory from Keynesianism to neoclassical search theory also shaped the role and use of the UV curve. The UV curve came into being at a time when economists had a strong belief in the effectiveness of Keynesian, aggregate demand management, and the main concepts that UV analysis aimed to measure, such as excess demand and cyclical

21 Other important contributions are Abraham and Katz (1986, 1987) and Brainard and Cutler (1993). For a survey of the aggregate shocks versus reallocation shocks debate, see Gallipoli and Pelloni (2008).

unemployment, are important Keynesian concepts. Their measurement, however, became more or less superfluous with the fall of Keynesianism. Shifts of the UV curve were not considered by advocates to be a serious threat to UV analysis, mainly because of the optimistic belief in the 1970s and 1980s that the underlying cause or causes of the shift of the UV curve could be identified and accounted for in the specification of the UV curve. The inability to do so rendered the UV curve underdetermined. It became impossible to distinguish between different movements of the UV curve: movement along the UV curve necessary for measurement, deliberate attempts to move the UV curve inwards by economic policy in order to reduce structural unemployment and unintended structural shocks of the UV curve for reasons yet unknown. Search theory circumvents the problems inherent in UV analysis by analysing flows, and overcomes the identification problem by assuming the Cobb–Douglas type of UV curves. In this way, the apparently inductively established empirical UV curve changed into a deductively derived UV curve, which is firmly rooted in and reinforces neoclassical economics. The paradigmatic change from Keynesianism to neoclassical search theory changed the role and interpretations of the UV curve from a measurement device of aggregate demand for Keynesians and an interpretation of full employment to an equilibrium condition for neoclassical search theorists and an important diagnostic tool for the labour market.

Much labour economic research of the past decades has centred on the Phillips curve and the UV curve as macroeconomic structural relations. Although the UV curve has played second fiddle for a long time due to the dominant place of the Phillips curve in economic analysis, the renewed interest in the UV curve is growing and the UV curve will undoubtedly serve an important function as one of our prime 'looking glasses' on the labour market for a long time to come.

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Abstract

The purpose of this paper is to provide an analysis of the impact the Unemployment–Vacancy (UV) curve (or Beveridge curve) had on economic theory and to provide an account of the subsequent radical changes in its place and role over the decades since its first appearance in 1958. The paper traces the historical development of the UV curve and argues that the role of the UV curve has changed from that of a measuring device, to a graphical representation of full employment, to an axiom necessary for matching models of unemployment to a diagnostic tool. This changing role is best understood in the light of the paradigmatic change from Keynesianism to neoclassical search theory.

Keywords

UV curve, Beveridge curve, UV analysis, structural relations, matching function, search theory, full employment, labour economics

JEL classification: B, E, J