Time Consuming Labor Mobility and Dynamic Behavior*

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This paper attempts to construct a dynamic model of the labor market which consists of two distinctive but interrelated sectors, assuming that it takes time to complete migration. Implications of the model are consistent with stylized facts of the labor market. The model shows that fluctuations in contract sector employment are greater than those in spot sector employment and that contract sector wage rates fluctuate less than spot sector wage rates. It also shows the countercyclical movement of intersectoral wage differentials. And the model suggests that a temporary shock generates persistent movements of wage rates and employment. (*JEL* J42, J62)

I. Introduction

Looking at the literature on the analysis of the U.S. labor market enables us to encounter some stylized facts. First, fluctuations in unionized contract sector employment are greater than those in nonunionized spot sector employment. Second, unionized sector wage rates fluctuate less than spot sector wage rates. Third, intersectoral wage differentials widen in recessions and narrow in booms.[1] Highly persistent unemployment is also an undisputed fact that should not be omitted.

Although a lot of studies have analyzed either a contract sector or a spot sector, it is natural that these analyses would not be able to explain the aforementioned stylized facts of the labor market in that

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[1]The third fact is a corollary of the second fact if wages in two sectors move in the same direction.

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they deal with a single type of labor market. This problem forces us to refer to the segmented labor market framework consisting of a contract sector and a spot sector. The works by McDonald and Solow (1985) and Hahn (1991, 1992) are remarkable in this sense. It is likely, however, that the theoretical analysis of segmented labor markets has not been fully developed yet considering the relative abundance of empirical works.

There have been two kinds of labor market segmentation in the theoretical literature: urban sector versus rural sector segmentation and primary sector (efficiency wage) versus secondary sector (spot wage) segmentation. A common feature of these two approaches is that one sector is characterized by higher wage rates rather than market-clearing wage rates so unemployment exists in the economy.

The urban versus rural segmentation approach, developed by Todaro (1969), Harris and Todaro (1970), and Demekas (1987) for example, basically depends on the geographic separation of the two sectors. Although this is a reasonable approach for the economies of less developed countries, it is not for the purpose of this paper.

The second approach depends upon the efficiency wage theory to rationalize the wage rate higher than the market-clearing one. Most recent theoretical works take this approach. Bulow and Summers (1986) and Jones (1987) are among those who emphasize the efficiency wage theory. This approach shows that even when all workers are homogeneous the wage differential exists in the economy.

All these preceding models are not able to fill the gap between the empirical findings and theoretical elaboration. In other words, although it is observed that the real economy contains two types of labor markets and that these labor markets are characterized by dynamics in wages and employment as well as continuous intersectoral relocation of workers, too less is developed at a theoretical level.

The purpose of this paper is to construct a dynamic model of the labor market which consists of two distinctive but interrelated sectors, and whose implications are consistent with aforementioned stylized facts. The key element in developing the model is time consuming labor mobility. The idea of time consuming labor mobility in the labor market is not unique in this paper. As capital takes some periods to be productive because of technology or as the theory of sectoral shifts argues, migration of a worker requires time to be completed (productive). Therefore every migrant is not able to find a job in the contract sector in that period when he leaves the spot sector. This is likely to be true of workers moving from the contract sector to the spot sector.

The paper is organized as follows. Section II provides evidence for certain stylized facts found in the U.S. labor market. The model is developed in section III and is analyzed in section IV. Concluding remarks are addressed in section V.

II. Stylized Facts of the Labor Market

A. Fluctuations in Employment and Wage Rates

One of the stylized facts of the labor market, mentioned by McDonald and Solow (1985), is that a shock, whether it is permanent or temporary, causes greater fluctuations in unionized contract sector employment than nonunionized spot sector employment while it causes smaller fluctuations in contract sector wage rates than spot sector wage rates.

Freeman and Medoff (1984) show that manufacturing employment has been the source of more than half of the economy's cyclical employment variation while it accounts for only one-fourth of nonagricultural employment and argue that it happens because the manufacturing sector is one of the two most heavily unionized sectors. The construction sector, which is the other one of the two, reveals similar variation in employment: it fell by 10 percent during the 1979-82 recession while total employment remained nearly stable (1984, pp.112-3). The comparison of employment fluctuations between the unionized and the nonunionized sectors is reported in Table 1. Fluctuations in total hours are four times larger in highly unionized industries than in low unionized industries and fluctuations in employment show a similar pattern.

One interesting thing in Table 1 is that differences in fluctuations are greater in all industries than in manufacturing industries. It is likely that manufacturing industries are highly unionized and thereby nonunionized employees in manufacturing industries can negotiate as close as unionized employees. Two arguments may explain this: first, there are spillover effects from the unionized sector and second, firms tend to compensate nonunionized workers to avoid potential unionization under the circumstances of union threat. As a consequence, there is no substantial difference between unionized and nonunionized workers in manufacturing industries.

The relative sensitivity between unionized and nonunionized sector

TABLE 1
CYCLICAL CHANGES IN HOURS WORKED AND EMPLOYMENT

	Variance of Cyclical Changes in Total Hours (in log units)	Variance of Cyclical Changes in Employment (in log units)
All Workers, All Industries (34)		
Lowest Unionization Industries (17)	0.011	0.008
Highest Unionization Industries (17)	0.045	0.029
All Workers, Manufacturing Industries (20)		
Lowest Unionization Industries (10)	0.017	0.012
Highest Unionization Industries (10)	0.026	0.015

Source: Freeman and Medoff (1984, Table 7-1).

wages to market conditions is estimated by Mitchell (1978) for the period 1960-76. Following his regression results, the sensitivity of nonunion wages to market conditions is 16.82 while that of average wage (combining both union and nonunion wages) is 6.87. In the same study, he estimates the sensitivity of wages for 93 industries and arranges the results according to the characteristics of industries, leading us to conclude that the more unionized, the less sensitive wages. The empirical study by Flanagan (1976) also shows that this is indeed the case: the response of nonunionized sector wages to labor market conditions is three times as greater as that of unionized sector wages for the period 1960-75.

B. The Intersectoral Wage Differential over Time

Another stylized fact of the labor market is that the intersectoral wage differential widens as the overall labor market weakens and narrows as it tightens. Lewis writes:

> ...there is substantial agreement in the evidence provided by

> earlier studies that the impact of unionism on the union/nonunion relative wage has varied rather widely over time and in a systematic manner. In particular, the relative wage effect estimates appear to be negatively correlated with the rate of inflation and positively correlated with the unemployment rate. (Lewis 1963, p. 191)

The work of Lewis stimulated the study of the relationship between wage differentials and business cycles. Many empirical studies have attempted to estimate intersectoral wage differentials between a union sector and a nonunion sector over business cycles. A stylized fact that emerges from these studies is that a negative shock causes the intersectoral wage differential to widen while a positive shock causes it to narrow.

The estimates for the relative wage, W_{1t}/W_{2t}, obtained by Lewis (1963, 1986) are reproduced in Table 2. The first column of Table 2 contains RW_t, the estimates for $\log(W_{1t}/W_{2t})$ over time. And wage differentials in natural units, WD_t are reported in the second column.

Table 2 shows that the wage differential increased a great deal during the Great Depression (the peak impact occurred in 1932-33 according to Lewis) and decreased almost to zero through World War II and the immediate postwar years (the trough occurred in 1947 and 1948 according to Lewis). The decline of the wage differential did not persist through the 1950s but rather increased steadily through this decade. In his later work, Lewis (1986) calculates an average wage differential of 15 percent for 1967-79 with a low value of 12 percent for 1967-69 and a high of around 20 percent for 1975-78. Comparing unemployment rates (u) in the third column of Table 2 with wage differentials leads to the conclusion that the intersectoral wage differential is countercyclical.

Johnson (1984) estimates wage differentials for the years 1960-79. His estimates are also reported in Table 2. Johnson's estimates are greater than Lewis' estimates because of upward bias resulting from the omission of control variables correlated with the union status variable.[2] However, his estimates also have the same macroeconomic implication as Lewis': intersectoral wage differentials fluctuate countercyclically. Freeman and Medoff (1984), Summers (1986) and many other researchers also present evidence for the countercyclical wage

[2]Lewis (1986) believes micro cross-sectional estimates reported in Table 2 are upper bounds because they are biased upward owing to the omission of control variables.

TABLE 2
ESTIMATED WAGE DIFFERENTIALS OVER TIME

Author	Period	*RW*	*WD*	*u* (%)
Lewis (1963)	1920-24	0.16	0.17	6.4
	1925-29	0.23	0.26	3.5
	1930-34	0.38	0.46	19.0
	1935-39	0.20	0.22	17.5
	1940-44	0.06	0.06	6.5
	1945-49	0.02	0.02	3.9
	1950-54	0.11	0.12	4.0
	1955-58	0.15	0.16	4.9
Lewis (1986)	1967	0.11	0.12	3.8
	1968	0.11	0.12	3.6
	1969	0.11	0.12	3.5
	1970	0.12	0.13	4.9
	1971	0.15	0.16	5.9
	1972	0.12	0.13	5.6
	1973	0.15	0.16	4.9
	1974	0.14	0.15	5.6
	1975	0.16	0.17	8.5
	1976	0.18	0.20	7.7
	1977	0.17	0.19	7.1
	1978	0.17	0.19	6.1
	1979	0.13	0.14	5.8
Johnson (1984)	1960-64	0.22	0.25	5.7
	1965-69	0.17	0.19	3.8
	1970-74	0.17	0.19	5.4
	1975-79	0.26	0.30	7.0

Source: Lewis (1963, Table 64; 1986, Table 9.7); Johnson (1984, Table 1-2); U.S. Department of Labor (1990).

differential.

III. The Model

A. The Unionized Contract Sector

The model for the unionized sector was basically developed by McDonald and Solow (1985). Wages in this sector are assumed to be set by bargaining process between a firm (an employer) and a union (consisting of homogeneous workers) such that the bargaining outcome is efficient, where each party has its own objective function to be maximized. A way to get such an efficient result is to introduce the solution proposed by Nash (1950, 1953).

The union members are identical, each having a monotonic and concave utility function $U(W_1)$ over the real wage rate in the contract sector W_1. As Dunlop (1944) recognizes, the organization (the union) also maximizes some objective function. The union's objective function is assumed to be[3]

$$L_1[U(W_1) - U(W^*)], \tag{1}$$

where W^* is a reservation wage and L_1 is the level of employment in the contract sector. Equation (1) says that the union wishes to maximize the membership's aggregate utility from employment over the utility level associated with the reservation wage which is derived from not working.

The firm's objective function is given by a usual profit function:

$$R(L_1) - W_1L_1, \tag{2}$$

where $R(L_1)$ is a concave revenue function and the firm is a profit maximizer.

The Nash bargaining problem is to maximize the product of two parties' objective functions over W_1 and L_1:

$$[R(L_1) - W_1L_1][U(W_1) - U(W^*)]L_1. \tag{3}$$

By manipulating first-order conditions, we have

$$W_1 - R'(L_1) = \frac{U(W_1) - U(W^*)}{U'(W_1)}, \tag{4}$$

$$W_1 = \frac{1}{2}[R'(L_1) + \frac{R(L_1)}{L_1}]. \tag{5}$$

The implication of equation (4) is that the slope of a union's indifference curve is equal to the slope of a firm's isoprofit curve. Therefore, equation (4) defines a contract curve and W_1 and L_1 are guaranteed to be on the contract curve, leading to efficient contracts. Equation (5), defining the equity curve, says that the real wage rate must be the arithmetic mean of the marginal revenue product and the average revenue product of labor. Note that this rule is derived from the specific

[3]The objective function that Dunlop develops is, in fact, the product of the wage rate and employment, that is total wage bill.

setting of objective functions in the Nash bargaining problem, that is the assumption of equal bargaining power of the two parties.

If the relative bargaining power between the firm and the union is different and the relative power is denoted by the measures x and $1-x$ for the firm and the union, respectively, then equation (5) will be the weighted average of the marginal and the average revenue products of labor:

$$W_1 = xR'(L_1) + (1-x)\frac{R(L_1)}{L_1}.$$

Three propositions can be obtained from the comparative static analysis (Mathematical proofs are omitted here). First, a rise in the reservation wage shifts the contract curve up. Second, an increase in the demand shifts the contract curve down and the equity curve up. Third, the effects of an increase in the demand on employment are positive while effects on the wage rate are ambiguous.

To get the reduced form for the wage rate, it is assumed that the revenue function satisfies constant elasticity with respect to employment:

$$R(L_1) = \theta_1 L_1^{\alpha}, \quad 0 < \alpha < 1, \tag{6}$$

where α is the elasticity of revenue with respect to employment and θ_1 is a demand shock to the contract sector, with upper and lower bounds θ_{max} and $\theta_{min} > 0$. Then, combining (4), (5), and (6) gives (7):

$$\left[\frac{1-\alpha}{1+\alpha}\right] W_1 U'(W_1) = U(W_1) - U(W^*). \tag{7}$$

Therefore, it follows immediately from (7) that the negotiated real wage rate in the contract sector is constant if the reservation wage W^* is unchanged.

If, in addition to the revenue function, the utility function is also of the constant elasticity form,

$$U(W_1) = W_1^b / b, \quad b < 1,$$

then, (7) reduces to the following relationship for a certain period t:

$$\frac{W_{1t}}{W_t^*} = \left[1 - b\left(\frac{1-\alpha}{1+\alpha}\right)\right]^{-1/b} \equiv k > 1, \tag{8}$$

where W_{1t} is the real wage rate in the contract sector in period t and the RHS is obviously constant. Therefore it can be denoted by k and is greater than one.[4] The negotiated wage rate is decreasing in the technology parameter α and is increasing in the elasticity parameter b.

Specifying the reservation wage enables us to connect the contract sector with the spot sector and thereby interaction comes about. In a segmented labor market scheme, it is assumed that the reservation wage is closely related to the real wage rate in the spot sector. Bulow and Summers (1986), for example, argue that contract sector firms need to observe wages offered in the spot sector to know their relative wages. And, as an empirical matter, the study by Flanagan (1976) suggests that this is indeed the case. Generally, the relation can be written as follows:

$$W_t^* = g(W_{2t}), \quad 0 \le \varepsilon^* \equiv \frac{W_2 g'(W_2)}{g(W_2)} \le 1, \tag{9}$$

where W_{2t} is the real wage rate in the spot sector in period t. Equation (9) states that the reservation wage is positively related to the spot sector real wage rate. Thus the reservation wage rises and falls with the spot sector real wage rate at most proportionally. The simplest story satisfying this restriction is that the reservation wage is equivalent to the real wage rate in the spot sector, say $W_t^* = W_{2t}$.

Combining this simplest form with equation (8) yields a linear relationship between the contract sector and the spot sector wage rates:

$$W_{1t} = kW_{2t}.$$

Note that k is a decreasing function of α and $1 - b$.

If the real wage rate in the contract sector is negotiated between a

[4]If we assume that the utility function is linear, that is $U(W_1) = bW_1$, then (8) becomes

$$\frac{W_{1t}}{W_t^*} = \frac{1+\alpha}{2\alpha} > 1.$$

The ratio between W_{1t} and W_t^* is independent of a parameter b but still constant. Thus the same relationship can be derived from a linear utility function. Following the insider-dominated approach, we also have a very similar outcome as (8):

$$\frac{W_{1t}}{W_t^*} = \left[1 - \frac{b(1-\alpha)}{\alpha}\right]^{-1/b} > 1.$$

Finally, an insider-outsider model by Lindbeck and Snower (1987) yields the wage rate positively related to the reservation wage plus turnover costs. Thus the nature of the negotiated wage behavior is robust to the model used for the contract sector.

union and a firm, employment is determined by (5) for each value of θ_{1t} and W_{1t}:

$$L_{1t} = \left[\frac{2W_{1t}}{\theta_{1t}(\alpha+1)} \right]^{1/(\alpha-1)} . \tag{10}$$

Equation (10) states that employment in the contract sector is positively related to the demand shock occurred in the contract sector and negatively related to the contract sector wage rate since α is less than 1.

B. The Nonunionized Spot Sector

The spot sector is defined as the market where a flexible wage rate W_2 equates the demand for labor and the supply of labor in every period. The demand for labor in the spot sector is a function of the real wage rate and a shock:

$$L^d_{2t} = \theta_{2t}D(W_{2t}), \ \ D'(W_{2t}) < 0, \tag{11}$$

where θ_{2t} is a demand shock to the spot sector with upper and lower bounds. If $\theta_{1t} = \theta_{2t}$ holds, then the shock is an economy-wide demand shock affecting both sectors equivalently. Otherwise, it is a sector-specific shock affecting either a contract sector or a spot sector or affecting both sectors differently. The demand function for labor is downward sloping with respect to the real wage rate and a positive (negative) shock increases (decreases) the demand for labor. Let N_{2t} stand for the supply of labor to the spot sector. Then the flexible real wage rate yields

$$N_{2t} = \theta_{2t}D(W_{2t}). \tag{12}$$

This segmented labor market story rests on the assumption of asymmetry in wage interdependence—the contract sector takes account of the spot sector wage rate through the reservation wage whereas the spot sector wage rate doesn't depend on the contract sector wage rate. Many segmented labor market studies rest on the same assumption and the empirical study by Flanagan (1976) provides evidence for the assumption that there is no spillover from the unionized contract sector wage rate to the nonunionized spot sector wage rate.

C. Time Consuming Labor Mobility

The contract sector representing labor unionism is assumed to consist of N_{1t} identical members. It is assumed that a random job selection process exists and L_{1t} members (the level of employment in the contract sector) are selected randomly, as in Harris and Todaro (1970), whenever the number of available jobs is exceeded by the number of job seekers.

The spot sector is assumed to consist of N_{2t} identical members, which is also endogenously determined. Due to the property of the competitive market, the supply of labor equals the demand for labor and so N_{2t} is the level of employment in this sector. As a consequence, there is no unemployment in the spot sector.

The key element in the two-sector labor market model is the labor mobility between the two sectors. Two polar cases about the speed of mobility can be mentioned. The simplest one is the immobility assumption which is not interesting. The other extreme case is the assumption of instantaneous mobility which has been commonly used in the static segmented labor market literature. However, such an assumption is unlikely to be plausible in the dynamic labor market framework. Thus the intermediate case is considered; time consuming mobility (partial mobility) instead of instantaneous mobility (free mobility) or immobility. The hypothesis of time consuming mobility is found in the studies by Lucas and Prescott (1974), Lilien (1982), and Hamilton (1988).

Time consuming migration in this paper is very analogous to the two-stage phenomenon found in the context of rural-urban migration:

> It is our opinion that a more realistic picture of labor migration ... would be that views migration as a two-stage phenomenon. The first stage finds the unskilled rural workers migrating to an urban area and initially spending a certain period of time in the so-called urban traditional sector, i.e., *reserved pool*. The second stage is reached with the eventual attainment of a more permanent modern sector job. (Todaro, 1969, p. 139). (Italics not in original)

Then what is meant by time consuming labor mobility in this paper? First, consider the case in which migration takes place from the spot sector to the contract sector: some workers would leave the spot sector and migrate from the spot sector to the contract sector. If it were not for mobility costs, they could join the contract sector instantaneously. But changing sectors and jobs entails mobility costs which are barriers to the instantaneous labor mobility. Migrants have to search for a new job with imperfect job information flows (search costs) and they need moving costs when they relocate to get a new job and training costs as well before production begins. Mobility costs are composed of these setup costs. Mobility cost or adjustment cost theory states that it is optimal to adjust partially in each period and that it takes long time to complete migration (adjustment) because instantaneous migration (adjustment) is very costly.

The second assumption the model is based on is that any worker who wants to find a new job in the contract sector has higher probability to be hired if he is separated from the spot sector. In other words, on-the-job search tends to spend less time in finding a contract sector job. In reality, it is true that some workers search and find a better job while they are holding a job. However, the efforts they can make in searching a new job must be less when they are employed than when they are unemployed, which means the probability to obtain a new job is smaller for employed workers.

Thus I postulate that any migrant who is eager for a contract sector job quits the spot sector job. To spend more time in searching a contract sector job and thereby to increase the chance of being hired in the contract sector, one is willing to quit the spot sector job. The other rationale for this assumption is that to the extent that spot sector jobs are regarded as inferior, some gesture of separation from the spot sector may increase the chance of being offered a contract sector job. In sum, this study allows workers in the spot sector directly to migrate to the contract sector with different probabilities to the hired so as to closely mimic the reality.

Migrants become unemployed by joining the reserved pool (the unemployment sector) N_3, where they wait for the permission to the contract sector. If follows from these assumptions that

$$N_{1t} = N_{1t-1} + \lambda_2 (N_{2t-1} - N_{2t}) + \lambda_3 N_{3t-1}, \ \ 0 < \lambda_2 < \lambda_3 < 1.$$

The number of workers in the contract sector in period t is the sum of workers from the previous period and the new entrants. New entrants consist of a fraction of current migrants (the second term) and a greater fraction of past migrants (the third term) who missed the chance of joining the contract sector in previous periods and remained in the reserved pool, N_{3t-1}. Because of mobility costs or time consuming migration, λ_i (i = 2, 3) is less than unity. The more costly the mobility, the smaller λ_i is.

These circumstances jointly lead to the implication that the actual number of periods necessary for migration from the spot sector to the contract sector is one for some migrants and more than one for others: because every migrant is homogeneous before he is selected, workers are chosen randomly and $\lambda_3 > \lambda_2$ holds in that the unemployed can search a job more intensively than the employed. This implies that some migrants, who are definitely unlucky, must remain in the reserved pool for several periods.[5]

Now let's consider the second case in which migration happens from the contract sector to the spot sector. The same assumptions made in the first case go for this case, too: mobility costs lead to time consuming migration and migrants must be separated from the current sector as in the first case. Thus migrants join the reserved pool and a fraction of them is able to find a spot sector job in that period, that is the adjustment coefficient λ_i (i = 1, 3, $\lambda_1 < \lambda_3$) is less than unity as before. Thus the number of workers in the spot sector in period t is the sum of workers from the previous period and the new entrants. Summarizing these two cases yields the following dynamic supply of labor to each sector:

$$\begin{cases} N_{1t} = N_{1t-1} + \lambda_2(N_{2t-1} - N_{2t}) + \lambda_3 N_{3t-1}, & \text{for the first case} \\ N_{2t} = N_{2t-1} + \lambda_1(N_{1t-1} - N_{1t}) + \lambda_3 N_{3t-1}, & \text{for the second case.} \end{cases} \tag{13}$$

The above story presupposes the existence of migrants. Then the next question is to ask why workers would migrate and what determines the size of migrants. Workers compare income streams of the two sectors and decide whether or not they will leave the current sector for a higher income stream. Formally the migration of the labor force is governed by the difference between PV_1 and PV_2 where PV_1(PV_2) is the expected present value of real income over a worker's lifetime in the contract sector (spot sector). Then we have

$$h(|PV_1 - PV_2|) = \begin{cases} N_{2t-1} - N_{2t} & \text{when } PV_1 \geq PV_2 \\ N_{1t-1} - N_{1t} & \text{otherwise,} \end{cases} \tag{14}$$

where $h'(\cdot) > 0$ and $h(0) = 0$.

Equation (14) states that migration takes place whenever there is a difference between PV_1 and PV_2 and ceases when both are equalized. If $PV_1 > PV_2$ holds, workers in the spot sector leave that sector and so the number of members of the spot sector decreases and *mutatis mu-*

[5]Of course, the probability for any migrant to remain in the reserved pool for a certain number of periods will decline geometrically as the number of periods increases. But the probability for an early migrant to be selected in a certain period is the same as that for a new migrant to be selected. If the "first-in-first-out" rule is adopted, then the probability would be higher for the past migrants than the current migrants.

tandis when $PV_1 < PV_2$. Other implications of equation (14) are that the degree of migration is the same for both directions because they have the same functional form and that the number of migrants positively depends on the gap between PV_1 and PV_2: the greater the gap is, the more workers would be required to migrate.

Two-direction mobility as in (14) seems to be contradictory to the following behavior of workers. Workers in the contract sector may not leave that sector to find jobs in the spot sector, although they are able to, when they are unemployed if they regard the spot sector as inferior and unreliable. Instead, the unemployed would remain in the contract sector rather than they move to the spot sector, queuing for the contract sector job in next period.

This behavior might be justified theoretically as well as empirically. First, as a theoretical matter, because the unemployed receive unemployment insurance benefits and also derive utility from leisure, this assumption must be true provided that the utility level from unemployment insurance benefits and leisure is greater than that from the wage in the spot sector minus moving costs. As emphasized by Bulow and Summers (1986), workers with stronger tastes for unionized contract sector jobs will opt for unemployment. Second, an empirical work by Clark and Summers (1979) shows that workers who lose contract sector jobs are unlikely to accept "temporary" jobs in the spot sector and that they tend to retain high reservation wage, resulting in a "semi-permanent mismatch" between workers and available employment opportunities.

However, this stickiness to the contract sector can be rationalized to the extent that the shock is so weak that it may not induce the inequality $PV_1 < PV_2$. Suppose that a negative shock hits the contract sector only. This shock induces PV_1 to fall below PV_2 by reducing current and/or future wages and chances of being hired in the contract sector. Then rational workers will move to the spot sector from the contract sector for higher present value of real income. A good example may be found in the deteriorating industry from where workers escape to the other industries because there is no prospect of getting better in the long-run. Thus the assumption allowing two-direction mobility seems to be much more reasonable.

The labor endowment condition states

$$N_{1t} + N_{2t} + N_{3t} = \bar{N}, \tag{15}$$

that is, the sum of workers in three sectors equals the constant labor force $\bar{N}$.

To better understand the dynamic evolution of the reserved pool, let us combine (13) and the endowment condition (15). Then we obtain a dynamic equation for the reserved pool as follows:

$$N_{3t} = \begin{cases} (1-\lambda_3)N_{3t-1} + (1-\lambda_2)(N_{2t-1} - N_{2t}) \text{ when } PV_1 > PV_2 \\ (1-\lambda_3)N_{3t-1} + (1-\lambda_1)(N_{1t-1} - N_{1t}) \text{ when } PV_1 < PV_2. \end{cases} \tag{16}$$

The reserved pool in period t is composed of members of the previous period who missed the chance of entering the contract sector again and new migrants who missed it for the first time. In period t + 1, a fraction of these members $\lambda_3 N_{3t}$ will join the contract sector together with a fraction of new migrants.

IV. The Analysis of Stylized Facts and Dynamics

A. Effects of An Aggregate Demand Shock

If a positive shock hits the economy and if there is a relative increase in the contract sector wage rate, the equilibrium condition $PV_1 = PV_2$ is distorted. As a consequence, migration takes place from the spot sector to the contract sector, provided that $PV_1 > PV_2$. This increase in the labor force in the contract sector (N_1) reduces the chance for a contract sector worker to be hired, other things being equal, causing the inter-sectoral wage differential to narrow to that extent.

Only the first case in which a demand shock hits the economy such that $PV_1 > PV_2$ will be discussed here because the other case can be analyzed in a very similar way. In the first place, only initial responses will be considered for the analysis of stylized facts. For this purpose, we have

$$PV_1 - PV_2 = J(W_{1t}, W_{2t}, L_{1t}, N_{1t}, \dots), \tag{17}$$

where $J_1 = \partial J / \partial W_{1t} > 0$, $J_2 = \partial J / \partial W_{2t} < 0$, $J_3 = \partial J / \partial L_{1t} > 0$,

$$J_4 = \partial J / \partial N_{1t} < 0.$$

It follows from (14) and (17) that

$$h(J(W_{1t}, W_{2t}, L_{1t}, N_{1t}, \dots)) = N_{2t-1} - N_{2t}. \tag{18}$$

Suppose that the demand shock is aggregate, that is $\theta_{1t} = \theta_{2t} = \theta_t$. Lagging (12) once and substituting it, together with (8), (9), and (10), yields equation (19):

$$h(J(k\,g(W_{2t}),\ W_{2t},\ \theta_t^A B k^{-A}\,g(W_{2t})^{-A},\ N_{1t})) \\ = \theta_{t-1}\,D(W_{2t-1}) - \theta_t D(W_{2t}), \tag{19}$$

where $A = 1/(1-\alpha) > 1$ and $B = [(\alpha+1)/2]^A$.
Equation (19) states that the spot sector wage rate is serially correlated. Thus even a temporary shock produces the persistence of the wage rate.

On the other hand, it follows from (12), (13), and (15) that

$$N_{1t} = (1-\lambda_3)\,N_{1t-1} - \lambda_2\theta_t\,D(W_{2t}) + (\lambda_2 - \lambda_3)\,\theta_{t-1}\,D(W_{2t-1}) + \lambda_3\bar{N}. \tag{20}$$

Thus (19) and (20) are simultaneous first-order difference equations for two endogenous variables N_1 and W_2. Then the stylized facts we are interested in are easily verified from the standard comparative static analysis.

In particular, it can be easily shown that the spot sector wage rate behaves procyclically:

$$\frac{dW_{2t}}{d\theta_t} = \frac{h'J_4\lambda_2 D - h'J_3 A L_{1t}/\theta_t - D}{X} > 0, \tag{21}$$

where $X = -h'J_4\lambda_2\theta_t D' + h'(J_1 kg' + J_2 - J_3\,A\,L_{1t}g'/g) + \theta_t\,D' < 0$. The elasticity of the spot sector wage rate is denoted by

$$\varepsilon_{2\theta} = \frac{dW_{2t}}{d\theta_t}\frac{\theta_t}{W_{2t}}. \tag{22}$$

Then it follows immediately from (8), (9), and (22) that

$$\varepsilon_{1\theta} = \frac{dW_{1t}}{d\theta_t}\frac{\theta_t}{W_{1t}} = \varepsilon^*\varepsilon_{2\theta}. \tag{23}$$

The contract sector wage rate moves procyclically provided that $\varepsilon^* \neq 0$ and the procyclical movement of the contract sector wage rate is smaller than or equal to that of the spot sector wage rate because $0 \leqq \varepsilon^* \leqq 1$. As McDonald and Solow (1985) argue, if $\varepsilon^* < 1$ is indeed the case, fluctuations in contract sector wage rates are smaller than fluctuations in spot sector wage rates, verifying a stylized fact. Furthermore it is apparent that intersectoral wage differentials narrow in booms and widen in recessions.

It is straightforward to show, from (12) and (21), that

$$\frac{dN_{2t}}{d\theta_t}\frac{\theta_t}{N_{2t}} = 1 + \theta_t\frac{dW_{2t}}{d\theta_t}\frac{D'}{D}. \tag{24}$$

For spot sector employment to be procyclical, the following condition

$$-1 < \theta_t \frac{dW_{2t}}{d\theta_t}\frac{D'}{D} < 0$$

must hold. This condition restricts the size of the demand shock satisfying the condition, $PV_1 > PV_2$. Above results state that a negative demand shock decreases the real wage rate and employment in the spot sector and the elasticity of spot sector employment is actually less than 1.

While the contract sector wage rate moves together with a demand shock, the level of contract sector employment can go either way. That is, from (10) and (23), it follows that

$$\frac{dL_{1t}}{d\theta_t}\frac{\theta_t}{L_{1t}} = A(1-\varepsilon_{1\theta}) \gtreqless 0 \text{ as } \varepsilon_{1\theta} \lesseqgtr 1. \tag{25}$$

Taking a look at (25), we can divide the total effects of a shock on contract sector employment into two parts: the first term of the RHS is the output effect following the procyclical pattern without exception (the demand for labor decreases when the demand for output decreases) and the second term of the RHS is the wage effect through which employment increases when a negative demand shock reducing the real wage rate hits the economy. The direction of (25) is determined by these two offsetting forces. If the output effect dominates the wage effect, then contract sector employment would fluctuate procyclically. For a procyclical pattern,

$$\frac{dL_{1t}}{d\theta_t} > 0 \text{ iff } \varepsilon^* \varepsilon_{2\theta} < 1. \tag{26}$$

Comparing (24) and (25) gives

$$\frac{dL_{1t}}{d\theta_t}\frac{\theta_t}{L_{1t}} > \frac{dN_{2t}}{d\theta_t}\frac{\theta_t}{N_{2t}} \text{ if } \varepsilon^* < -\varepsilon_{2w}, \tag{27}$$

where ε_{2w} denotes the wage elasticity of the demand for labor in the spot sector, $D'W_{2t}/D$.

B. Phase Diagram

Equations (19) and (20) summarize the dynamics of the system in N_1 and W_2. To analyze the dynamics, let's lead both equations one period ahead to obtain

$$h(J(k\, g(W_{2t+1}),\ W_{2t+1},\ \theta^{A}_{t+1}Bk^{-A}\, g(W_{2t+1})^{-A},\ N_{1t+1})) \\ = \theta_t\, D(W_{2t}) - \theta_{t+1}D(W_{2t+1}), \tag{28}$$

$$N_{1t+1} = (1 - \lambda_3)\, N_{1t} - \lambda_2\theta_{t+1}D(W_{2t+1}) + (\lambda_2 - \lambda_3)\ \theta_t\, D(W_{2t}) + \lambda_3\bar{N}. \tag{29}$$

Equation (28) can be rewritten as follows:

$$W_{2t+1} - W_{2t} = G(W_{2t},\ N_{1t}), \tag{30}$$

where $G_1 = \partial G \,/\, \partial W_{2t}$ must be negative for the existence of a stable point and $G_2 = \partial G \,/\, \partial N_{1t} < 0$. The curve SS is the locus of $W_{2t+1} - W_{2t} = 0$, that is $G(W_{2t},\ N_{1t}) = 0$ and decreasing as in Figure 1 since

$$\left.\frac{dW_2}{dN_1}\right|_{SS} = -\frac{G_2}{G_1} < 0.$$

On the other hand, the curve UU, the locus of $N_{1t+1} - N_{1t} = 0$, is implied by equation (31).

$$N_{1t+1} - N_{1t} = -\lambda_3 N_{1t} - \lambda_2\theta_{t+1}D(W_{2t} + G(W_{2t},\ N_{1t})) \\ + (\lambda_2 - \lambda_3)\ \theta_t\, D(W_{2t}) + \lambda_3\bar{N}. \tag{31}$$

It is easy to show that

$$\left.\frac{dW_2}{dN_1}\right|_{UU} = \frac{\lambda_3 + \lambda_2\theta_{t+1}D'G_2}{-\lambda_2\theta_{t+1}D'(1+G_1) + (\lambda_2 - \lambda_3)\theta_t D'} > 0, \tag{32}$$

provided that $-1 < G_1 < 0$, which is the stability condition of the model.

The phase diagram is depicted in Figure 1. The intersection of two singular curves determines steady state values of N_1 and W_2, denoted by N_1^e and W_2^e, respectively. The spot sector wage rate is increasing at all points below SS curve and decreasing at all points above the curve. Similarly the number of contract sector workers is increasing at all points to the left of UU curve and decreasing at all points to the right. Therefore E is a stable equilibrium.

Taking a look at the equation system (19) and (20), we can say that the spot sector wage rate and the number of contract sector workers are serially correlated, which in turn implies that employment in each sector is also serially correlated. Suppose that a positive demand shock hits the economy and that contract sector employment responds positively to it such that some workers in the spot sector migrate to the contract sector for higher present value. Because migration is time consuming, the effects of a one-period shock are long-lived by affecting future migration. In addition, they pervade all the variables in the

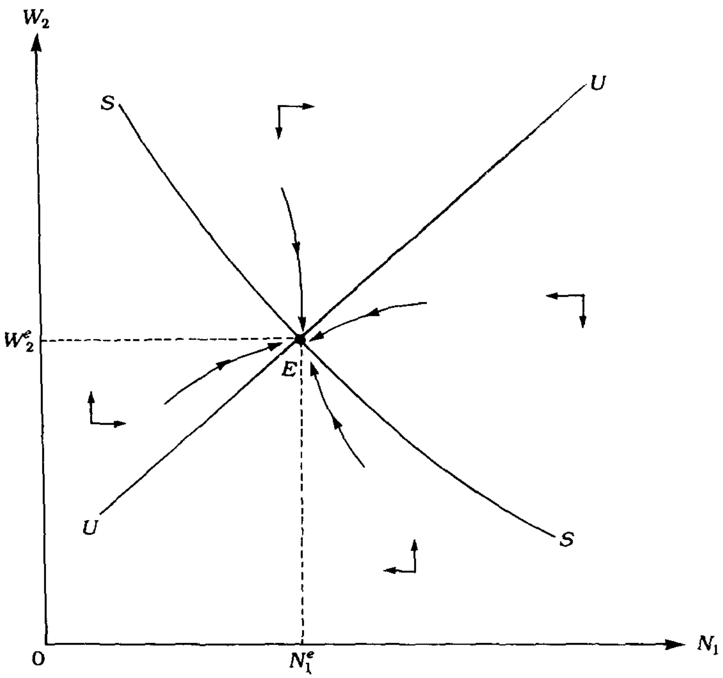

FIGURE 1
DYNAMICS OF N_1 AND W_2

economy showing co-movements since they are closely interrelated each other.

C. Effects of Unemployment Benefits

Now let us consider the case in which the unemployed receive unemployment benefits, V. The introduction of unemployment benefits affects the unionized contract sector by raising the present value of the sector. In other words, V is an argument of the function J.

$$PV_1 - PV_2 = J(W_{1t}, W_{2t}, L_{1t}, N_{1t}, V, \ldots), \tag{33}$$

where $J_v = \partial J / \partial V > 0$.

Under these circumstances, the dynamic system in N_1 and W_2 consists of equations (34) and (35).

$$W_{2t+1} - W_{2t} = G(W_{2t}, N_{1t}, V), \tag{34}$$

$$N_{1t+1} - N_{1t} = -\lambda_3 N_{1t} - \lambda_2 \theta_{t+1} D(W_{2t} + G(W_{2t}, N_{1t}, V)) \tag{35}$$

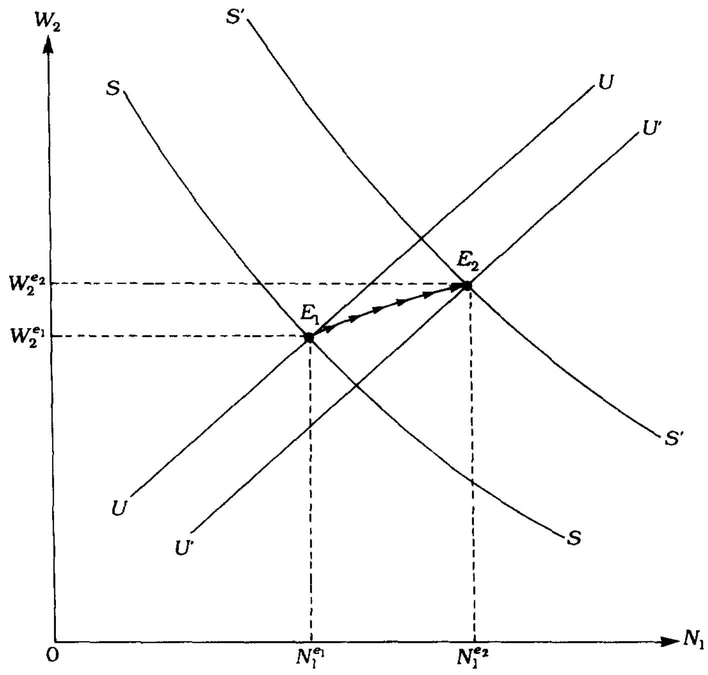

FIGURE 2
EFFECTS OF AN INCREASE IN V

$$+ (\lambda_2 - \lambda_3)\ \theta_t\ D(W_{2t}) + \lambda_3 \bar{N}.$$

It is easily verified that $G_v = \partial G / \partial V > 0$. The shifts of singular curves due to V are as follows:

$$\left.\frac{dW_2}{dV}\right|_{SS} = -\frac{G_v}{G_1} > 0,$$

$$\left.\frac{dW_2}{dV}\right|_{UU} = \frac{\lambda_2 \theta_{t+1} D' G_v}{-\lambda_2 \theta_{t+1} D'(1 + G_1) + (\lambda_2 - \lambda_3)\theta_t D'} < 0.$$

The phase diagram for this case is depicted in Figure 2. An increase in V shifts SS curve upward and UU curve downward. The original steady state is denoted by E_1. The labor market moves, along the stable path, to a new steady state E_2 where both the number of contract sector workers (N_1^{e2}) and the spot sector wage rate (W_2^{e2}) are higher than those before the increase in V.

V. Concluding Remarks

The implications of the model developed in the paper are consistent with certain stylized facts. First, fluctuations in employment in the contract sector are greater than those in the spot sector while the real wage rate in the contract sector is more stable than that in the spot sector. Second, the movement of intersectoral wage differentials over the business cycle is countercyclical.

Furthermore, the model shows that involuntary unemployment exists in equilibrium. Search theory explaining the labor market well tells only voluntary unemployment by using the misperception about the prevailing wage level. Without the misperception, the existing unemployment rate in the search model is simply the natural rate. Finally, the model reveals that a one-period shock is able to generate the persistence of unemployment.

Time consuming labor mobility, which the model in this paper depends upon, is one of the two sources of mobility costs for workers in the literature. The other type of mobility costs for workers is pecuniary costs. The difference between them is that the former measures mobility costs by time while the latter by money. It will be worthwhile to pursue the approach that uses pecuniary costs as well. It may yield rather different implications.

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