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Sticky Wages, Labour Demand Elasticity and Rational Unemployment

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Abstract

It is widely acknowledged that even in the presence of involuntary unemployment, real labour markets are characterized by sluggish wage adjustments and the persistence of unemployment. In this paper we give a simple explanation focusing on this phenomenon. We show, in fact, that sticky wages may be the natural outcome of rational decisions, taken by competing workers who may find it optimal to demand higher wages than full-employment wages. The key element driving the result is the slope (or elasticity) of labour demand schedule; in the case of rigid labour demand, wage requests of workers are kept high because of reduced unemployment opportunity costs. This contrasts with other approaches to the analysis of unemployment, where only the level of labour demand (i.e. the macroeconomy) is considered. In addition, the desire to work and effort required in the execution of the job, also influence the degree of wage stickiness.

Keywords: Sticky wages, involuntary unemployment, labour demand elasticity, game theory.

JEL Classification: C72, E24, J23, J64

1. Introduction

Sticky wage theories are currently the most popular approach to the analysis of unemployment. If on the one hand such models appear as sophisticated and formally elegant explanations of unemployment, on the other hand they often rest on rather ad hoc and implausible assumptions. The goal we pursue in this paper, therefore, is to provide a simple and general explanation to wage stickiness and persistent involuntary unemployment. We shall be flexible with regard to whether wages are nominal or real because we are going to follow a partial equilibrium approach. As the goods

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market and inflation are not considered in this context, in fact, the distinction between nominal and real wages is pointless.

The benchmark for the sticky wage models is represented by the Classical (Marginalist) theory of unemployment, which holds the Walrasian presumption that wage adjustments always settle imbalances between demand and supply of labour. In this view unemployment is largely voluntary and therefore does not need to be explained (nor pondered over).[1] However, in reality the observed wage adjustments are not as prompt as they are supposed to be, according to the Classical theory, and unemployment is acknowledged to be an involuntary and persistent phenomenon.

In the picture designed by sticky wage models, the labour market is still intrinsically Walrasian and prone to attain the balance of demand and supply, but wages are prevented from adjusting to full employment levels by frictions of one sort or another. These theories can be therefore classified according to how they explain the nature of the rigidities that cause market-clearing to fail. Since the existing literature relevant to this subject is very extensive, in the text that follows, we concisely recall the principal strands of research that give this phenomenon its credence.

Among the principal examples, we find *contracting* models (e.g. Taylor, 1979) and search models (e.g. Diamond, 1982) to be among the more significant. Unfortunately, the approaches indicated in the examples do not provide true economic explanations and basically border on tautology; the former stating that wages do not adjust because predetermined job contracts prevent them from adjusting, the latter claiming that individuals cannot find a job because the process of a search for a firm willing to hire is expensive. Also, even though legal commitments and search costs may partly explain the presence of persistent equilibrium unemployment, these frictions could hardly be satisfactory explanations of its cyclical variations. In fact, if frictions cause a given level of unemployment, then in principle their variations should cause variations in unemployment; but cyclical movements in frictions preceding those of the unemployment rate, are hardly observed. The explanation to unemployment variations should be therefore, more effectively sought elsewhere.

Another popular way to explain sluggish wage adjustments is represented by the *efficiency-wage* theories (e.g. Shapiro and Stiglitz, 1984), which argue that firms, in the presence of imperfect monitoring, might find it convenient to pay higher wages than those prevailing in full-employment conditions, in order to prevent workers from shirking. Efficiency-wage models provide economic explanations of sticky wages, but, perhaps for the wrong reasons. Crucial to the analysis, in fact, is the naive, unproven and unnecessary assumption that workers have a tendency to shirk in full-employment conditions. Moreover, real firms may not pay 'high' wages to reduce the temptation of shirking because they have the option of many other incentives, such as wages linked to individual productivity. Efficiency-wage theories can be questioned as far as their predictions are concerned. As a matter of fact, these models hold that wages are fully flexible outside equilibrium, but fixed at equilibrium. Hence, they do not explain why wages are sticky even in situations where there is an abundance of labour supply, but suggest why equilibrium wages must always lie above the market-clearing level, and

[1] Classical attitude toward the unemployed is not dissimilar from that held by Queen Marie Antoinette toward the Parisians asking for bread during the French Revolution.

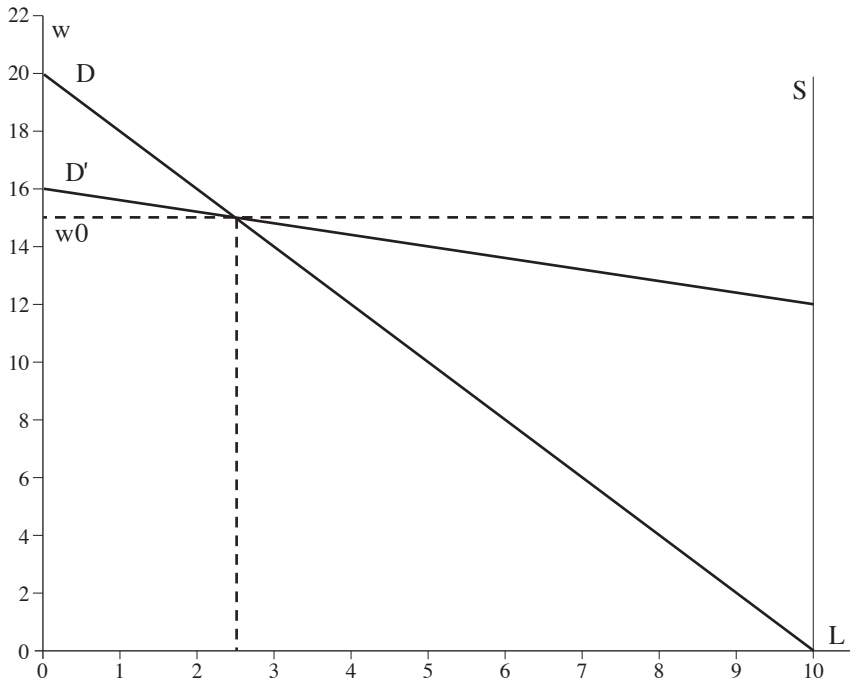
why full employment can never be attained, regardless of labour demand. Last but not least, there is one more aspect that to our knowledge has so far never been recognized. In these models, equilibrium unemployment occurs at the intersection between labour demand and the no-shirking condition curve. The no-shirking condition curve represents the wage to be paid in order to induce a given amount of employees to exert effort, that is to induce them to provide their labour, and basically matches a canonical forward-leaning labour supply schedule. In fact, both functions are mappings from offered wages to labour supply. Thus, the efficiency-wage approach, apart from the formal complicacies and the rather ad hoc assumptions that characterize it, is very similar to the Classical theory.[2]

As a conclusion to our brief review, we point out that while maintaining the involuntary nature of unemployment, the sticky wage approach reduces it to a peculiar equilibrium of the labour market. This is the starting point of the present paper, where we are going to assume an alternative perspective. In our opinion, in fact, what can be observed in labour markets at the usual time frequencies is neither a position of equilibrium, nor a permanent situation of disequilibrium, but a slow process of adaptation, possibly converging towards some equilibrium. Consequently, wages should be regarded neither as fixed, nor as fully flexible. The correct research question, therefore, is not to explain why a smooth adjustment process eventually moves into a situation characterized by involuntary unemployment, but is to explain why this process may be more or less sluggish. To understand that the difference is substantial, let us consider figure 1 where two different labour markets are depicted: both share the same rigid labour supply S, same current wages w_0, and same levels of unemployment, but one is characterized by a steep (inelastic) labour demand D, while the other is characterized by an elastic labour demand D'. Full-employment wages are respectively equal to 0 and 12.

Paradoxically, according to economic theory, the two scenarios are identical. On the one hand Classical theory holds that both markets will quickly converge to full employment, even though in the case of inelastic demand workers are supposed to accept a null wage. On the other hand, the sticky wage approach predicts that unemployment will persist in both scenarios, although in the case of elastic demand, the wage reduction necessary to reach full employment is small. However, simply relying upon common sense, we believe that anyone would agree with the fact that a relatively prompt adjustment to full employment is more likely to occur in the elastic labour demand case, while more resistance should be experienced in the rigid demand case. The essence of this paper is exactly to prove that to rational workers the two scenarios are indeed different.

[2] Efficiency wages supporters may point out that at equilibrium, unemployment is involuntary. However, in our opinion, semantic tricks are being played here. In fact, if the unemployed were hired at an infinitesimally lower wage, they would shirk, and shirking workers are ones who do not want to supply labour. Therefore, they are not different from voluntarily unemployed workers (aside from an economically small epsilon, of course!).

Figure 1 - Two alternative labour markets: with rigid (*D*) and elastic demand (*D´*)



To formalize the above intuition, we set up a stylised game-theoretic framework where rational unemployed workers compete for a job by bidding wage offers. Although they are ready to work at any wage level (including full-employment wages), at the same time, they would also like to earn as much as possible. However, because of competition, high bids might drive them out of the market. Workers, therefore, face a trade-off between the certainty of finding a job at a low wage and the risk of experiencing a long spell of unemployment caused by too exorbitant wage bids. In solving this dilemma, workers may actually find it optimal to request high wages initially, and reducing their demand later, if necessary. Thus, sluggish wage adjustments and the consequent persistent unemployment may be the natural outcome of competition among rational workers and not of macroeconomic disequilibrium, or microeconomic frictions impeding firms from hiring. We point out that, in spite of marked formal differences, our approach might be seen as an instance of competitive search modelling (Moen, 1997; Shimer, 1996), where firms' wage posting is combined to directed job search by workers (see, Rogerson, Shimer and Wright, 2005).

The key factor driving our result is the slope (or the elasticity) of labour demand schedule, which normally is not given much consideration in the analysis of unemployment; when demand is inelastic, sticky wages and persistent unemployment

are more likely to show up, while full employment can be restored more easily when labour demand is elastic. This finding contrasts with other approaches, such as Keynesian economics, where only the level of labour demand is regarded as the cause of unemployment. Moreover, we find that two other factors of secondary importance can also play a role in increasing wage stickiness; namely, the degree of patience characterizing the workers, and the effort required by the job. In particular, we can deduce that generally only the poor vie for ill-paid and hard jobs.

Besides the traditional dichotomy of voluntary and involuntary unemployment, we propose here a third concept that we take the liberty to call 'rational unemployment'. It is not involuntary, as no rigidity prevents workers from immediately finding a job by bidding the full-employment wage, and it is not even voluntary in the Classical sense because workers are, in principle, available to work at any wage level. In a sense, we can think of rational unemployment as a lost bet.

The remainder of the paper is organized as follows: In section 2 we describe the model and discuss the main result. In the third section we extend the model by introducing the working effort, as well as analyse the relationship between desire to work and the effort required by the job. Section 4 is the conclusion of the paper.

2. The model

In the text that follows, we are going to set up a partial equilibrium framework where macroeconomic conditions are given and not influenced by the level of employment.

Consider a labour market made up of one firm and two competing unemployed workers.[3] At the current wage w_0, the firm has no vacancies, but it is willing to open one vacancy at wage rate w_1 and two vacancies at w_2, with $w_0 > w_1 > w_2$. The workers are available to accept any wage level in order to get the job. As a consequence, w_2 reflects the wage rate in the full-employment scenario. The workers compete for the two jobs; each bidding a wage offer.

The firm's labour demand might be interpreted as a monopsonistic employer's behaviour that optimally decides how many workers to hire at different wage rates, or more conveniently, as a reduced form of the market demand, capturing the overall macroeconomic situation. In such a situation, therefore, our model is equivalent to a price-setting duopoly model with quantity constraints where workers facing a labour market demand seek to sell their (limited) labour supply.

The game lasts two periods and everything is common knowledge. Even though considering an infinitely repeated game would seem more appropriate to explain persistent unemployment, we stick to the simpler two-stage game because results qualitatively coincide.

To determine the payoff functions, we have to consider three possible cases. In the first case, both workers bid w_2 and the firm (or the market) opens two vacancies, so that they get the job at the proposed wage. This is the Classical solution, with wages immediately set at full employment level. We assume that the second-period wage is discounted by a non-negative factor $\beta \leq 1$.

[3] From a formal viewpoint, our model resembles that of Montgomery (1991), where two firms post wages and two workers apply for a job. However, similarities stop there.

In the second case, it is assumed that one worker bids w_1, and the other bids w_2. Hence, the one bidding less immediately gets the job at wage w_2, while the other stays unemployed, since she is demanding a higher wage for the job. Assuming an efficient rationing rule, in the second period the labour demand decreases by one at any wage rate, as one worker has been employed in the previous period. Consequently, at w_1 the firm has no more vacancies, and has only one at w_2. Thus, the unemployed is forced to bid w_2, in order to get the job. Again, we assume that the second-period wage is discounted by a non-negative factor. In this case, unemployment is persistent, as it takes two periods to disappear, even though the wage, at which both workers find the job, is the full-employment wage w_2.

In the last case, both workers bid w_1, and the firm opens only one vacancy. We assume that each worker has 1/2 a probability to get the job at w_1. The play of the game in the second period depends on whether the employed worker can retain the wage w_1 or not. So, further on, we first discuss the scenario in which the employed worker secures her/his job at wage w_1, also in the second period. At the end of this section, we consider the other case, where the job and the wage w_1, cannot be automatically retained. We will show that the two cases lead to the same major result, namely that wage stickiness depends on labour demand elasticity.

Let us make the hypothesis that the employed worker of the first period retains her/his job at wage w_1, in the second period as well. The choice of this assumption can be justified in many ways; for example, by invoking insider-outsider arguments, or envisioning that a firm and a worker may sign a long-term job contract. In addition, there exists a large volume of empirical literature, showing that nominal wages are generally characterized by downward rigidity for such different reasons as preventing labour turnover, and preventing reduced labour effort, or more simply, for reasons of perceived equity among workers (Campbell and Kamlani, 1997; Bewley, 1999).

The unemployed worker faces a reduced labour demand in the second period, as is explained above. However, the firm has already one worker employed at wage w_1, and it is likely that the firm is not willing anymore to open another vacancy at wage w_2. Hence, in order to keep the firm's choices consistent with a profit-maximizing behaviour, we may assume that the unemployed worker can get the job only at a wage $w_3 \leq w_2$, such that one worker is paid at w_1, and one worker is paid at w_3, as if together on an average, the two workers are paid at wage w_2. As a consequence, hiring another worker, while the first employed worker is retaining the job at the same (high) wage w_2, is still a rational choice for the firm. Thus, assuming risk-neutrality (and discounting future earnings) each worker bidding w_1 in the first period has an overall expected payoff of

$$\pi_i(w_1, w_1) = \frac{(1+\beta)w_1 + \beta w_3}{2}. \tag{1}$$

In this case unemployment is persistent. In addition, wages adjust slowly, from w_0 to w_1, and then from w_1 down to w_3.

The payoff matrix given in figure 2 summarizes the game. As we can see, the Classical outcome '(w_2,w_2)' is indeed a Nash Equilibrium of the game. However, the crucial point is to assess its plausibility.

Figure 2 - Workers' payoffs

	w_1	w_2
w_1	$\frac{(1+\beta)w_1+\beta w_3}{2}, \frac{(1+\beta)w_1+\beta w_3}{2}$	$\beta w_2, (1+\beta)w_2$
w_2	$(1+\beta)w_2, \beta w_2$	$(1+\beta)w_2, (1+\beta)w_2$

For the time being, let us consider the extreme case of $w_3 \leq 0$; if both workers choose the pair of strategies '(w_1,w_1)', then in the second period the unemployed cannot find a job at a positive wage; though, the pair '(w_1,w_1)' can still be an equilibrium if

$$\frac{(1+\beta)w_1}{2} \geq (1+\beta)w_2$$

Alternatively, if $w_1 \geq 2w_2$, that is if the labour demand schedule is very steep, or inelastic. In such a situation, this solution Pareto-dominates the Classical equilibrium, and identifies itself as the focal point of the game. Its meaning is straightforward; when an excessive wage reduction becomes necessary to immediately secure a job, the workers might find it optimal to risk a longer spell of unemployment in order to gain a higher wage or, more specifically, not to end up with too low a wage. Thus, when labour demand is rather inelastic, wages adjust slowly and unemployment takes time to disappear, simply as a result of rational choices; thus exemplifying our definition of rational unemployment.

Furthermore, in broader terms, we can define the Rational Unemployment Region (RUR) as all the possible combinations of values for the vector (β,w_1,w_2,w_3), such that rational unemployment and sluggish wages show up as equilibrium phenomena. The RUR is given by the set of non-negative values satisfying

$$\frac{(1+\beta)w_1+\beta w_3}{2} > (1+\beta)w_2;$$

that is,

$$w_1 - w_2 > w_2 - \frac{\beta}{1+\beta}w_3 \qquad (2)$$

Inequality (2) helps to show the importance of the elasticity of labour demand; the larger the difference between w_1 and w_2, or conversely, the smaller the gap between w_2 and w_3, the higher the possibility of having persistent unemployment.

The RUR also shows how the degree of 'patience' β influences wage stickiness and unemployment. If the workers are patient (β close to one), as in the case of individuals endowed with enough savings to live without working, or supported by their families, or again benefiting from unemployment subsidies, then the RHS of inequality (2) is smaller, and the pair of strategies '(w_1,w_1)' is more likely to be an equilibrium. The interpretation of the role of β is clear-cut; if workers are not compelled to bid down the wage by some contingency (i.e. if their budget constraint

is not binding), they actually could find it optimal to try to get the job at a high wage (w_1), at the risk of remaining unemployed for a longer period. Conversely, when β is close to zero, that is, when unemployed workers are impatient to find a job because their budget constraint binds, the Classical outcome '(w_2,w_2)' is more likely to be the unique solution of the game. This finding is consistent with the fact that poor people are more inclined to accept low wages.

As anticipated, at the end of this section we discuss the scenario in which the worker employed at wage w_1 cannot automatically retain her/his salary in the second period. In this case, the model becomes a two-stage repeated game, and the workers' second-stage actions may come to depend on their first-period behaviour. However, in order to make our point clear, we limit our study to consider the extreme case in which both workers find a job at wage w_2 during the second period. This changes equation 1 into

$$\pi_i(w_1, w_1) = \frac{1}{2}(w_1 + \beta w_2) + \frac{1}{2}(\beta w_2) = \frac{w_1 + 2\beta w_2}{2}$$

Given that the payoff from working two periods at wage w_2 is $(1 + \beta)\ w_2$, wages are sluggish and 'rational unemployment' is an equilibrium if

$$\frac{w_1 + 2\beta w_2}{2} > (1+\beta) w_2$$

Alternatively if $w_1 > 2w_2$, that is the factor at which the labour demand schedule is reflected as very steep, or inelastic. So, we have the same result once again. Actually, we have an even stronger result when labour demand is inelastic. In such a situation, bidding w_1 is a position of equilibrium in the second-period subgame. Therefore, we may have, as subgame-perfect Nash equilibrium, a pathological situation in which unemployment never disappears because the workers bid w_1 in both periods.

In the next section we extend the model to include the effort of working, and we will see that in this case as well, our framework forecasts reasonable results.

3. Effort and unemployment

In this section, working effort is introduced as an influencing factor. We will see that when the effort required by the work is higher, workers are more reluctant to bid down the wage (the strategies '(w_1,w_1)' become the Pareto-dominant equilibrium). In addition, we find a convincing relationship between effort and patience.

Now, working costs an effort e to workers, whereby their payoff from working reduces to $w - e$. Suppose in addition that $e \leq w_2$ (otherwise in the second period, there is no incentive to work whatsoever). The new payoff matrix is shown in figure 3, where we set $w_3 = w_2$ to make the algebra simpler.

Figure 3 - Workers' payoffs

	w_1	w_2
w_1	$\frac{(1+\beta)w_1+\beta w_2-(1+2\beta)e}{2}, \frac{(1+\beta)w_1+\beta w_2-(1+2\beta)e}{2}$	$\beta(w_2-e), (1+\beta)(w_2-e)$
w_2	$(1+\beta)(w_2-e), \beta(w_2-e)$	$(1+\beta)(w_2-e), (1+\beta)(w_2-e)$

Again, the RUR is given by

$$\frac{(1+\beta)w_1+\beta w_2-(1+2\beta)e}{2} > (1+\beta)(w_2-e);$$

that is

$$w_1-2w_2 > \frac{1+2\beta}{1+\beta}e-2e-\frac{\beta}{1+\beta}w_2 \tag{3}$$

For given factors w_1 and w_2, the occurrence of rational unemployment depends on β and e. Since the derivative of RHS of inequality (3) with respect to both β and e is negative, these two parameters increase the likelihood of persistent unemployment[4]. In fact, effort reduces the value of a job, and therefore the incentive to work; thus it is logical for workers to ask for higher wages. However, it is even more interesting to study how the parameters β and e interact with each other, as shown below.

First, for a given e, we define $\hat{\beta}(e)$ as the maximum degree of patience that workers may possess, such that the LHS in (3) is not greater than the RHS, making the Classical solution '(w_2,w_2)' the unique equilibrium of the game. So, $\hat{\beta}(e)$ is such that

$$w_1-2w_2 = \frac{1+2\hat{\beta}}{1+\hat{\beta}}e-2e-\frac{\hat{\beta}}{1+\hat{\beta}}w_2$$

From this calculation we arrive at (after some trivial algebra)

$$\hat{\beta}(e) = \frac{a-e}{w_1-w_2} \tag{4}$$

In this equation we have set $w_1 - 2w_2 = -a$.

If the degree of patience characterizing the workers is lower than the threshold $\hat{\beta}(e)$, then the full-employment equilibrium is the only outcome; conversely, if it exceeds $\hat{\beta}(e)$ then the sticky wages/persistent unemployment solution '(w_1,w_1)' becomes the focal point of the game.

Equation (4) shows that threshold $\hat{\beta}(e)$ is clearly decreasing in e (as $w_1 > w_2$), which implies that higher effort levels are compatible with the Classical outcome only for a smaller degree of patience. In other words, more patient workers (say 'richer'

[4] $\frac{\partial RHS}{\partial e} = -\frac{1}{1+\beta} < 0$ and $\frac{\partial RHS}{\partial \beta} = -\frac{w_2-e}{(1+\beta)^2} < 0$, as we postulate $w_2 - e > 0$.

workers) can only tolerate low effort levels before the focal point of the game becomes '(w_1,w_1)'. On the contrary, less patient workers (say 'poorer' workers) can still have an incentive to bid a low wage w_2 even though the job becomes harder. This finding is consistent with the fact that in general, hard and ill-paid jobs are performed by the poor.

4. Conclusion

The goal of this paper is to give a clear-cut rationale for the sluggish wage adjustment that is commonly experienced, especially in the conditions of involuntary unemployment. We have proved that persistence of unemployment is not necessarily the fruit of macroeconomic disequilibrium, or frictions impeding the proper working of labour market mechanisms, but that it may simply be the natural consequence of decisions motivated by self-interest, taken by rational workers.

We believe that unemployment levels and their variations are ultimately macroeconomic phenomena, determined by such factors as aggregate demand, pace of technological progress, or composition of the population. However, our purpose was to explain why a given level of unemployment may take a long time to disappear entirely, even when macroeconomic conditions (in our model represented by labour demand) are compatible with full employment. In other words, we did not want to explain why unemployment levels vary, but why they do *not* vary. This perspective, therefore, rules out the necessity to take into account the labour demand dynamics, and justifies our choice of a partial equilibrium approach. In fact, for given macroeconomic conditions determining an exogenous labour demand function, we can analyse in isolation how workers' decisions may cause persistence of unemployment.

We did so by working with a theoretical apparatus characterized by extreme formal simplicity. We assumed that unemployed workers compete for a job by bidding wage offers and that, although they are ready to work at any wage rate, at the same time they would also like to earn as much as possible. Workers, therefore, face a trade-off between the certainty of finding a job at a low wage, and the risk of experiencing a long spell of unemployment, caused by too exorbitant wage bids. We have showed that workers may indeed be reluctant to immediately bid low wage offers and want to assume the risk of remaining unemployed for a long period. We have therefore referred to this kind of unemployment as rational unemployment, to stress that it is neither voluntary in the Classical sense, chiefly because workers do want to secure a job, nor involuntary, as no rigidity prevents workers from bidding the full-employment wage level.

The major factor driving the result is the *elasticity* of labour demand, which is, in general, neglected in the analysis of unemployment. Labour demand rigidity, in fact, lowers the convenience of finding a job, since it requires the workers to bid a low wage level. As a consequence, it decreases the opportunity cost of being unemployed. This marks a sharp difference with other approaches, where only the level of labour demand is considered.

The model also predicts that poor people are more inclined to accept low wages and hard jobs. This finding, which is largely consistent with common sense and everyday experience, helps to increase our confidence that the proposed approach to unemployment is viable and potentially fruitful.

Extensions might include those that make the degree of impatience endogenous, or those that explicitly consider opportunity costs in the workers' decisions. As an example, it is often wondered why the unemployed do not move to other cities to find a job. A likely explanation is that workers might face opportunity costs in moving, for instance because in their city they already own a house and the wage they might earn in another city might not be high enough to arrange for a new house. Again, workers may be burdened with fixed costs to pay every month, or minimum consumption levels to attain; if labour demand is inelastic and the wage they expect to earn is not sufficient to meet their needs, it is then that they may continue to ask for high wages. Moreover, this can also provide a rationale for reasons why individuals may eventually exit the labour force.

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