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Abstract: An aggregate labor force participation rate model based on a neoclassical two-period labor-supply model is derived and estimated using annual time-series data for the Philippines. The findings cast doubts on LDC labor market models that posit an infinitely elastic labor supply curve.

Key words: aggregate labor supply, labor force participation rate.

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I. Introduction

An infinitely elastic labor supply curve has been for a long time a fixture in the development literature. It draws intellectual support from a large body of theoretical work, the most prominent of which are the writings of Lewis (1954) and Ranis and Fei (1961). Recently, however, the appeal of a horizontal labor supply curve waned somewhat as empirical studies that used microdata detected a positive labor supply response to the real wage rate, in accordance with a prediction of a neoclassical labor supply model (see, e.g., Bardhan 1979, Rosenzweig 1980).

In view of these findings, parallel interest has grown in deriving an empirical counterpart of a standard labor supply model using aggregate data in an LDC setting. This interest has been fueled by the central role that the labor market plays in modern macroeconomic analysis, especially in the study of business fluctuation, a phenomenon of sufficient importance nowadays in heavily indebted LDCs.

This paper reports on an attempt to estimate an aggregate labor force participation equation based on a neoclassical two-period labor supply model. It pulls together major strands from the studies of Lucas and Rapping (1969), Heckman and Willis (1977), and Clark and Summers (1982) to derive the estimating equation. The empirical setting for this study is the Philippines, which in recent years has been experiencing some undesirable business fluctuation arising from its huge foreign debt.

II. Theoretical Considerations

I rely on a standard microeconomic model of labor supply to derive an aggregate labor force participation rate model. Lucas and Rapping provide the starting point. I consider identical individuals in an economy producing a single homogeneous good. It is assumed that each person has a two-period utility function of the form:

$$U = u(c, \bar{c}, l, \bar{l}) \tag{1}$$

where c and l stand for current goods consumption and leisure hours, respectively. The bar refers to future quantities of the two commodities. It is assumed that each of the arguments in (1) has a positive marginal utility.

The representative individual is assumed to maximize (1) on condition that the present value of consumption does not exceed the present value of work and nonwork income. There is also a time constraint which stipulates that total fixed time available is exhausted by leisure and work hours, h, in any given period. Assuming that second-order conditions for the existence of an interior solution are satisfied, the first-order conditions of a constrained utility-maximization problem yield an hours-of-work function.

$$h = h(w/p, \bar{w}/p(1+r), \bar{p}/p(1+r), A/p) \tag{2}$$

where w is the current nominal wage, p is the current price level, r is a nominal interest rate used to discount future wage, $\bar{w}$, and future price, $\bar{p}$, and A is nonwork income.

Suppose leisure is a normal good. Following standard labor-supply theory, a change in the current real wage involves a substitution and an income effect on

current leisure. The wage rise raises the relative price of leisure thereby inducing substitution in favor of market work. At the same time, however, the wage increase raises income, and leisure being a normal good, more of it will be consumed. Thus the net effect of a wage change on work is either positive or negative depending on the relative magnitudes of the substitution and income effects. One gets $\partial h/\partial (w/p) > 0$, if the substitution effect outweighs the income effect; however, $\partial h/\partial(w/p) < 0$, if the income effect dominates.

As for the effect on current leisure of a change in the future real wage, if a person expects a high wage in the future and the substitution effect outweighs the income effect, then quantity demanded of future leisure falls. Assuming current and future leisure are substitutes, then the person is induced to consume more leisure in the current period as compensation for the loss of future leisure. The following is thus expected: $\partial h/\partial(\bar{w}/p(1+r)) < 0$. It is to be noted that this follows from the condition that the substitution effect dominates the income effect. If, however, the income effect dominates, then the assumption that current and future leisure are substitute yields $\partial h/\partial(\bar{w}/p(1+r)) > 0$.

Thus, there is an ambiguity as to the effects of changes each in current and future real wage on current work hours. The respective signs depend on the relative magnitudes of the income and substitution effects of a wage change.[1]

As regards the effect of future relative price on current leisure, assume that consumption of goods and leisure are complements. If future price is expected to go up, then quantity demanded of future goods goes down. Assuming complementarity, quantity demanded of future leisure also falls. And if current and future leisure are substitutes, then current leisure rises to compensate for the fall in future leisure. Thus $\partial h/\partial(\bar{p}/p(1+r)) < 0$.

Concerning nonwork income, it is hypothesized that $\partial h/\partial(A/p) < 0$. That is, a pure wealth effect on current leisure is exerted by nonwork income. Summarizing the above, the following signs are expect:

$$\partial h/\partial(w/p) \gtrless 0 \quad \partial h/\partial(\bar{w}/p(1+r)) \gtrless 0 \quad \partial h/\partial(\bar{p}/p(1+r)) < 0 \quad \partial h/\partial(A/p) < 0 \qquad (3)$$

The next step is to establish the link between hours of work and labor force participation. Following Heckman and Willis, labor force participation is described by a binary variable, y_t. That is:

$$y_t = \begin{cases} 1 & \text{if } h_t > 0 \\ 0 & \text{if } h_t = 0, \quad t = 1, 2 \end{cases} \qquad (4)$$

where h_t is obtained from a constrained two-period utility maximization

Holding price constant, let w_t denote the offered market wage and w_t^* the reservation wage of the individual. Then y_t may also be written in the following form:

$$y_t = f(w_t - w^*) = \begin{cases} 1 & \text{if } w_t - w_t^* > 0 \\ 0 & \text{if } w_t - w_t^* \leq 0. \end{cases} \qquad (5)$$

This means, an individual takes a job if the offered wage exceeds the reservation wage; otherwise, the job offer is rejected.

So far the discussion has been in terms of a single individual making a labor force participation decision. To get an aggregate model, I follow Clark and Summers. Both w_t and w_t^* are postulated to be random variables with a known joint distribution $g(.,.)$. The aggregate labor force participation rate, LFPR, may be written thusly:

$$LFPR = P(h_t > 0) = \iint_{w_t > w_t^*} [g(w_t, w_t^*)]\, dw^t\, dw_t^*. \qquad (6)$$

The variables affecting h_t, and consequently LFPR, are shown in (2), while the expected signs are summarized in (3).

III. Empirical Analysis

Using (2) and (6), I estimate a regression model of the form:

$$LFPR_t = X_t \beta_t + \epsilon_t \qquad (7)$$

where x is a row vector of regressors corresponding to the arguments $(w/p, \bar{w}/(1+r)p, \bar{p}/(1+r)p, A/p)$, β is a column vector of coefficients, t refers to the time period and ϵ is a random normal error term.

Postulating a log-linear relationship, the regression model takes the specification:

$$\ln (LFPR)_t = \beta_0 + \beta_1 \ln (W/P)_t + \beta_2 \ln (\bar{W}/(1+R)P)_t + \beta_3 \ln (\bar{P}/(1+R)P)_t + \beta_4 \ln (A/P)_t + \epsilon_t \qquad (8)$$

where W is an index of nominal wage, P a consumer price index, and R a nominal interest rate. I expect the following signs: $\hat{\beta}_1 \gtrless 0$, $\hat{\beta}_2 \gtrless 0$, $\hat{\beta}_3 < 0$, and $\hat{\beta}_4 < 0$.

The future variables $\bar{W}$ and $\bar{P}$ are unobserved. To get their empirical equivalents, I assume that expectation formation is based on first-order autoregressive models for W and P, namely: $W_t = \alpha + \beta W_{t-1} + u_t$ and $P_t = \tau + \delta P_{t-1} + v_t$. Ordinary least squares estimates (OLS) of these models are used to

generate forecasts of wage and price for the immediately following year. The forecast values are discounted using R and deflated by P.

There is no available measure of nonwork income, A. I tried as a proxy variable an index of commercial share prices.

Equation (8) was estimated by OLS using annual time-series data for the period 1959-1980. The series for the dependent variables, LFPR, is taken from various issues of the Yearbook of Labor Statistics, published by the Philippines' Department of Labor and Employment; it can also be constructed from data appearing in the International Labor Statistics (ILO, various issues). The regressors in (8) are all taken from the International Financial Statistics (IMF, 1988).

The OLS result of (8) is shown below:

$$\ln (LFPR)_t = \underset{(30.558)}{4.458} \underset{(-2.573)}{-4.331} \ln (W/P)_t + \underset{(2.579)}{3.826} \ln (\bar{W}/(1+R)P_t$$

$$\underset{(-2.520)}{-3.838} \ln (\bar{P}/(1+R)P)_t \quad \underset{(0.076)}{-0.005} \ln (A/P)_t \qquad (9)$$

$R^2 = 0.385$ s.e.e. = 0.066 D-W=1.794 F = 3.979

The numbers in parentheses represent t-ratios. The estimated coefficients are significantly different from zero at five percent level of significance, except the one for nonwork income.

According to (9), there is support for the income effect of a wage change dominating the substitution effect, evident from the negative coefficient for ln (W/P) and the positive coefficient for $\ln(\bar{W}/(1+R)P)$.[2] This finding is consistent with the observation from simple correlation analysis, whereby, despite a decline in real wages, labor force participation rate is rising over time (see, e.g., Oshima, de Borja and Paz 1986).

There is also support for the complementarity hypothesis between consumption of goods and leisure. The expected negative sign for the coefficient of $\ln (\bar{P}/(1+R)P$ is obtained.[3] As for the effect of nonwork income, the expected negative sign is obtained, but it is not statistically significant.[4] Estimating (8) without the proxy variable for nonwork income, the following is obtained:

$$\ln (LFPR)_t = \underset{(38.882)}{4.463} - \underset{(-2.823)}{4.371} \ln (W/P)_t + \underset{(2.736)}{3.850} \ln (\bar{W}/(1+R)P)_t \quad (10)$$
$$\underset{(-2.665)}{-3.860} \ln (P/(1+R)P)_t$$

$\bar{R}^2 = 0.424$ s.e.e. = 0.064 D-W= 1.791 F = 5.654

From the above, the result of dropping (ln A/P) as a regressor leads to some improvement, judging by the changes in $\bar{R}^2$ and the F-statistic.

As an extension of the regression model, I test for the effect of the open unemployment rate, U, on LFPR. Two competing hypotheses in this regard are the encouraged or discouraged worker effect of unemployment on labor force participation. The result follows:

$$\ln (LFPR)_t = \underset{(28.160)}{4.227} \underset{(-3.516)}{-4.843} \ln (W/P)_t + \underset{(3.305)}{4.109} \ln (\bar{W}/(1+R)P)_t$$
$$\underset{(3.224)}{-4.127} \ln (\bar{P}/(1+R)P_t + \underset{(2.376)}{0.214} \ln U_t \quad (11)$$

$\bar{R}^2 = 0.553$ s.e.e. = 0.057 D-W= 2.256 F = 6.883

From (11) above, I find support for the hypothesis that the unemployment rate encourages labor force participation. There is also an improvement in the estimate after adding ln U as a regressor, judging by the t-ratios, $\bar{R}^2$, and F-statistic.

IV. Concluding Remarks

The aim of this paper has been to estimate an aggregate labor force participation rate model based on a neoclassical two-period labor supply model. The econometric results are as follows: (1) LFPR responds significantly to current real wage and discounted expected future real wage with the income effect dominating the substitution effect; (2) LFPR is negatively affected by the discounted expected future price level and complementarity between consumption of goods and leisure is evident; (3) LFPR responds positively to unemployment in support of the encouraged-worker effect. In view of these results, one should be circumspect about assuming a horizontal labor supply curve even in so-called labor-surplus economies of LDCs.

REFERENCES

Bardhan, Pranab K., 1979, Labor Supply Functions in a Poor Agrarian Economy, American Economic Review, 69, 73-83.

Clark, Kim B. and Lawrence H. Summers, 1982, Labor Force Participation: Timing and Persistence, Review of Economics Studies, 49, 825-44.

Heckman, James J., 1974, Life Cycle Consumption and Labor Supply: An Explanation of the Relationship Between Income and Consumption Over the Life Cycle, American Economic Review, 64, 188-194.

_____ and Robert J. Willis, 1977, A Beta-Logistic Model for the Analysis of Sequential Labor Force Participation by Married Women, Journal of Political Economy, 85, 27-58.

Lewis, W. Arthur, 1954, Economic Development with Unlimited Supplies and Labor, Manchester School of Economic and Social Studies, 22, 139-91.

Lucas, Robert E. and Leonard E. Rapping, 1969, Real Wages, Employment and Inflation, Journal of Political Economy, 77, 721-54.

Oshima, Harry, Elizabeth de Borja and Wilhelmina Paz, 1986, Rising National Income per Worker and Falling Real Wages in the Philippines in the 1970s, Philippine Review of Economics and Business, 223 (Sept/December), 151-190.

Rosenzweig, Mark R., 1980, Neoclassical Theory and the Optimizing Peasant: An Econometric Analysis of Market Family Labor Supply in a Developing Country, Quarterly Journal of Economics, 94, 31-55.

Ranis, Gustav and John Fei, 1961, A Theory of Economic Development, American Economic Review, 51, 533-65.

FOOTNOTES

1. A precise statement in comparative-statics terms, appears in Heckman (1974).

2. The single-period autoregressive model used to predict expected future nominal wage is:

$$W_t = \underset{(0.109)}{0.102} + \underset{(68.964)}{1.053}\ W_{t-1}$$

$\bar{R}^2 = 0.996$ s.e.e. = 1.439 D-W= 1.790 F = 4756.05

t-ratio in parentheses

3. To get expected future price level, I used the following model:

$$P_t = \underset{(-1.310)}{-1.536} + \underset{(40.174)}{1.164}\ P_{t-1}$$

$\bar{R}^2 = 0.987$ s.e.e. = 2.832 D-W= 1.837 F = 1613.99

4. Clark and Summers (p.835) report a similar result from their asset-return variable.