

## WHAT HAPPENED TO THE SEARCH THEORY IN THE LATE 1960'S: A METHODOLOGICAL STUDY OF THEORY TRANSFORMATION

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*The paper investigates how economists transform an existing theory as they employ it to explain a new fact, using the search theory and the Phillips curve as the case material. It thus demonstrates that the transformation of search theory was far from 'rational' in the sense of Lakatos. The transformation was filled with irregularities including non-theoretic approach, disputable assumption, and invalid solution. It also suggests that we cannot write a sensible history of search theory without introducing the 'external' element, that is, the Phillips curve. A Lakatosian reconstruction is simply impossible insofar as the developments of search theory in the late 1960's are concerned.*

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### I. INTRODUCTION

In their 1976 survey of the literature on search, Lippman and McCall presented the search theory as designed mainly to "explain persistent positive levels of unemployed resources." It is also said that the development of search theory has started with Stigler (1961, 1962). Stigler, however, proposed the notion of search in a quite different context. As a matter of fact, he never once mentioned unemployment in his two papers. What then did happen to the search theory between 1961 and 1976? It is the question the present paper raises, and the answer is that the search theory underwent a major transformation in the late 1960's.

The purpose of this paper, however, is not merely to confirm that the search theory was transformed a few years after its inception. More emphasis is given to *what* led economists and *how* economists proceeded to transform the search

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theory. Two points are thus made: economists transformed the search theory so that it could serve as microfoundation of the Phillips curve, and the transformation involved various irregularities including non-theoretic approach, disputable assumption, and invalid solution.

This paper may be said to offer a history of the search theory, but I prefer to call it a methodological case study. It suggests among others that the Lakatosian demarcation between 'internal' and 'external' history is inappropriate in the case at hand.<sup>1</sup> In fact, little would remain in the text if 'irrationalities' were relegated to footnotes. The paper also illustrates how an existing theory is transformed to explain a newly established fact, using the search theory and the Phillips curve as the case material. In doing so, it intends to pick up some clues to the structure of scientific development in the economic discipline.

Eight sections follow. Sections II and III examine the search theory and the Phillips curve as they were prior to application of the former to explanation of the later. Sections IV and V identify the theoretic problems that should have been solved for a successful application. Sections VI to VIII evaluate how economists coped with the tasks, respectively focusing on what Lakatos would take to be irrational. Section IX sums up the discussion with a sketch of the developments of search theory in the 1970's.

## II. THE SEARCH THEORY AS STIGLER PROPOSED IT

Stigler had introduced the notion of search in his 1961 paper before he applied the notion to the labor market analysis in his 1962 paper. The two papers are respectively entitled "The economics of information" and "Information in the labor market". We shall examine them to provide a point of departure for our study of the transformation of search theory.

### Price Dispersion and Search in a Commodity Market

Stigler (1961) called it a fact that "[the] dispersion [of asking prices] is ubiquitous even for homogeneous goods". The fact led him to two different, but possibly related issues; the degree and sources of price dispersion, and the behavior of buyers who face the price dispersion. He started with the latter, in which the dispersion of asking prices is a premise.

To the presumed dispersion of asking prices, Stigler added an innovative assumption. It is that a buyer knows the distribution of asking prices but not what price to be asked by any given seller. Given the 'imperfect assumption' as Stigler called it, the buyer conducts a 'search' to find out a few sellers' asking

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<sup>1</sup> Lakatos (1978, pp. 102-138) draws a sharp demarcation between 'internal' and 'external' history, relegating all 'irrationalities' to the latter. Adherence to a 'refuted' or inconsistent theory is one such irrationality.

price. The search, of course, is costly in time and money.<sup>2</sup>

Stigler continued to analyze the buyer's search strategy. A buyer decides how many prices to ascertain prior to purchase, the decision being such that the expected marginal return is equal to the marginal cost of search. The former is

$$q \left| \frac{dP_{\min}}{dn} \right| \quad (1)$$

where  $q$  is the quantity to purchase,  $P_{\min}$  the expected minimum price from a random sample of size  $n$ . That is,

$$P_{\min} = E[\min\{p_1, p_2, \dots, p_n\}] \quad (2)$$

The optimal amount of search, therefore, depends upon the distribution of asking prices as well as search cost.

Having analyzed a buyer's price search, Stigler directed attention to a seller's price setting. A seller was assumed to expect no reactions of other sellers to his/her decision about price. In other words, sellers play a Cournot-Nash game with each other. Towards buyers, however, sellers are monopolistic. Sellers understand that a higher price is less likely to be the lowest of those a buyer has randomly selected to identify.

Stigler then employed an expository assumption that the asking prices constitute a uniform distribution, which made it easier to determine the expected number ( $N_i$ ) of buyers who would purchase from a seller asking  $p_i$ :

$$N_i = KN_b n(1 - p_i)^{n-1} \quad (3)$$

where  $K$  is a properly defined constant,  $N_b$  the total number of buyers, and  $n$  the number of sellers whom a typical buyer would consult.

Stigler was thus ready to derive a seller's revenue and cost as functions of his/her asking price, and ultimately determine the profit-maximizing price. He could then explain why a seller sets the price higher or lower than others, leading to the issue of the degree and sources of price dispersion. Although he had not worked out the issue, he drew various implications concerning the dispersion of prices. He argued, for instance, that "greater amounts of search will lead to a smaller dispersion of observed selling prices" (1961, p. 217), and that "the greater the increase in average cost with volume, the smaller will be the dispersion of prices" (1961, p. 220).

To sum, Stigler (1961) proposed the search theory as an explanation of the

<sup>2</sup> This part of the assumption is particularly innovative. Although various economic theories had incorporated the same kind of imperfect information prior to Stigler's contribution, few of them had taken into formal consideration that an agent could improve the information for some costs.

dispersion of asking prices for a homogenous good. It is true that he first took the price dispersion as a premise, but it is only a strategy of analysis. He intended to return the price dispersion as a conclusion. In other words, the dispersion of price was not an *explanan* but an *explanandum* in his search theory. It also is the case in Stigler (1962), where the search theory is applied to explain the dispersion of wages.

### Wage Dispersion and Search in the Labor Market

In his 1962 paper Stigler analyzed a worker's search. Naturally, the analysis is comparable to that of a buyer's search. Stigler first invoked an induction to establish that different wages are offered even for homogeneous workers. He then constructed a model on the idea that "a worker will search for wage offers ... until the expected marginal return equals the marginal cost of search" (p. 96). The former was specified as

$$\frac{dw_m}{dn} \frac{(1+i)^t - 1}{i(1+i)^t} \quad (4)$$

where  $w_m$  represents the expected maximum wage offer a worker would encounter in  $n$  searches.<sup>3</sup> Since an increase in  $w_m$  would be effective over the expected duration ( $t$ ) of employment, its present value depends upon the interest rate ( $i$ ). Although Stigler gave quite a few pages to the analysis of a worker's search, it is unmistakable what his main interests were:

The most direct implication of the formal analysis is that the gains from search are larger the longer the prospective period of employment. When search is more extensive, however, the dispersion of wage rates will be smaller ... (pp. 98-99)

Stigler predicted a smaller dispersion of wages for male compared to female workers. A same comparison was made between younger and older workers.

His interest in the dispersion of wages as *explanandum* is apparent from his discussion on search cost as well. Having identified what determines a worker's cost of search, he made a few predictions about their effects on the dispersion of wages. In addition, Stigler raised a counterfactual question regarding the sources of wage dispersion: "Under what conditions will this search eliminate all disper-

<sup>3</sup> The expected maximum wage ( $w_m$ ) is not difficult to derive from the cumulative probability function of wage offers, say  $F(w)$ .

$$W_m = \int_0^{\infty} wF(w)^n dw$$

But Stigler only provided an approximation of it assuming a normal distribution of wage offers

$$w_m = \mu + .65n^{.37}\sigma$$

sion of wage rates for homogeneous labor?"

### The Direction of Development Not Taken

As it has been suggested, Stigler's analysis of price dispersion was incomplete. He discussed the degree and sources of price dispersion without deducing the dispersion of price offers as a market equilibrium. That is, he was not explicit about how the Cournot-Nash game among sellers would yield a non-degenerating distribution of price offers. His analysis of wage dispersion was no better. He was not successful in deducing a non-degenerating distribution of wage offers as a Cournot-Nash equilibrium among employers.

The incompleteness of Stigler's work suggests what progress *could* have been made as a matter of course. Many a reader of his 1961 and 1962 papers would have noticed a well-defined but unsolved issue, namely, the market equilibrium issue. As we shall see soon, however, it is not this issue that concerned economists at least for a while. Hence a question: What led the newly born theory to develop in a rather unexpected direction?

### III. THE PHILLIPS CURVE

An answer to the above raised question is already given in Introduction: Stigler's search theory was transformed to provide the Phillips curve with microfoundation. In this section we shall briefly review what economists had made of the Phillips curve before they engaged Stigler's search theory in it.

In his 1958 paper A. W. Phillips inspected the annual data of money wage and unemployment rates in the U. K. for the period 1861-1913, and drew a statistical relationship between the two variables.

$$\dot{W} + 0.900 = 9.638U^{-1} \quad (5)$$

where  $\dot{W}$  represented the rate of change in  $W$ , which he measured by  $(W_{t+1} - W_{t-1})/2W_t$ . He also noted that the loci of  $\dot{W}$  and  $U$  constituted a 'loop' around the fitted curve in the counterclockwise direction.<sup>4</sup>

Economists for one reason or another readily accepted both the negative, nonlinear curve and the counterclockwise loop as an established fact. They were also eager to "construct a theoretical model that [would] satisfactorily account for the relationship," whether or not they shared the Popperian methodology with Lipsey<sup>5</sup>:

<sup>4</sup> Phillips proposed the equation

$$\dot{W} + \alpha = \beta U' + \delta(\dot{U}/U)$$

and took the 'loop' to support his hypothesis  $\delta < 0$ .

<sup>5</sup> Strongly influenced by Popper's view of science, Lipsey was leading the LSE staff seminar

First, the relation ... is open to serious misinterpretation, and such misinterpretations can be prevented only when the model which underlies the relations is fully specified. Second, ... if we have a model explaining the relationship, we will know the conditions under which the relation is expected to remain unchanged. Then if a change occurs, the model will predict why this has happened and this prediction will give rise to further tests from which we can learn. Third, unless it is a very *ad hoc* one, the model will give rise to further testable predictions in addition to the testing of these we will gain further relevant information. (Lipsey, 1960, p.12)

And a few economists directed attention to Stigler's search theory.

There was another element involved in this line of research. Phelps (1967) and Friedman (1968) argued that the relationship captured by the Phillips curve was the outcome of people's misperceptions about prices, which would be corrected sooner or later. Phelps and Friedman thus predicted that unemployment would return to its 'natural rate' in the long run, regardless the rate of money wage inflation. Obviously, one of the principal ingredients of the natural rate hypothesis was an adaptive mechanism, the key feature of the mechanism being that "it takes time for people to adjust to a new state of demand". (Friedman, 1968, p.10) The natural rate hypothesis was well accepted by those who attempted to graft the Phillips curve on Stigler's search theory. Alchian (1970), Holt (1970), and Mortensen (1970a) were among the works of this line, and will be examined below.

#### IV. FROM SEARCH TO UNEMPLOYMENT

Recall that Stigler proposed the job search theory as an explanation of *wage dispersion* rather than an explanation of *unemployment*. The theory, therefore, had to undergo transformation before it was applied to explain the Phillips curve.

First of all, searching for a job and being unemployed came to be understood as two sides of the same coin. Alchian (1970) illustrates how economists obtained the identification of job search with unemployment. Given that wage offers are drawn from a normal distribution with mean  $\mu$  and variance  $\sigma^2$ , the expected maximum wage offer from  $n$  drawings will be approximately<sup>6</sup>

$$W(n) = \mu + \sigma \sqrt{2 \log n} \quad (6)$$

Alchian replaced this equation with

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on 'Methodology, Measurement, and Testing.' See de Marchi (1988).

<sup>6</sup> Compare this to Stigler's approximation. See footnote 4 to compare this with Stigler's approximation.

$$W(v, t) = \mu + \sigma \sqrt{2 \log(vt)} \quad (7)$$

through the assumption that a constant number ( $v$ ) of observations was made in each period. In Equation (7),  $t$  denotes the number of periods that a worker has spent searching for a favorable job, and hence the number of periods during which a worker was unemployed.

In the above-discussed way or another, economists made a connection between the two notions, job search and unemployment. To use the term of Lakatos (1976, 1978), there was a 'concept-stretching,' or a movement from the intended interpretation to an unintended interpretation of a given concept. The concept-stretching, however, played a different role than that Lakatos (1978) assigned in a history of Euclid geometry. It was not intended to refute an existing theory, but, at least partially, to deduce an established fact (the Phillips curve) from an existing theory (the job search theory).

## V. PROBLEMS THAT HAD TO BE SOLVED

Whatever the intention was, economists could not stretch the concept of job search without difficulties. Note that two propositions underlie the connection. One is that a worker searches for jobs *sequentially*: a job seeker contacts one firm after another. The other is that workers, or at least some workers, do not undertake *on-the-job search*: they either search or work, but not both at the same time. Both propositions, however, are problematic. In this and the following two sections we will identify the problems and see how economists attacked or avoided them.

### Disputability of Sequential Search

Recall that Stigler (1962) did not explicitly discuss whether a job seeker contacts either one firm after another or a chosen number of firms at one time. Stigler, who was only interested in the amount of search, had no particular reason to discuss the issue of sequential versus parallel search. So far as the amount of search is concerned, there is no difference between the two types of search.

The issue, however, came to the surface when economists connected job search to unemployment. Obviously, the *amount of search* will not necessarily correspond to the *length of search* if a worker does not search sequentially but in parallel. Economists thus presupposed, implicitly in most cases, that a job seeker contacts one firm after another.<sup>7</sup>

The argument for sequential search, however, was logically and empirically

<sup>7</sup> Some economists even imagined and criticized that Stigler had modeled a worker to search sequentially but predetermine the amount of search, a strategy given the label 'fixed-sample search.'

disputable. For a logical counterexample, if the per contact cost is lower when a worker can and does contact several firms at a time, then the parallel search may be more profitable. For an empirical counterexample, a young Ph.D. in economics, who seeks an academic job, does not search sequentially: he/she does not defer other applications or interviews until the result of the first contact is known.

How then did the economists who attempted to transform Stigler's job search theory into a microeconomic theory of the Phillips curve handle the problem? The answer is that they *ignored* it, intentionally or unintentionally, except to suggest implicitly that the institution somehow prevent workers from searching simultaneously. Once advanced, the argument for sequential search was not challenged for several years thereafter.<sup>8</sup>

### Manageability of Sequential Search

Though it was granted that a worker searches sequentially, economists still had a problem to solve. They had to answer the question: When does the worker accept an identified offer? One immediate answer from economists was that the worker would accept an offer if and only if the wage rate is higher than a critical level which Holt and David (1966) called 'acceptance wage.' This answer would have been complete if a worker's choice of his/her acceptance wage had been fully explicated. But it was not the case. Alchian (1970) thus confessed that sequential search defied precise formulation or solution. (p. 52)

Defeated economists reacted in different ways. For instance, Alchian (1970) *disregarded* the argument for sequential search and used the available model of fixed-sample search, despite the fact that the model was at odds with the view that the amount of search corresponded to the length of search. Holt (1970) had a different idea: he advanced a *descriptive hypothesis* about the acceptance wage and tried to make the hypothesis look plausible. Mortensen (1970a) took another approach: he *modeled* sequential search *anyway*. These two approaches will be closely examined in Sections VI and VII, respectively.

### Plausibility and Superiority of On-the-Job Search

Now let us consider the proposition that workers do not undertake on-the-job search, which is essential to identifying job search with unemployment. To repeat, job search would not imply unemployment if workers search for another job while having a job.

The exclusion of on-the-job search, however, is as problematic as the proposition that a worker searches sequentially rather than in parallel. Why doesn't an

<sup>8</sup> The 'parallel, fixed-sample search' was reintroduced by Wilde (1977), Gal *et. al.* (1981), Burdett and Judd (1983), and Morgan (1983).



unemployed worker take the first offer and then continue searching, if the worker so desires, while simultaneously receiving earnings?

This potential objection forced economists either to adopt and informally justify a *direct hypothesis* that workers do not undertake on-the-job search, or to build an *ad hoc model* in which workers are allowed but will not choose on-the-job search.<sup>9</sup> The famous parable of 'island economy' suggested by Phelps illustrates the former:

I have found it instructive to picture the economy as a group of islands between which information flows are costly: to learn the wage paid on an adjacent island, the worker must spend the day traveling to that island to sample its wage instead of spending the day at work. (Phelps, 1970, p.6)

That is, Phelps simply assumed away the possibility of on-the-job search without further discussion.<sup>10</sup>

An example of the other response is Alchian (1970). Having *somehow* formulated both on-the-job search and out-of-job search, he suggested that the former is superior since the cost of search is much less for the former. Mortensen (1970a), which we will examine in Section VII, is another example of this kind. Assuming that the per period probability of receiving a job offer is much higher for an unemployed worker, Mortensen built a model in which an unemployed worker may prefer not to undertake on-the-job search. But it should be noted that both formulations were incomplete and crude.<sup>11</sup> The deficiency seems to have been accepted as a fair price for achieving the proclaimed goal -- microeconomic foundations for the Phillips curve!

## VI. DESCRIPTIVE HYPOTHESIS AND RHETORIC

It has been noted that sequential search "defied precise formulation or solution, and defeated economists responded in different ways". In this section we will take a closer look at response of Holt (1970), who advanced a descriptive hypothesis concerning the acceptance wage.

Holt first downgraded the approach he was not going to take:

We do not require that the aspiration level be clear and sharp, only that it reflects some regularity in probability terms. Indeed, job opportunities have so many dimensions that the decision process tends to be rather unstable as attention shifts between characteristics that are, in turn, desirable and

<sup>9</sup> It is not just a potential objection. Tobin (1972) criticizes the attempts to use search theory to explain unemployment, and the main thrust of his criticism was that search did not necessarily imply being unemployed.

<sup>10</sup> Lucas and Prescott (1974) reiterated the parable.

<sup>11</sup> Burdett (1978) constructed a more complete model of on-the-job search.

undesirable. In such complex choices we do not expect sophisticated optimization, but only that some degree of selection takes place that favors the better alternatives. (pp. 61-62)

Can we take these statements as saying that economists had better *not* deduce a worker's acceptance wage, which Holt also called the 'aspiration level,' by formulating and solving the worker's optimization problem? It seems that this is a proper reading. In fact, Holt called psychology to the rescue: "A thorough understanding of the aspiration-level mechanism must await further work by social psychologists" (p.62).

Having said this, Holt suggested a *descriptive hypothesis* about the aspiration level of the  $i$ th unemployed worker. According to him, the level is given as follows:

$$w_{t+T}(i) = w_t(i) A_i \frac{W_{t+T}}{W_t} \exp(-D_i T) r_{t+T} \quad (8)$$

where  $w_{t+T}(i)$  is his wage aspiration level at the time  $t+T$ ;  $t$  the time the worker entered the labor market;  $T$  the length of time he has been unemployed,  $w_t(i)$  his wage rate at the end of his previous job;  $A_i$  a constant, usually greater than one, that sets the initial aspiration level;  $W_{t+T}/W_t$  the ratio by which general wages have changed during his unemployment;  $D_i$  a constant which is the rate at which aspirations decline exponentially in response to unemployment; and  $r_{t+T}$  a random variable whose geometric mean is unity to reflect sporadic and non-wage factors that influence the wage aspiration level (p. 63).

How then could Holt justify this hypothesis? Holt invoked two kinds of authority. One was the research by psychologists:

The adaptive aspiration level that has received considerable attention by psychologists offers a suitable starting point both as a behavioral hypothesis and as a rational search strategy. (p.61)

Holt actually quoted a few papers and books written by psychologists. The other authority Holt invoked was empirical evidence.

For instance, ... there appears sufficient empirical support for [the] existence [of acceptance wage] and its decline during unemployment period to accept it as a working hypothesis. We will discuss some of the evidence later. (p.62)

Holt thus discussed several empirical works based on the data that had been gathered by asking people about their acceptance wage, though he noted sticky

problems of such works.

## VII. AD HOC MODEL WITH INVALID SOLUTION

Whatever justification Holt gave to his approach, Mortensen (1970a) must have had a different view.<sup>12</sup> Mortensen did not start with a descriptive hypothesis about the acceptance wage, but somehow deduced the acceptance wage from 'deeper' hypotheses.

According to Mortensen, the acceptance wage requires that if an unemployed worker is offered the wage then the worker will be indifferent between reject-it-and-search and take-it-and-search. Mortensen also assumed that the per period probability of receiving an offer is smaller when the worker is employed than it is when the worker is unemployed. Note that Mortensen was trying to derive the acceptance wage in the case where a worker searches sequentially and is allowed the option of on-the-job search.

The acceptance wage Mortensen somehow deduced from the above assumptions is

$$[(s_0 - s_1)/s_0]\hat{w}^e \quad (9)$$

where  $\hat{w}^e$  denotes a worker's expectation of the average of potential wage offers, and  $s_0(s_1)s$  the per period probability that the worker will make a contact with a potential employer while being unemployed (employed).

No explanation about how Mortensen derived the acceptance wage seems to be necessary for our discussion, except to say that the derivation was drastically *invalid*. Ironically, the invalid derivation helped Mortensen to continue constructing a microeconomic model of the Phillips curve. In his formulation and solution, the dispersion of wage offers had no effect on an unemployed worker's acceptance wage: all that is significant is the average wage offer. This simplicity made it much easier for Mortensen to undertake the next steps of model construction, which we will examine in the next section.

To repeat, Mortensen (1970a) took a different approach than Holt (1970). Whereas the latter proposed a descriptive hypothesis concerning an unemployed worker's acceptance wage, the former attempted to deduce the acceptance wage from 'deeper' hypotheses. The deduction of Mortensen, however, was drastically invalid, and his model was built upon the invalid deduction.<sup>13</sup>

<sup>12</sup> I do not mean by this that Mortensen refuted Holt's hypothesis concerning the acceptance wage. To the contrary, Mortensen (1970, p. 168) said: Holt provided us with an ingenious description of the choice and search process engaged in by an unemployed participant in the labor market when information is imperfect and search is expensive.

<sup>13</sup> Mortensen (1970b) derived the acceptance wage much more coherently than and, of course, very differently from Mortensen (1970a).

## VII. SUPERIMPOSITION OF ADAPTIVE EXPECTATIONS ON IMPERFECT INFORMATION

In this section we will look at Mortensen's model of job search from a different perspective. In particular, we will see how the imperfect information hypothesis was distorted in Mortensen's model.

Recall that the imperfect information hypothesis was one of the most important elements of Stigler's search theory. According to the hypothesis, a worker knows the distribution of wage offers. The worker's knowledge or information is imperfect only in the sense that the worker does not know the wage that will be offered by a particular employer at a given time.

This hypothesis, however, underwent a radical change when Mortensen (1970a) introduced expectation to job search theory. In Mortensen's model of job search, a worker relies upon his/her expectation about the distribution of potential wage offers when the worker decides whether or not to accept an identified offer. In other words, the worker does not have an exact knowledge even about the distribution of potential wage offers, and thus has to make a fallible guess about it. That is why the expected average wage offer ( $\hat{w}^e$ ) -- not the actual average wage offer ( $\hat{w}$ ) -- appears in Equation (9).

Having replaced knowledge with expectation, Mortensen postulated that a worker's expectation depends primarily on the offers the worker has as yet received. To be precise,

$$\hat{w}^e(t) = \hat{w}(t) \exp(hg^e) \quad (10)$$

where  $\hat{w}(t)$  denotes the average of wage offers received during a time interval  $2h$  in length prior to the current date  $t$ , and  $g^e$  the expectation about wage inflation. Let us listen to Mortensen's explanation of the above formula. First, regarding the term  $\hat{w}(t)$ :

The participant forms his expectation about the market average wage by combining information about wage offers that he obtained during the prior search period, [e.g. the period between  $t-2h$  and  $t$ .] (p. 175)

Second, regarding the term  $\exp(hg^e)$ :

If...the rate of wage inflation is approximately constant during [the period], the [mathematical] expectation of  $\hat{w}(t)$  is approximately equal to the true average of the population of wage offers at the midpoint [i.e. at the time  $t-h$ ] ... If [the participant] expect[s] wage inflation, it would be rational for [him] to adjust  $\hat{w}(t)$  for it. (p. 176)

To rephrase, a worker's information about wage offers is not only imperfect but

also incomplete and outdated. The information is incomplete in the sense that it is restricted to a sample of wage offers, and the information is outdated in the sense that the sample is drawn from the population of wage offers of which the distribution is constantly changing. The worker must use this incomplete, outdated information to estimate the distribution or mean of wage offers. The estimation is then adjusted by the worker's fallible expectation about wage inflation.

Obviously, the natural rate hypothesis was primarily responsible for this distortion of the imperfect information hypothesis. As was noted in Section III, one of the principal ingredients of the natural rate hypothesis was an adaptive expectations mechanism or something similar. A mechanism of this kind was superimposed on the imperfect information hypothesis, resulting in the incomplete, outdated information hypothesis.

## IX. SUMMARY, DISCUSSION AND EPILOGUE

We have seen how Stigler's job search theory was transformed when it was employed to explain an established fact captured by the Phillips curve. First, the concept of search was violently stretched to imply unemployment. Second, a worker's search strategy was further explicated and specified to be compatible with the concept stretching. Third, the sequential search thus specified, however, defied precise formulation or solution, leading to different reactions -- disregard, a descriptive hypothesis, or an incoherent model. Fourth, the adaptive expectation mechanism, which was one of the principal gradients of the natural rate hypothesis, was superimposed on the imperfect information hypothesis, resulting in a distortion of the latter.

In short, the transformation was far from 'rational' in the sense of Lakatos. It was filled with irregularities, of which we could not make sense without taking into consideration the 'external' element, that is, the Phillips curve. A Lakatosian reconstruction is simply impossible insofar as the developments of job search theory in the late 1960's are concerned. Were the external element and related irregularities moved to footnotes, little would remain in the main text.

A Lakatosian reconstruction, however, is not insensible of the history of job search theory around 1970 and after. The interest of economists in using or misusing the search theory to rationalize the Phillips curve did not last long, probably due to the success of an alternative approach, namely, the rational expectation theory. Nonetheless, economists did not return to the search theory as Stigler had proposed it. The search theory continued to be viewed as a theory of unemployment, if not as a theory of the inverse relation between unemployment and wage inflation. The view gained more weight as McCall (1970) successfully modeled sequential search and diverse extensions followed. It is thus no surprise that in their 1976 survey of the literature on search, Lippman and McCall presented the search theory as designed mainly to "explain persistent positive levels of unemployed resources".

## REFERENCES

- Alchian, A.A. (1970), "Information Costs, Pricing, and Resource Unemployment," in *Microeconomic Foundation of Employment and Inflation Theory*, ed. by E.S. Phelps, Norton, 27-52.
- Burdett, K. (1977), "On-the-Job Search and Quit Rates," in *Studies in Modern Economic Analysis*, eds. by M. Artis, and A.R. Nobay, Oxford University Press, 23-53.
- Burdett, K., and K.L. Judd (1983), "Equilibrium Price Dispersion," *Econometrica*, 51, 4, 955-969.
- de Marchi, N. (1988), "Popper and the LSE Economists," in *The Popperian Legacy in Economics*, ed. by N. de Marchi, Cambridge University Press.
- Friedman, M. (1968), "The Role of Monetary Policy," *American Economic Review*, 58, 1, 1-17.
- Gal, S., M. Landsberger, and B. Levykson (1981), "A Compound Strategy for Search in the Labor Market," *International Economic Review*, 22, 3, 597-608.
- Holt, C.C. (1970), "Job Search, Phillips' Wage Relation, and Union Influence: Theory and Evidence," in *op. cit.*, ed. by E.S. Phelps, 53-123.
- Holt, C.C., and M.H. David (1966), "The Concept of Job Vacancies in a Dynamic Theory of the Labor Market," in *The Measurement and Interpretation of Job Vacancies*, NBER, New York, 75-141.
- Lakatos, I. (1976), *Proof and Reputations: The Logic of Mathematical Discovery*, Cambridge University Press.
- \_\_\_\_\_. (1978), *The Methodology of Scientific Research Programmes*, Cambridge University Press.
- Lippman, S.A., and J.J. McCall (1976a), "The Economics of Job Search: A Survey I," *Economic Inquiry*, 14, 2, 155-189.
- \_\_\_\_\_. (1976b), "The Economics of Job Search: A Survey II," *Economic Inquiry*, 14, 3, 347-368.
- Lipsey, R.G. (1960), "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1862-1957: A Further Analysis," *Economica*, 1-31.
- Lucas, R.E., and E.C. Prescott (1974), "Equilibrium Search and Unemployment," *Journal of Economic Theory*, 7, 2, 188-209.
- McCall, J.J. (1970), "Economics of Information and Job Search," *Quarterly Journal of Economics*, 84, 1, 113-126.
- Morgan, P.B. (1983), "Search and Optimal Sample Size," *Review of Economic Studies*, 50, 4, 659-675.
- Mortensen, D.T. (1970a), "A Theory of Wage and Employment Dynamics," in *op. cit.*, ed. by E.S. Phelps *et al.*, 167-211.
- \_\_\_\_\_. (1970b), "Job Search, the Duration of Unemployment and the Phillips Curve," *American Economic Review*, 60, 5, 847-862.

- Phelps, E.S. (1967), "Phillips Curves, Expectations of Inflation and Unemployment Over Time," *Economica*, 34, 254-281.
- \_\_\_\_\_(1970), "Money Wage Dynamics and Labor Market Equilibrium," in *op. cit.*, ed. by E.S. Phelps *et al.*, 124-166.
- Phillips, A.W. (1958), "The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957," *Economica*, 283-299.
- Stigler, G.J. (1961), "The Economics of Information," *Journal of Political Economy*, 69, 3, 213-225.
- \_\_\_\_\_(1962), "Information in the Labor Market," *Journal of Political Economy*, 70, 5, S94-S105.
- Tobin, J. (1972), "Inflation and Unemployment," *American Economic Review*, 62, 1, 1-18.
- Wilde, L.L. (1977), "Labor Market Equilibrium under Nonsequential Search," *Journal of Economic Theory*, 16, 2, 373-393.