QUALITY OF LIFE AND LABOR MARKETS IN METROPOLITAN AREAS

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I. Introduction

Models of the labor market often assume that labor supply and labor demand are functions of the real wage and that the productivity of labor depends primarily on factors internal to the firm. This paper constructs and tests an alternative model in which both labor supply and labor demand are functionally dependent upon the environment of the community. The environment will be defined in terms of a set of quality of life (QOL) variables employed by Liu (1976).

The interaction of environment and labor markets is not a new area of study. Fox (1974), for example, has defined the concept of "total income" which includes psychological, social, or generally non-monetary income, as well as an explicit wage income. In general, the greater the quality of life in a metropolitan area the lower the wage necessary to bring forth a given supply of labor.

The demand for labor is also affected by variations in quality of life. Several authors have noted the relationship between individual health and quality of life (Abt, 1975); and Koshal and Koshal, 1974, 1980). A community with a higher quality of life will have a generally healthier population and labor force, and therefore less working time lost due to illness. In addition, a healthier labor force is likely to be more productive on the job. Therefore, a community with a higher quality of life is very likely to have a more productive labor force, *ceteris paribus,* leading to a greater wage paid to a given quantity of labor.

Another topic of concern in regional labor market analysis is spatial wage differentiation. Several authors have analyzed explicit wage differentials between urban areas (Israeli, 1979; Kelley, 1977; Power, 1981; Goldfarb and Yezer, 1976; and Tolley, 1979). Other authors have examined occupational wage differentials with direct, or even indirect, implications for spatial variation (Brown, 1980). Wage differentials have been the "classical" explanation of interregional migration (Fabricant, 1970; Hart, 1975a; 1975b; Cebula and Bloomquist, 1976; Kim, 1977; and Graves, 1976). Related to wage differentials is the literature on regional per capita income variation, pioneered by Kuznets (1955, 1963) and Williamson (1965), and regional dualism prominent in development literature (Chenery, 1962; Moriarty, 1978).

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Previous studies attempting to explain wage differentials have suggested industry mix, labor productivity, cost of living, age of capital stock, unionization, and technology differences as causes (see Moriarty, 1978). Kelley (1977), Hoch (1976), and Power (1981) have argued that city size has an impact on wage differentials, although disagreeing on the direction. Brown (1980), in investigating occupational wage differentials, concludes that neither endogenous job characteristics nor individual characteristics fully explain occupational wage differentials. This supports the contention by Tolley (1979), Israeli (1979), Kelley (1977), and Power (1981) what wage differentials are due (at least in part) to amenity factors (i.e., quality of life).

II. The Model

The first step in determining the impact of quality of life (QOL) on the labor market is to construct a model of market behavior. Typically, such models are based on specifications of labor supply and demand functions which incorporate some measure of QOL. Such is the case here as well. The point of departure for this model is the relaxation of the assumption that labor markets will be in a continuous state of equilibrium. This point will be dealt with below.

To understand the environment in which the model is applicable, imagine a region in which there are a variety of different communities, each of which is distinguished by its QOL and prevailing wage rate. The amount of labor supplied in each community is an increasing function of the wage rate and QOL; in other words, a decrease in QOL will result in the labor supply curve shifting upward so that the total quantity supplied will remain the same only if there is some increase in the wage.

In a world with no search or relocation cost each individual would select the community with the wage/QOL combination which maximizes his utility. Assuming QOL is fixed in the short-run, wage rates will adjust to insure labor market equilibrium in each community. Under the circumstances above, one would anticipate an inverse relationship between QOL and equilibrium wages.

In reality, of course, there are both search and relocation costs which prevent instantaneous response to changes in QOL and wages in the various communities. The solution described above will be appropriate to the steady state, but in general one would expect to observe deviations from the steady state solution.

These deviations occur because labor has a tendency to remain where it is. Relocation costs are high, and individuals must be assured of a sufficient return to justify their relocation. Consequently, it may not be in their best interest to respond to short-run deviaitons in QOL and wages from their steady state values.

Ideally these short-run rigidities would be modelled by incorporating lagged values of QOL and wages in the labor supply function. Unfortunately these data do not exist. Instead, community population is included in the labor supply function as a proxy for the labor force. Thus, the assumed form of the labor supply function for any given community is

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$$\ln N^s = Y_0 + Y_1 \ln w + Y_2 \ln QOL + Y_3 \ln Pop \qquad (1)$$
$$Y_1, Y_2, Y_3 > 0$$

where N^s is labor supply, w is the real wage, and Pop is current population.

The labor demand curve is derived under the assumption that firms will maximize profits subject to Cobb-Douglas production technology. The representative firm's objective function is

$$\Pi = A(QOL, Pop) K^\alpha N^\beta - wN - rK \qquad (2)$$
$$\alpha, \beta > 0 \quad \alpha + \beta < 1$$

where K and N are capital and labor inputs respectively and r is the cost of capital. The technology coefficient (A) is assumed to be an increasing function of population (through agglomeration effects) and QOL.

The first order conditions for a maximum are

$$A(QOL, Pop) \beta K^\alpha N^{\beta-1} = w \qquad (3)$$

$$K = \frac{\alpha}{\beta} \frac{w}{r} N \qquad (4)$$

Combining these two equations and assuming that

$$A(QOL, Pop) = B \, QOL^{\eta_1} Pop^{\eta_2}, \quad B, \eta_1, \eta_2 > 0 \qquad (5)$$

yields the following expression for labor demand in logged form:

$$\ln N = \pi_0 - \pi_1 \ln w + \pi_2 \ln QOL + \pi_3 \ln Pop. \qquad (6)$$

where

$$\pi_1 = \frac{1}{1-\alpha-\beta} > 1,$$

$$\pi_2 = \frac{1}{1-\alpha-\beta} \eta_1 > 0,$$

$$\pi_3 = \frac{1}{1-\alpha-\beta} \eta_2 > 0,$$

These expressions are derived under the assumption that labor's and capital's share, as well as the cost of capital, are constant across communities.

The model may be closed by assuming that the labor market in each community clears. However, casual observation indicates that at any single point in time, labor markets do not clear: not only does unemployment exist, but it exists in varying degrees across communities. This evidence suggests that wages do not adjust instantaneously to variations in labor supply and labor demand. To account for this observation, the employment rate is introduced as the proportion of the labor force which is employed. In log form this definition is

$$\ln(1-u) + \ln N^s = \ln N \qquad (7)$$

where u is the unemployment rate.

Substituting (7) into (1) and solving (1) and (6) for 1nN and lnw yields the following reduced-form system:

$$1nN = \delta^{10} + \delta^{11} \ln QOL + \delta^{12} \ln Pop + \delta^{13} \ln(1\text{-}u) \qquad (8)$$

$$1nw = \delta^{20} + \delta^{21} \ln QOL + \delta^{22} \ln Pop + \delta^{23} \ln(1\text{-}u) \qquad (9)$$

where

$$\delta_{11} = \frac{1}{\tau} (\pi_1 Y_2 + \pi_2 Y_1) \quad \delta_{21} = \frac{1}{\tau} (\pi_2 - Y_2)$$

$$\delta_{12} = \frac{1}{\tau} (\pi_1 Y_3 + Y_1 \pi_3) \quad \delta_{22} = \frac{1}{\tau} (\pi_3 - Y_3)$$

$$\delta_{13} = \frac{1}{\tau} \pi_1 \qquad\qquad \delta_{23} = \frac{1}{\tau}$$

$$\tau = \pi_1 + Y_1.$$

These expressions imply the following parameter space restrictions:

$$\delta_{11}, \delta_{12} > 0$$

$$0 < \delta_{13} < 1$$

$$\delta_{23} < 0.$$

An increase in QOL will cause both the labor supply and demand curves to shift to the right. The resultant change in the real wage will depend upon the relative magnitude of the shifts. If labor supply increases by more than labor demand ($Y_2 > \pi_2$), then the real wage will fall. The restriction on the population coefficients are similar since this variable enters the model with the same sign restrictions as QOL. An increase in the employment rate is represented by a movement down the labor demand curve (thus $\delta_{23} < 0$). If labor supply were perfectly inelastic ($Y_1 = 0$), then a one percent increase in the rate of employment would yield a one percent increase in employment. But since the reduction in the real wage yields a decline in the quantity of labor supplied, employment will increase by less than one percent. Thus, δ_{13} will be positive but less than one.

Note that since (1-u) is a function of the quantity of labor supplied and demanded its inclusion as an endogenous variable will create simultaneity bias. To avoid this difficulty, an instrumental variable is defined by regressing 1n(1-u) on the nominal wage rate, the price level, the output to labor ratio, and the output to population ratio, all in logged form. The output to labor ratio is designed to pick up productivity effects. The output to population ratio is intended as a scale variable, and the nominal wage rate and price level are included as proxies for the Philips curve relationship.

III. The Data

The data necessary to test the model constructed in the previous section are available at the SMSA level for 1970. QOL is proxied as a log-linear function of the following variables (taken from Liu (1976)):

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Pov = percent of families with income above the poverty level,

Cr = property crime rate,

Pol = mean annual inversion frequency.

QOL is defined as

$$QOL = EXP\,[\varepsilon_1\,Pov\,-\varepsilon_2\,Cr\,-\varepsilon_3\,Pol]$$

where $\varepsilon_1 > 0$ (i = 1,2,3). The characterization of QOL is, by necessity, arbitrary. This particular specification is chosen because a) it is felt that it summarizes relevant aspects of the community's environment in terms of variables that are readily available to the potential inhabitant, and b) the signs of ε_1, ε_2, and ε_3 are unambiguous in sign (unlike, say, the coefficient on weather conditions). Population, price indexes, and overall unemployment are also provided by Liu (1976). Unemployment data are available only for the overall labor force. To obtain the employment rate in the manufacturing sector, the following relationship is posited:

$$\frac{(1-u_m)}{(1-\bar{u}_m)} = b_o\,\frac{(1-u)}{(1-\bar{u})}^{b_1} \tag{10}$$

$$b_o,\, b_1 > 0,$$

where u_m is the rate of unemployment in the manufacturing sector and barred variables indicate natural rates. In logged form this equation becomes

$$\ln(1-u_m) = \ln b_o + \ln(1-\bar{u}_m) - b_1\ln(1-\bar{u}) + b1\ln(1-u).$$

Note that since the first three terms on the right hand side of the equation are constant, they will not appear in the regressions. The modification implies that the reduced-form parameters δ_{13} and δ_{23} should be rewritten as

$$\delta_{13} = \frac{1\,b_1}{\tau} \qquad \delta_{23} = \frac{1\,b_1}{\tau}.$$

Although δ_{13} will remain positive, it need not be less than one.

Data on manufacturing wages, labor, and value added are obtained from the *Annual Survey of Manufacturers 1970-71.* The wage data are constructed by dividing the wage bill by total labor hours. Wages and values added are then converted to real dollars using the deflator mentioned above. The dependent variables are the real wage rate and number of hours of employment in the manufacturing sector. These data are available for 229 of the 243 SMSAs.

V. The Results

The regression results are presented in Table 1. The model predicts that an increase in population or the employment rate will result in an increase in employment. Both of these conclusions are supported by the results, although the coefficients on the employment rate are unreasonably high (suggesting a value of b_1 in excess of 60). This may be indicative of measurement error either in the original data or in the presumed relationship between overall employment and unemployment in the manufacturing sector. Another possi-

bility is that the labor supply curve shifts outward in response to an increase in the employment rate, suggesting that the latter is a proxy for QOL. The estimated value of δ_{11} in excess of unity indicates the presence of agglomeration effects. In the wage equation population is insignificant while the rate of employment possesses a negative and significant coefficient as predicted.

The coefficients on the QOL proxies also satisfy the restrictions of the theory. A one percent increase in the proportion of families above the poverty level yields 3.4 and 1.1 percent increases in employment and the average wage rate, respectively. This result is consistent with a rightward shift of both the labor supply and demand curves. The positive coefficient on the wage rate indicates that the magnitude of the shift of the demand curve exceeds that of the supply curve.

An increase in the property crime rate is associated with significant reductions in both employment and the wage rate. This result is consistent with the hypothesis that productivity is inversely related to the crime rate, a conclusion supported by the work of Denison (1978). Changes in air quality have no significant impact on either employment or the wage rate.

TABLE 1a

	lnN	lnw
C	-300.259 (11.7)	87.334 (10.7)
lnPop	1.048 (30.5)	.009 (.8)
ln(1-u)	62.591 (11.2)	-19.907 (11.2)
lnPov	3.431 (7.0)	1.107 (7.2)
lnCr	-.396 (4.5)	-.076 (2.7)
lnPol	.000 (0)	.624 (1.4)
R^2	.86	.44

a Absolute value of the t-statistic in parentheses.

The results of Table 1 are consistent with the theory and suggest that the effect of QOL operating through increased productivity dominate the effect operating through increased utility of employees. In fact the only conclusion which can be drawn on the utility effect is that it is relatively small. The estimates do not provide any indication as to whether an increase in QOL shifts the labor supply curve down (as predicted by the theory) or up.

One source of this disappointing result may be the presence of regional differences in labor markets. The presence of inter-regional productivity

differences has been well documented (see Moomaw, 1981). The source of these productivity differences may be regional variations in the utility response of labor to a change in QOL. To test for the presence of inter-regional differences, the following model is estimated:

$$\ln N = \delta_{10} + \delta_{11} \ln Pop + \delta_{12} \ln(1\text{-}u)$$

$$+ a_N (a_1 \ln Pov + a_2 \ln Cr + a_3 \ln Pol)$$

$$+ b_N (b_1 RD_s + b_2 RD_{sw} + b_3 RD_w)$$

$$+ c_N [RD_s (c_1 \ln Pov + c_2 \ln Cr + c_3 \ln Pol)$$

$$+ RD_{sw} (c_4 \ln Pov + c_5 \ln Cr + c_6 \ln Pol)$$

$$+ RD_w (c_7 \ln Pov + c_8 \ln Cr + c_9 \ln Pol)] \tag{11}$$

$$\ln w = \delta_{20} + \delta_{21} \ln Pop + \delta_{22} \ln(l\text{-}u)$$

$$+ a_w (d_1 \ln Pov + d_2 \ln Cr + d_3 \ln Pol)$$

$$+ b_w (e_1 RD_s + e_2 RD_{sw} + e_3 RD_w)$$

$$+ c_w [RD_s (f_1 \ln Pov + f_2 \ln Cr + f_3 \ln Pol)$$

$$+ RD_{sw} (f_4 \ln Pov + f_5 \ln Cr + f_6 \ln Pol)$$

$$+ RD_w (f_7 \ln Pov + f_8 \ln Cr + f_9 \ln Pol)] \tag{12}$$

where

$RD_s = 1$ For all SMSAs in the South or East South Central census regions (and zero otherwise).

$RD_{sw} = 1$ For all SMSAs in the West South Central census region (and zero otherwise).

$RD_w = 1$ For all SMSAs in the Mountain or Pacific census regions (and zero otherwise).

This model is constructed so that regional effects may be introduced in several different ways by constraining the values of a_N, b_N, c_N (a_w, b_w, c_w) to zero. For instance the original model corresponds to the restriction $b_N = c_N = b_w = c_w = 0$. The different models are classified as follows:

1) Full Model: equation (11) and (12)
II) $b_N = b_w = 0$: no regional constant effects
III) $c_N = c_w = 0$: no regional QOL effects
IV) $a_N = c_N = 0$, $a_w = c_w = 0$: no QOL effects
V) $b_N = c_N = 0$, $b_w = c_w = 0$: no regional effects (original model)
VI) $a_N = b_N = c_N = 0$, $a_w = b_w = c_w = 0$: no regional or QOL effects.

Model V corresponds to (8) and (9), i.e. regional differences are ignored.

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Model II attributes regional differences entirely to QOL, and model III postulates that regional differences exist but are independent of QOL. Model IV is consistent with the hypothesis that variations in the wage rate and in employment are independent of QOL and thus due entirely to region. Model VI is the "bare-bones" model which hypothesizes that variation in the wage rate and employment across SMSAs is entirely attributable to differences in population and the rate of employment.

The full model (I) places no restrictions on the coefficients of (11) or (12). The estimates for this model are presented in Tables 2a and 2b. In the employment equation, the only significant regional variable is air pollution in the western region. In the wage equation, the only significant regional variable is air pollution in the southwest. The results for the northeast region are suggestive of a significant QOL effect operating through utility. The coefficients on poverty and pollution in the employment equation are insignificant while the coefficients in the wage equation are significantly positive. This result is consistent with an expansionary effect upon labor demand and a contractionary effect upon labor supply of approximately the same magnitude. As the theory predicts, an increase in pollution reduces QOL and thus causes an upward shift of the labor supply curve. But since the poverty variable measures the proportion of the population *above* the poverty level, one would expect the labor supply curve to shift down in response to an increase in this variable. Thus this result is contrary to the theory.

TABLE 2a

Dependent Variable: lnN[a]

		South	Southwest	West
C	-243.496			
	(8.6)			
lnPop	1.046			
	(32.4)			
ln(1-u)	50.550			
	8.6			
RD[b]		2.332	1.667	22.866
		(.2)	(.2)	(1.2)
lnPov	2.448	-254	-.442	-4.474
	(1.0)	(.1)	(.2)	(1.1)
lnCr	-.110	-.314	-.069	.149
	(1.0)	(1.3)	(.3)	(.6)
lnPol	.171	.272	.109	-1.240
	(.6)	(.8)	(.2)	(1.8)
R^2	.89			

a. Absolute value of the t-statistic in parentheses.
b. Coefficients on regional variables are marginal effects.

Dependent Variable: lnw[a]

		South	Southwest	West
C	87.540 (9.3)			
lnPop	.008 (.8)			
ln(1-u)	-20.700 (10.5)			
RD[b]		2.698 (.6)	4.722 (1.3)	8.330 (1.3)
lnPov	1.557 (2.0)	-.295 (.3)	-.350 (.4)	-1.502 (1.1)
lnCr	.014 (.4)	-.127 (1.5)	-.107 (1.2)	-.065 (.7)
lnPol	.271 (3.0)	-.121 (1.0)	-.681 (3.6)	-.327 (1.4)
R^2	.52			

For footnotes see end of Table 2a.

The elements of the first column indicate the significance of eliminating various components from the full model. In the employment equation, neither the regional constants nor the regional QOL variables provide a significant degree of explanatory power. Broader reductions do yield a significant F-ratio. Specifically, when all region-specific indicators are removed from the model there is a significant decline in explanatory power (compare models I and V). In the same vein, the significance of QOL effects on employment is apparent through comparison of IV with the full model. The conclusions for the wage equation are similar except that the region-specific QOL variables are marginally significant in this case. This result suggests that the definition of QOL varies from region to region and that inter-regional wage differentials are, at least in part, attributable to differences in the definitions.

The remaining columns of the table contain the F-ratios under different definitions of the full model. For instance the entries in column two are derived under the assumption that the full model contains no regional constants. A perusal of these entries indicates that QOL is a significant determinant of both employment and the wage rate with or without the regional constants and/or the regional breakdown of QOL. The results also show that when QOL is absent from the model, the regional constants are highly significant (compare model IV with model VI).

The significance of regional differences cannot be gleaned from the tables but must be inferred through application of the F-test. Table 3 presents the

F-rations for the relevant comparisons among the six models listed above. The statistic is defined as

$$F(k_o - k_a, M) = \frac{SSR(H_o) - SSR(H_a)}{MSE(H_o)} \cdot \frac{1}{(k_o - k_a)}$$

where

SSR $(\cdot)$ = Regression sum of squares
H_o = Hypothesized (restricted) model
H_a = Alternative (unrestricted) model
k_o = number of restrictions in the hypothesized model
k_a = number of restrictions in the alternative model
M = degrees of fredom in the hypothesized model

The terms "restricted" and "unrestricted" should be interpreted in a relative sense, e.g., model IV is restricted relative to model III. The hypothesis in this case is that regional QOL factors have no significant explanatory power when added to the model containing no constant regional differences.

TABLE 3

Alternative Model

LNN

		I	II	III	IV	V	VI
Hypothesized	I	X	X	X	X	X	X
Model	II	.6	X	X	X	X	X
	III	1.0	X	X	X	X	X
	IV	2.3**	X	6.1**	X	X	X
	V	4.9**	6.4**	16.6**	X	X	X
	VI	9.4**	11.7*	22.0**	35.5**	22.7**	X

ALTERNATIVE MODEL

LNw

		I	II	III	IV	V	VI
Hypothesized	I	X	X	X	X	X	X
Model	II	.9	X	X	X	X	X
	III	1.9*	X	X	X	X	X
	IV	4.6**	X	12.0**	X	X	X
	V	2.6**	3.2**	4.6**	X	X	X
	VI	6.4**	7.8**	12.7**	11.6**	19.8**	X

*   Significant at 5% level
** Significant at 1% level
X   F-ratio not calculated

V. Summary and Conclusions

The purpose of this paper is to construct and test a model of the labor

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market which accounts for the impact of the quality of life on the labor demand and labor supply functions. The model is a disequilibrium one in the sense that it incorporates unemployment and gradual migration. However, no attempt is made to model either of these processes.

The model assumes that QOL for each SMSA ia a log-linear function of the proportion of population above the poverty level, the property crime rate, and a measure of air quality; the test is performed for 229 SMSAs for which labor market and QOL data are available. The results indicate that the impact of QOL on the labor market is concentrated in changes in productivity. There is little evidence (for or against) the contention that utility is an increasing function of QOL. Rejection of the theory requires a significantly positive coefficient on QOL in the employment equation and a significantly negative coefficient in the wage equation.

There is evidence that regional differences persist in employment and wages even after QOL has been incorporated in the model. Ideally the theory should explain these discrepancies without resorting to region-specific definitions of QOL. On the other hand, the results suggest that the different definitions of QOL may provide an explanation for observed regional wage differentials. At any rate, it appears that further research should be guided in the direction of obtaining more extensive specifications of QOL.

The policy implication of the theory presented here is that government policies designed to modify the environment of the community may possess external effects in the labor market. As long as employment or the real wage rate is an element of the community's welfare function, these externalities should be taken into account in determining the optimal amount of social capital.

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