Intersectoral Mobility and Short-Run Labor Market Adjustments

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This article presents a model of labor market adjustments as a sequential process of reallocation among various market and nonmarket sectors. Training costs introduce friction into the process, while fixed costs of working limit work sharing, resulting in unemployment. Adjustments in sectoral labor market variables to demand shocks can follow very different patterns, depending on relative demands and the expected duration of the shocks. In particular, a permanent boom in a sector may result in an initial increase in unemployment and reduction in working hours even as employment increases, reflecting contemporaneous substitution between the margins and intertemporal substitution in recruitment.

I. Introduction

Ever since Lilien's (1982) seminal work on sectoral shift, there has been a continuing debate on the empirical importance of sectoral mobility in aggregate fluctuations (see, e.g., Abraham and Katz 1986; Murphy and Topel 1987; Loungani and Rogerson 1989; Loungani, Rogerson, and Sonn 1989; Altonji and Ham 1990; Palley 1992; and Brainard and Cutler 1993). Evidence from the Western economies is mixed at best, but the positive relationship between labor mobility and aggregate unemployment suggested by the sectoral-shift hypothesis appears to be contradicted by recent experiences in the newly industrializing countries. In Hong Kong, the past decade has been a period of rapid structural transformation at a pace far outstripping that in the United States in the seventies (see Lilien 1982), as the opening up of China and a fresh supply of cheap labor in southern

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China prompted an exodus of manufacturing industries from the British colony. Between 1980 and 1993, the number of persons engaged in manufacturing in Hong Kong fell by 47% in absolute terms, while the employment share declined from 46% to 20%.[1] Yet most laid-off workers have been quickly absorbed by the equally fast expanding service sectors. Consequently, the unemployment rate has remained remarkably low throughout this economic transformation, in fact showing a general declining trend rather than an increase as suggested by the sectoral-shift model (unemployment rates averaged 3.7% from 1980 to 1986 but decreased to 1.6% for the period 1987–93). While the robust secular growth in the region over this period no doubt contributed to the low overall unemployment, the observation nevertheless casts doubt on the conventional sectoral-shift prediction of mandatory search unemployment.

Given the apparent limitations of the sectoral shift hypothesis, this article attempts to construct an equilibrium model of labor mobility that is rich enough to accommodate different responses to sectoral shocks observed under diverse market conditions, without requiring unemployment to be a necessary outcome of the process. I hope that, by dissecting the mechanism of adjustment at the disaggregate level, implications for aggregate behavior can be derived. The integral element of friction in the reallocation process is introduced by monetary cost (training), rather than time cost. And, instead of relying on search or matching (as in Lucas and Prescott 1974; and Rogerson 1987), unemployment is motivated by nonconvexities or indivisibilities (Burdett and Mortensen 1980; Hansen 1985; Greenwood and Huffman 1987; and Rogerson 1988), though not by imposing perfectly rigid working hours, but in the form of fixed costs borne either by the firm or the workers. The subsequent constraint on work sharing among workers results in layoffs in downturns. This emphasis on layoffs among stayers rather than search unemployment among movers is consistent with the evidence offered by Murphy and Topel (1987), as well as the experience in Hong Kong, where much of the residual unemployment comprises workers in the declining sectors who prefer to wait for opportunities in their initial occupations, citing the lack of marketable skills in other sectors as the reason for not moving.

Within this framework, I will show that the responses of employment, average working hours, and unemployment in each sector within a multisectoral economy can exhibit very different behavior, depending on the magnitude and expected duration of sector-specific shocks, as well as on general market opportunities. While an increase in expected sectoral demand will generally raise the employment level, current working hours may actually decline if a prolonged expansion is anticipated and firms have

[1] By comparison, the decline in manufacturing's employment share in the United States between 1969 and 1980 was only from 28.7% to 22.4%.

to recruit in advance in order to minimize adjustment costs, reflecting a substitution between employment and working hours. More surprisingly, a persistent boom may also raise sectoral unemployment, as workers from elsewhere enter the sectoral labor market to apply for jobs in anticipation of long-term opportunities, even if it means unemployment in the short run and despite the adjustment cost involved, while the same expectations discourage the outward mobility of the unemployed among existing workers.[2] In contrast, if sectoral demand is held constant, an improvement in general economic conditions, and therefore alternative opportunities for the workers, would tend to reduce employment and/or unemployment in any given sector and may result in a compensatory increase in working hours among remaining workers, highlighting again the substitution across the margins and the fact that it is relative, rather than absolute, demands that drive the allocation of workers across sectors. Some of these results bear resemblance to those derived from Rogerson's (1987) two-period two-sector model, but the more general setup here offers an alternative interpretation of the nature of unemployment (temporary layoffs or lining up for jobs among both movers and stayers as opposed to search unemployment) and allows for the analysis of the different responses of a labor market to transitory and permanent sectoral shocks. The model also incorporates elements from Topel's (1986) analysis of geographic mobility and Haltiwanger's (1984) investigation of the distinction between temporary and permanent job separations, but it extends both by endogenizing the intensive margin, an important component of the short-run adjustment process. While I do not explore the relationship between the allocation of labor inputs and inventory management as Topel (1982) does, the omission is compensated for by a structural analysis of unemployment that is missing in that model.

The remaining parts of this article are organized as follows. The next section presents the assumptions and the setup of an intertemporal model of disaggregated labor markets as well as the characteristics of the equilibrium allocation. Section III analyzes the adjustment process in the face of demand shocks. Section IV concludes.

II. A Theoretical Model

Suppose there are I sectors in an economy with a finite horizon of T periods, presided over by a central planner. Similarly trained workers are homogeneous, but whenever a worker is switched from one sector to another, say, sector i, a sector-specific training cost, $c_i(m_{it})$, is incurred, where m_{it} is the number of new workers in sector i in period t. It is assumed that $c_i(m_{it}) = c_i'(m_{it}) = 0$ for $m_{it} \leq 0$; $c(m_{it}) > 0$, $c_i'(m_{it}) > 0$, and $c_i''(m_{it}) > 0$ for

[2] A similar result, though motivated by search, is suggested by Burdett and Mortensen (1980); and Fallick (1993).

$m_{it} > 0$.[3] Sector-specific human capital previously accumulated by a worker depreciates completely as soon as he leaves for another sector, so that a worker who returns to an industry in which he has worked prior to the previous period will have to be retrained. After training (assumed to be instantaneous), the worker joins the sectoral labor force (N_{it}). At the beginning of each period, after the state of the economy (represented by a vector, $\boldsymbol{\theta}_t$) is known, labor input (hours of work [h_{it}] and number of employed workers) in each sector will be determined, the workers being picked randomly from the sectoral labor force. The others are counted as unemployed (u_{it}) within the sector.

The production function for sector i in period t takes the form of $\boldsymbol{\theta}_{it} f_i((N_{it} - u_{it})h_{it})$, implicitly assuming constant capital input and perfect substitutability between men and hours. Each worker is endowed with 1 unit of time per period, so that $0 \leq h_{it} \leq 1$. Unemployed workers, and employed workers after their working hours, engage in household production yielding a constant output of R per unit time, alternatively known as the value of leisure. A time-invariant sector-specific fixed cost (D_i)[4] and a variable cost ($g_i(h_{it})$, assumed convex) of working are also assumed. Each sector's product is a perfect substitute for all others in consumption, and utility is intertemporally separable.

The planner's problem can be formalized as follows: at time t, he solves

$$
\begin{aligned}
S_t = \max \Bigg\{ \sum_{i=1}^{I} & [\boldsymbol{\theta}_{it} f((N_{it-1} + m_{it} - u_{it})h_{it}) \\
& + u_{it}R + (1 - h_{it})(N_{it-1} + m_{it} - u_{it})R \\
& - c_i(m_{it}) - (g_i(h_{it}) + D_i)(N_{it-1} + m_{it} - u_{it})] \\
& + \rho E_t S_{t+1} \Bigg\},
\end{aligned}
$$

[3] In models of dynamic adjustment, a symmetric quadratic adjustment cost function is often used instead of the asymmetric one adopted here, Topel (1986) being an exception. In the present context, a positive cost for a negative m implies some sort of social cost of separation, such as the cost of subsequent search on either or both sides. It is conceptually straightforward to modify the present setup and use instead a symmetric cost structure, but the main qualitative results of my analysis would not be materially affected.

[4] The variable D_i can also be interpreted as reflecting the sector-specific set-up cost of production. Each operating plant usually involves some fixed or set-up costs that are incurred regardless of the intensity of the production activities. If the number of plants in each sector is large and there is strong diminishing returns, then it is reasonable to assume that the number of operating plants is proportional to the number of employed workers, so that the total set-up cost for sector i is $(N_{it} - u_{it})D_i$.

where the maximization on the right-hand side is with respect to m_{it}, u_{it}, and h_{it}, subject to $\sum_{i=1} m_{it} = 0$ for $i = 1, \ldots, I$.[5] The value function at time t, S_t, is the maximized sum of expected total output less the expected total social costs of market production from t onward, discounted at a rate of ρ. Social output includes market products as well as household products produced by the unemployed and employed workers in their nonmarket time, while social costs include the fixed and variable costs of working and the costs of training new workers. The adding up constraint implies a constant work force.

The first-order conditions for current period dependent variables are

$$\boldsymbol{\theta}_{it} f'_{it} \cdot (N_{it-1} + m_{it} - u_{it}) - [R + g'_i(h_{it})](N_{it-1} + m_{it} - u_{it}) = 0, \tag{1}$$

$$-\boldsymbol{\theta}_{it} f'_{it} h_{it} + h_{it} R + g_i(h_{it}) + D_i \leq 0, \tag{2}$$

$$\begin{aligned} \boldsymbol{\theta}_{it} f'_{it} h_{it} - [c'_i(m_{it}) + g_i(h_{it}) + D_i - (1 - h_{it})R] \\ - \mu_t + \rho E_t(\partial S_{t+1}/\partial m_{it}) = 0, \end{aligned} \tag{3}$$

where $f'_{it} = f'_i((N_{it} - u_{it})h_{it})$, and μ_t is the Lagrange multiplier for the adding up constraint in period t. Conditions (1) and (2) show the marginal conditions for hours of work and unemployment, respectively. In each case, the marginal cost of increasing labor input (by raising working hours or reducing unemployment) in terms of disutility of work and lower household production must not exceed the marginal return from market production. If, in sector i, u_{it} is interior, then conditions (1) and (2) imply that

$$-h_{it} g'_i(h_{it}) + g_i(h_{it}) + D_i = 0, \tag{4}$$

which is a function of h_{it} only. Thus, whenever $u_{it} > 0$, hours of work for those employed are going to be fixed at some value, $h_i^* > 0$, that satisfies (4). When $u_{it} = 0$, (2) holds in strict inequality (except for the marginal case of u_{it} just arriving at the corner), so that $h_{it} g'_i(h_{it}) - [g_i(h_{it}) + D_i] > 0$. By convexity of g_i, these results imply that h_{it} will not fall below h_i^*. Note that these "reservation" working hours depend only on the fixed and variable costs of working in each sector but are independent of demand conditions.

Equation (3) shows the marginal condition for reallocating a worker to a new sector. The first term on the left-hand side is the marginal product

[5] The usual Inada condition that $f'(0) = \infty$ guarantees $N_{it} - u_{it} = N_{it-1} + m_{it} - u_{it} > 0$ and $h_{it} > 0$ for all i. Also, in order to simplify the solution, the constraints that $h_{it} \leq 1$, $N_{it-1} + m_{it} \geq 0$ for all i are assumed to be nonbinding. Thus, h_{it} will always be interior, and m_{it} will never take on values such that $N_{it} < 0$.

of a worker in the destiny sector, while the second, bracketed, term is the social cost of training him and employing his service in the first period of his tenure. The Lagrange multiplier μ_t can be interpreted as the shadow price of an additional worker, or the opportunity cost of using the marginal worker in a particular sector. The last term captures the effect of reallocating a worker to sector i on welfare in all subsequent periods. Since m_{it} can be positive or negative, the solution must be interior along this margin. This equation is rather intractable but can be manipulated to yield the 1-period effect of sectoral reallocation. Update (3) by one period, multiply by ρ, take expectations at t, and subtract from (3) using the definition of S_t to get

$$\boldsymbol{\theta}_{it} f_i' h_{it} = y_t - R + c_i'(m_{it}) - \rho E_t c_i'(m_{it+1}) + Rh_{it} + g_i(h_{it}) + D_i, \tag{5}$$

where $y_t = \mu_t - \rho E_t \mu_{t+1}$. Equation (5) equates the marginal return to the marginal cost of reallocating a worker to sector i in the current period rather than waiting till the next. The latter, on the right-hand side of (5), can be decomposed into two components: (i) the excess of current training cost over expected future cost, $c_i'(m_{it}) - \rho E c_i'(m_{it+1})$; and (ii) the social marginal cost of committing a worker to production in sector i in the current period, $y_t - (1 - h_{it})R + g_i(h_{it}) + D_i$. The term y_t is the 1-period shadow wage of an additional worker. It can be interpreted as a measure of opportunities for workers in period t and is increasing in the exogenous demand variables. But if we assume that demands follow stationary stochastic processes that are independent across sectors, then, for a large enough number of sectors, marginal changes in the initial condition (summarized by N_{it-1}) and the realization of $\boldsymbol{\theta}_{it}$ in any one industry will have negligible effects on y_t.[6] We can then simplify the notations by focusing on a representative sector, dropping the i subscript in the following.

Equilibrium allocation in the current period will satisfy equations (1), (2), and (5), subject to the initial condition on N_{t-1}. In the absence of reallocation, so that N_t is fixed, it is straightforward to show that adjustment in labor utilization in response to small exogenous shifts in demand will be in either h_t or u_t, but not both. The equilibrium and the adjustment mechanism are, however, more complex when there is labor mobility. Combining equations (1) and (5) gives

$$g'(h_t) = \left(\frac{y_t - R + c'(m_t) - \rho E c'(m_{t+1})}{h_t}\right) + R + \left(\frac{g(h_t) + D}{h_t}\right). \tag{6}$$

[6] A similar assumption is made in Topel (1986).

This expression, which equates the marginal costs of adjusting working hours and labor force, defines the locus of pairs of m_t and h_t, which, given y_t and information on future $\boldsymbol{\theta}$'s, represents the schedule of efficient labor input in period t. Intersection between this schedule and the marginal product of the labor (man-hours) curve gives the optimum values of m_t and h_t. Note that, when there is unemployment, so that $g'(h^*) = [g(h^*) + D]/h^*$, equation (6) is reduced to

$$y_t - R + c'(m_t) - \rho E_t c'(m_{t+1}) = 0, \tag{7}$$

which implicitly determines a value of m_t as a function of y_t, N_{t-1}, and expected future demand (because $m_{t+1} = m_{t+1}(N_{t-1} + m_t, E\theta_{t+\tau})$ for $0 < \tau \leq T - t$). In this case, stock adjustment in the sectoral labor force (m_t) is driven purely by the incentive to economize on training cost in preparation for potential future expansion. The difference between current employment, determined by current demand conditions, and the sectoral labor force ($N_{t-1} + m_t$) gives the number of unemployed workers.[7]

The above exercise has very intuitive interpretations. When current demand expands, labor input can be raised by either increasing the number of workers or extending the hours of work, both of which increase the marginal costs of production at an increasing rate owing to the assumed convex cost structures. The elasticity of either margin with respect to demand changes would therefore depend on the specific forms of these costs. Reduction in input in response to declining demand can likewise occur along these two margins, but because of the fixed cost involved in working, hours are inflexible below a certain minimum (h^*), limiting the amount of work sharing. In contrast, downward adjustment along the extensive margin can be effected either by reallocating workers to other sectors or by temporary layoffs. Since, by assumption, sector-specific human capital depreciates completely when a worker is trained for production in another sector,[8] temporary layoffs have the advantage of possible savings in future training costs should additional hands be needed subsequently. However, unemployed workers are kept from market production for at least 1 period

[7] Intuitively, in a decentralized setting, even though current unemployment in the sector implies that current wage would be no higher than in other sectors, workers are attracted by the prospect of expected higher future wages brought about by stickiness in stock adjustment that thwarts immediate equalization of wages.

[8] The assumption that sector-specific human capital depreciates completely once a worker is trained for production in another sector is made for expositional convenience. In reality, one would expect the worker to retain some of the specific skills even after she has left the sector for some time. The results of this model do not, however, depend on this assumption and will continue to hold if depreciation occurs gradually over time.

so that a price is paid in the form of forgone market output even though household production is increased. Efficiency in allocation of resources requires equalization of the marginal costs to the value of marginal product of labor input along all margins, which is succinctly summarized by the equilibrium conditions ([1] and [6] when $u_t = 0$, or [1], [4], and [7] when $u_t > 0$).

III. The Adjustment Process in Different Regimes

The fact that there are different sets of equilibrium conditions implies the existence of different regimes, with different labor force characteristics (i.e., whether the sectoral labor force is expanding or contracting, and whether there is full employment or unemployment), and responses of labor market variables to demand and parametric changes may differ across regimes. In any particular sector, the (ex ante probability of) occurrence of each of these regimes is affected by the values of the parameters (such as parameters of the training cost and fixed cost functions) as well as sectoral and general demand conditions. Therefore, in order to analyze the adjustment mechanism, we must first understand the relationship and transition among the various regimes.

To facilitate the formulation of the solution, define $\boldsymbol{\theta}_t^*$ as the value of $\boldsymbol{\theta}_t$ such that unemployment is just at a corner, that is, when $u_t = 0$ and $h_t = h^*$. Then, the properties of θ_t^* are implicit in the following equations, which are no more than the conditions for an unemployment equilibrium (eqq. [1], [4], and [7]) with the additional constraint that $u_t = 0$:

$$R + g'(h^*) = \boldsymbol{\theta}_t^* f'((N_{t-1} + m_t)h^*), \tag{8}$$

$$g'(h^*)h^* = g(h^*) + D, \tag{9}$$

$$0 = y_t - R + c'(m_t) - \rho E_t c'(m_{t+1}). \tag{10}$$

Given the parameters of the system, θ_t^* is a function of y_t. Intuitively, in the simplest case in which expectations of future demand are not affected by current demand, poorer opportunities in the general labor market (i.e., a smaller y_t) will reduce the incentive for workers to leave any particular sector, so that a higher sectoral demand is needed to keep the sectoral labor force fully employed. This implies that $\boldsymbol{\theta}_t^*$ is decreasing in y_t. However, things are more complicated in the more general case in which current demand affects expectations. If sectoral demands are highly serially correlated, then expectations of a persistent boom fueled by high current demand may attract workers into the sector, even to the extent that there are not enough jobs around for all in the current period. In this case, if u_t

is to remain zero, better general demand conditions (i.e., a higher y_t) must exist in order to stem the influx of workers, and θ_t^* would be positively related to y_t. More specifically, if $E_t\theta_{t+1} = (1 - \kappa)\bar{\theta} + \kappa\theta_t$, where $0 \leq \kappa \leq 1$ and $\bar{\theta}$ is a constant, then it can be shown that

$$\frac{d\theta_t^*}{dy_t} \gtrless 0$$

$$\text{as } \Delta_t = f'(\cdot)\left(\rho\,\frac{\partial E_t c'(m_{t+1})}{\partial m_t} - c''(m_t)\right) - \kappa\theta_t^* f''(\cdot)h^*\rho\,\frac{\partial E_t c'(m_{t+1})}{\partial E_t\theta_{t+1}} \gtrless 0.$$

The model does not impose any restriction on the sign of Δ_t. The expression is related to comparative statics on u_t, and it can be shown that in a period in which $u_t > 0$, $du_t/d\theta_t \gtrless 0$ as $\Delta_t \gtrless 0$. Obviously, the more persistent the sectoral shock is expected to be, the larger κ will be, and the higher will be the chance that $\Delta_t > 0$, so that $d\theta_t^*/dy_t > 0$, and $du_t/d\theta_t > 0$ when $u_t \geq 0$. Note also that, since $c''(m_t) = 0$ when $m_t \leq 0$ but > 0 if $m_t > 0$, it is possible that $d\theta_t^*/dy_t < 0$ when $m_t > 0$ but $d\theta_t^*/dy_t > 0$ for $m_t \leq 0$.

Along the same line, define θ_t^{**} as the value of θ_t such that there is no stock adjustment in the current labor force, that is, $m_t = 0$. The properties of θ_t^{**} depend on whether there is unemployment. If $u_t = 0$, then, in addition to equation (1), equation (6) holds as well, while, if $u_t > 0$, equations (4) and (7) apply instead, in both cases with the additional constraint that $m_t = 0$. It can be shown that, as long as $\kappa \geq 0$, θ_t^{**} is always increasing in y_t, which is intuitive. Better opportunities in the overall market tend to encourage workers in any given sector to try their luck somewhere else, so that a higher sectoral demand is necessary to keep them from leaving. In particular, when there is unemployment within the sector, the marginal cost of keeping a worker is higher so that a larger increase in sectoral demand is needed to maintain m_t at zero given an increase in overall opportunities (y_t). This implies that $d\theta_t^{**}/dy_t|_{u>0} > d\theta_t^{**}/dy_t|_{u=0} > 0$.

Using these results, we can plot θ_t^* and θ_t^{**} as functions of y_t. These functions divide the joint distribution of θ_t and y_t into different sets, each corresponding to a different regime. Given the parameters of the system, the actual configuration depends on the slope of θ_t^* and therefore on the sign of Δ_t. If we assume, for simplicity, a quadratic training cost function, then there are three general cases:

CASE 1. $\Delta_t < 0$ for all m_t. Then $d\theta_t^*/dy_t$ is decreasing, and the distribution of regimes is illustrated in figure 1*A*. As sectoral demand increases, the sector would, in general, change from an unemployment equilibrium to a full-employment equilibrium, and from loss to gain in the sectoral labor force. However, the actual path will still depend on general demand conditions (y_t), with outward mobility more likely if better external op-

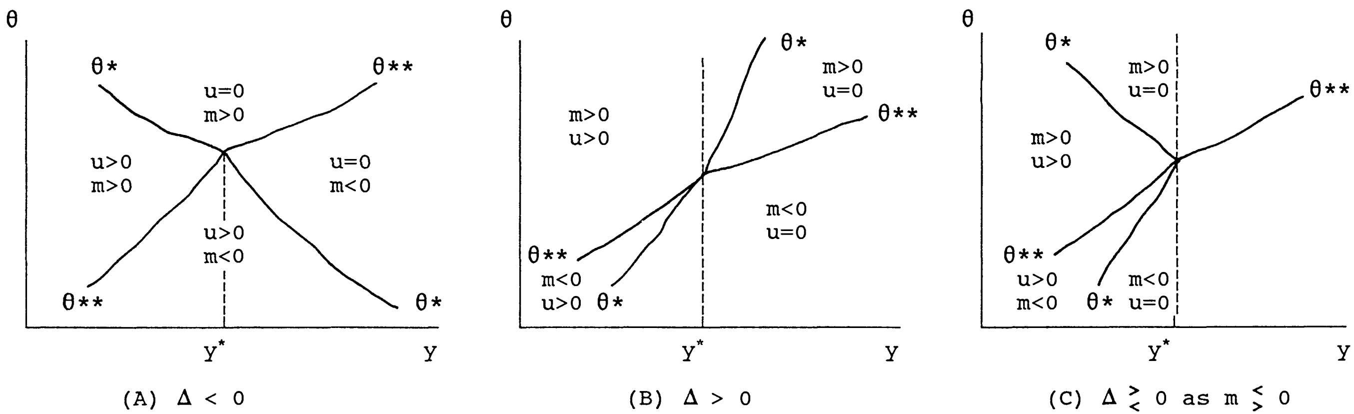

FIG. 1.—Distribution of regimes

portunities are available. Combining these with comparative statics within each regime allows us to plot labor market variables as functions of $\boldsymbol{\theta}_t$, and these are represented in figure 2. The current sectoral labor force is always increasing, and unemployment always nonincreasing, in $\boldsymbol{\theta}_t$, so that employment always increases with sectoral demand. Average working hours are also increasing in current demand as long as they are free to adjust under full employment conditions. This pattern of adjustment is more likely to be observed in response to a transitory shock (when κ is small) so that recruitment and current labor input are geared more toward satisfying immediate production needs. In the face of higher sectoral demand, given diminishing returns and increasing costs along both margins, it is intuitive that both employment and working hours will expand, while unemployment decreases (or remains at zero). Conversely, employment

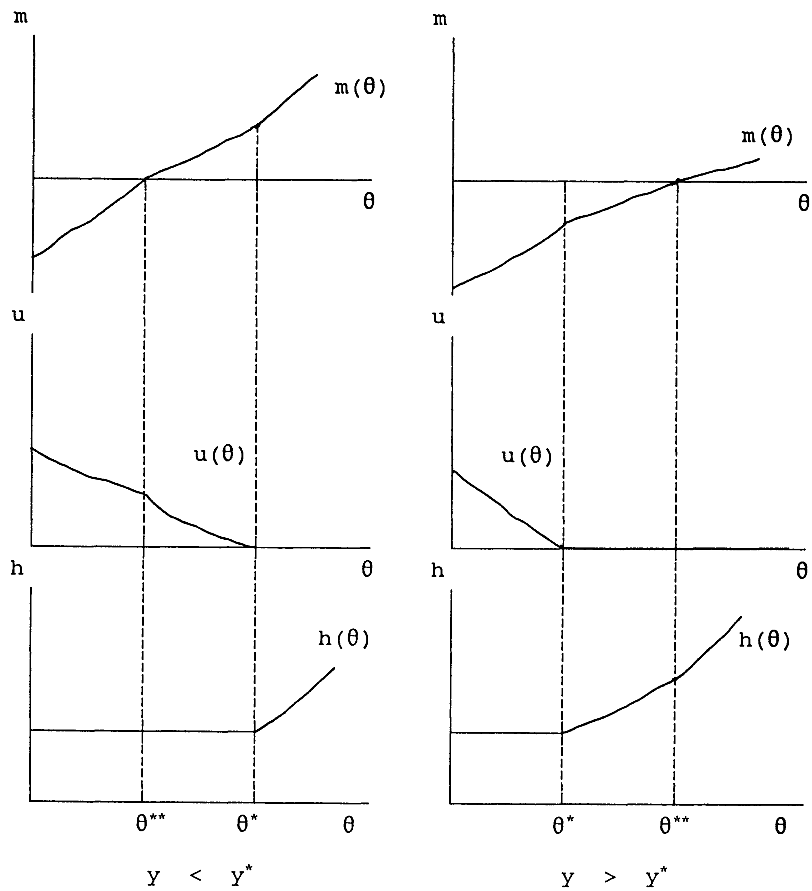

FIG. 2.—Labor market variables as functions of $\theta(\Delta < 0)$

and hours in depressed sectors will decline. Some workers may even be laid off and leave the sector, but many will stay and wait for recall since the setback is anticipated to be temporary, particularly if the overall economy is weak.

CASE 2. $\Delta_t > 0$ for all m_t. Then $d\boldsymbol{\theta}_t^*/dy_t$ is increasing, and the distribution of regimes is illustrated in figure 1*B*. This adjustment pattern is rather different in that the probability of unemployment increases with sectoral demand. Also, comparative statics show that, while employment increases with sectoral demand, it does so at a lower rate than the inflow of workers, so that unemployment actually increases with demand. Moreover, movements along the extensive and intensive margins tend to be in opposite directions in response to demand shocks. This apparently counterintuitive pattern of adjustment, illustrated in figure 3, is more likely to occur in the face of persistent sectoral shocks (when κ is large). For example, with a persistent boom that calls for a drastic expansion of the sectoral labor force, it is socially optimal to start retraining immediately in order to avoid incurring higher cost in the future. In more extreme situations, this may result in less intensive use of available workers, or, if working hours are driven to the minimum, increasing unemployment as more and more workers enter, particularly if the shift in current demand is modest relative to the long-term prospects. In short, it is future employment opportunities that attract new workers into and keep old workers within the sector even if it means temporary unemployment and/or lower working hours.

CASE 3. $\Delta_t \gtrless 0$ as $m_t \lesseqgtr 0$. Then $d\boldsymbol{\theta}_t^*/dy_t$ is increasing when $m_t < 0$ but decreasing when $m_t > 0$. This can be considered a hybrid of the first two cases, resembling case 1 when the sector is contracting, but similar to case 2 when it is expanding. The resulting distribution of regimes is illustrated in figure 1*C*. While employment and the sectoral labor force continue to rise with demand, responses in unemployment and working hours are no longer monotonic. As figure 4 shows, unemployment occurs only when external opportunities are relatively poor ($y_t < y^*$) and over some intermediate range of sectoral demand, while working hours deviate from h^* at more extreme values of $\boldsymbol{\theta}_t$.

These multiple cases, with their respective patterns of adjustment, imply that different sectors may respond to sectoral shocks differently, depending on the values of system parameters and expectations. One immediate observation from comparing the distribution of regimes at different values of $y_t (y_t < y^*$ vs. $y_t > y^*)$ is that, ceteris paribus, the probability of an unemployment equilibrium in any given sector tends to be lower with better general opportunities, for obvious reasons. When the value of production elsewhere in the economy is low, it may be worthwhile to maintain some reserve labor supply, particularly if the sector is expected to expand in the future. As discussed in the last section, reallocation of workers is costly not only because retraining cost is involved but also because previous investment is lost, so that unnecessary mobility is to be avoided. When general demand for labor is high (y_t is large), however, it will be too costly to keep workers idle, and surplus labor in any particular sector tends to be reallocated. This highlights the fact that it is relative demand, rather than the absolute level of current sectoral demand, that determines the direction and extent of adjustment in the sectoral labor force. It also illustrates that sectoral reallocation, by itself, does not generate, but rather tends to alleviate, unemployment, a point emphasized by Murphy and Topel (1987). Where information about opportunities is efficiently disseminated and the market is geographically concentrated (as in a small economy like Hong Kong), mobility across sectors may not carry too much dead-

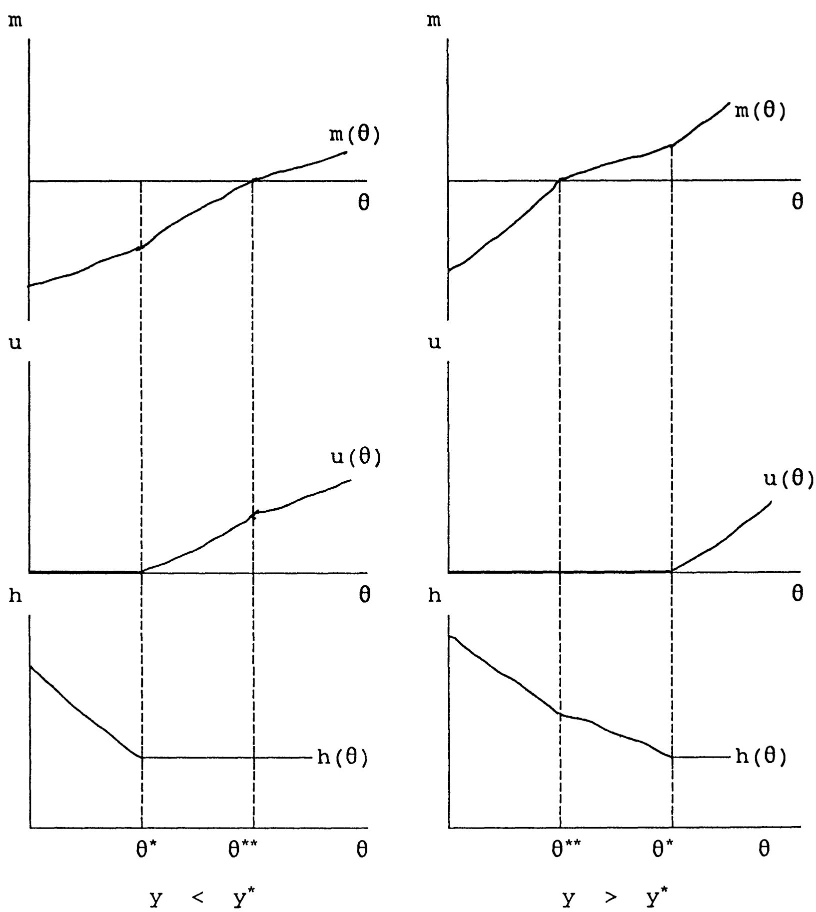

FIG. 3.—Labor market variables as functions of $\theta(\Delta > 0)$

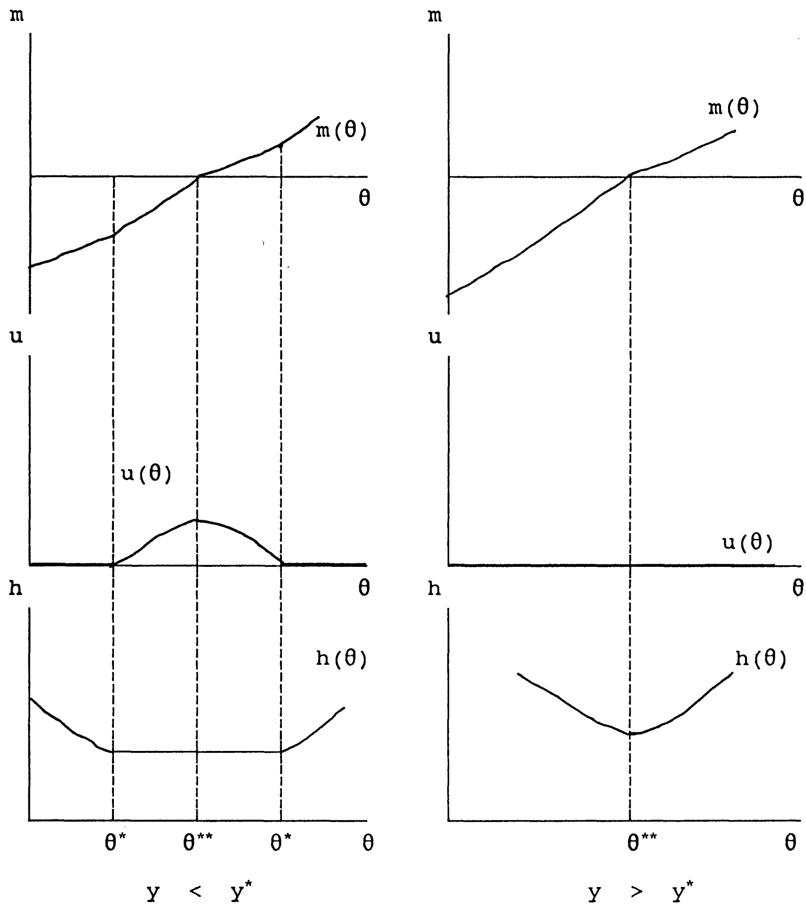

FIG. 4.—Labor market variables as functions of $\theta(\Delta \gtrless 0$ as $m \lesseqgtr 0)$

weight loss in search time and may lead to low unemployment even as an economy undergoes fundamental structural changes in the process of growth.

But perhaps the most striking difference is to be found in the comparison between adjustments to shocks of different expected durations. Figures 2–4 show that, although the labor force and employment are always increasing in sectoral demand, working hours and unemployment can adjust in either direction, depending on the sign of Δ_t, which in turn depends on the persistence of the shock (κ). A transitory sectoral shock tends to reduce unemployment and elicit a larger immediate adjustment in working hours, while a persistent boom that calls for a substantial stock adjustment can in fact raise unemployment and depress current average hours as a result of the substitution between the different margins of labor input.[9]

Since changes in expectations usually take time, even a shock that ends up being permanent may be expected to be transitory at the outset. As a result, sectoral redistribution of the labor force tends to be gradually phased in over time as expectations adjust, at a lower rate than predicted by the model. The first pattern of adjustment (for $\Delta_t < 0$) is therefore likely to be most commonly observed. The additional friction in mobility may also contribute to aggregate unemployment. In an economy facing (perceived) temporary shifts in sectoral demands, if the increase in layoffs in the depressed sectors dominates the reduction in unemployment in the booming sectors, as would be the case if all sectoral labor markets are close to full employment to begin with, then overall unemployment may increase, which is consistent with the U.S. experience as interpreted by Murphy and Topel.

Stickiness in expectations aside, there is another reason why worsening unemployment or decreasing working hours are not usually observed in sectors showing persistent growth. If the training cost function is very convex ($c''(m_t)$ is large for $m_t > 0$), as would likely be the case if the expanding sector requires high skills, then Δ_t can be negative for $m_t > 0$ even if demand is highly serially correlated and Δ_t is positive for $m_t < 0$. In this latter case, the adjustment mechanism would be represented by figure 4. In an expanding sector, the sharply escalating marginal cost of training constrains the expansion in the sectoral labor force, so that currently available trained workers will have to be used more intensively and extensively to meet the current demand for labor input. This restores comovement in employment and working hours even in response to shocks that are expected to persist.

The scenario is particularly relevant in an economy undergoing rapid structural transformation toward more service- or skills-oriented production. The abrupt and permanent shift in relative demands, and the resulting need for extensive (and intensive) retraining of labor in the process, means that workers are recruited into the expanding sectors less for the luxury of economizing on future training cost than for alleviating bottlenecks in current production. As the labor markets tighten in these sectors, working hours need not drastically decrease (or unemployment increase) in the declining sectors because many redundant workers, not expecting recovery

[9] This result contrasts with Rogerson's (1987) that a "permanent" sectoral shock will always raise current working hours. This is because in Rogerson's 2-sector, 2-period model, there is only one chance for moving workers across sectors. There is therefore no question of economizing on future mobility cost that can lead to "overrecruitment" and declining hours in the current period in response to a persistent positive shock in my model.

in the future, will exit, leaving better opportunities for those who stay. This may explain the low overall unemployment and high average working hours observed in Hong Kong despite (or rather because of) high intersectoral mobility of workers.

IV. Conclusion

In this article, a model of sectoral mobility is presented for the analysis of labor market adjustments in a multisectoral economy. The existence of the fixed cost of working restricts intensive margin adjustment beyond a certain minimum level, while training costs create friction in labor mobility. The solution to efficient utilization of labor resources therefore involves not only an optimal choice of the level of employment and working hours but also of unemployment in each sector, regulated by a sequential process of stock reallocation driven by both longitudinal considerations (e.g., expectations about the duration of shocks) and cross-sectional considerations (e.g., relative demands across sectors). Different regimes exist in which labor inputs respond differently to changing demand conditions, so that employment and hours in an industry do not necessarily follow smooth adjustment paths as demand fluctuates over time. In fact, while employment always increases with sectoral demand conditions, depending on the perceived persistence of the demand shock and the quality of alternative opportunities, observed hours and the employment rate can be moving in either the same or opposite directions. In particular, an anticipated permanent expansion in sectoral demand can result in a temporary decrease in working hours, coupled with a temporary increase in both the sectoral labor force and unemployment, as recruitment is spread over time in order to economize on future training costs. However, a sharply escalating marginal training cost would restore the comovement in employment and working hours in response to positive demand shocks.

The result that employment will always respond positively to current demand shift, even a transitory one, while working hours may respond negatively seems to go against the established theory that hours rather than employment tend to respond first to (and increase with) demand conditions. The discrepancy arises from a difference in assumptions: no fixed cost in adjusting employment is assumed in the current setting, so that there is no delay in adjustment along the extensive margin. It is conceptually straightforward to generate the conventional result by incorporating a fixed cost of training, but this is not done in order to keep the analysis simple and to highlight the alternative insights. Also, apart from the example of a structurally transforming economy where permanent changes in relative demands cause a rapid intersectoral reallocation of labor, the present model may apply better in many industries in which volatile demands result in a sizable reserve pool of laid-off workers who can be recalled at minimal costs.

The model can also be extended to the analysis of mobility across regions within an economy. In particular, although the counterintuitive pattern of adjustment to permanent shocks is less often observed in intersectoral reallocation, it can effectively explain high urban unemployment in many developing countries, where the promise of better opportunities lures rural labor to the cities even though there are long queues for jobs there. In this application, the work is a simple extension of Topel's (1986) model of local labor markets. In an international perspective, the model may also be used to interpret the observed diversity in the patterns of labor market adjustment across economies. For example, much has been written about the differences in the ways in which Japanese and American firms respond to exogenous shocks. By analyzing the differences in the training costs and fixed costs of working involved, we may gain insights into the cause of such diversity without resorting to ad hoc cultural and social explanations. However, the complexity of the current model makes it difficult to derive analytical results without imposing restrictive and arbitrary assumptions about the forms of the various functions. More extensive research in that direction awaits future effort.

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