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SHADOW WAGE RATE FOR URBAN PUBLIC PROJECT EVALUATION IN THAILAND

Somnuk Tubpun

Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

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I. Introduction and Problem Setting

The determination of the economic merits of a project from the government's point of view depends on the national benefits derived from the project being larger than the real costs of investment and operation of the project. If the markets perform perfectly, the market prices of each of the elements on the benefit side and the cost side show the true values of goods and the opportunity costs of factors. These prices can be applied directly in computation of project benefits and costs. However, the condition theoretically required for market prices to correspond exactly to the opportunity cost conditions, such as full employment of resources, perfect competition, perfect mobility of inputs, cannot be found in the real world, especially in developing countries.

Distortions to the markets in developing countries are numerous. The following are among the more outstanding ones.

1) The existence of rapid inflation causes the international value of the country's own currency to be overvalued because of the modern convention of maintaining "fixed" exchange rate. This distortion tempts many economists to develop techniques for estimating the shadow price of foreign exchange.

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** Rockefeller Foundation Fellow, Department of Agricultural and Applied Economics, University of Minnesota.

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Among them are Bruno [1965]; Little and Mirrlees [1969, 1976]; Dasgupta, Sen and Marglin [1972]; Balassa [1973]. A useful application of these techniques is found in Beyer [1975].

2) Capital market does not perform perfectly so that the market rate of interest is not an appropriate rate of discount. What the appropriate social rate of discount should be has been discussed extensively in Arrow [1967], Baumol [1968], Harberger [1968] and Bradford [1975].

3) Monopoly powers in less developed nations are very strong so that market prices do not reflect the social opportunity costs of the marginal unit of goods and services.

4) There may be an excess supply of labor in comparison with the available jobs at an "acceptable" income. The wage actually paid employees in industrial sector may be greater than the value of the marginal product of the labor at full employment. This may call for the use of shadow wage in valuation of benefits and costs of the public projects [Meyers, 1974]. The methodologies and formula for deriving shadow wage rates are the concern in this paper and will be discussed in more detail later.

It should be noted that significant costs in term of money and time are involved in estimating the shadow wage or shadow price. Therefore, unless there is good reason to believe that the market prices of resources are grossly distorted and that more reliable estimates are practical, one should use market prices as a starting point in project appraisal. The effort of making minor corrections may not be justified by the gains of somewhat better project appraisal.

This paper will review the existing methodologies for estimating the shadow wage rate. Assumptions and some special characteristics as well as drawbacks of each metholology are discussed. From these special characteristics, a formula is derived for estimating wages for Thai economic conditions.

The paper is organized in three sections. First, some economic and social characteristics of the Thai economy are discussed that are important in constructing a suitable formula for the shadow wage rate. Second, there is a review and discussion of existing methodologies. Finally a formula is developed for deriving the shadow wage rate for Thailand.

II. The Important Features of the Thai Economy in Estimating the Shadow Wage Rates.

It is widely accepted that labor market distortions in the Thai economy are great and estimation of shadow wage rate to use in public project evaluation is desirable and worthwhile. This study will restrict itself to dealing with large public projects in urban areas. One can think of the project proposed to develop the Klong Toey slum areas by building housing units as an example. The shadow wage rate to be applied should be constructed such that it reflects the following considerations.

1) Two of the national goals stated in the National Economic and Social Development Plan are economic growth and improving income distribution. There is no explicit recognition of one having the first priority. Sometimes the government states clearly that the latter will be emphasized more than the former, but on many occasions the actions taken by the government lead in the opposite direction. However, this is not our main concern. The point is, shadow wage rates should reflect the redistributional effects as well as the maximization of outputs or satisfaction in the Thai society.

2) An empirical study by Sunkul [1973] concluded that there exists underemployment or surplus labor in the agricultural sector of Thai economy. It is composed of two components, namely the seasonal unemployment and the disguised unemployment. This implies that the marginal product of

labor in this sector and in the slack season is not equal to zero (but may be close to zero). The withdrawal of labor from this sector for a period longer than a crop year would cause the output of this sector to decline.

3) In the urban areas, there are two sectors of employment which, in Harberger's terminology [1971], are called the "informal" or "unprotected" sector and the "formal" or "protected" sector. Only the wage rate in the protected sector is subject to the minimum wage law. Workers in the informal sector are, for example, vendors of toys, miscellaneous products and lottery tickets; servants; and taxi drivers who share a rented cab together. These workers are hopeful of obtaining jobs in the formal sector. There are migrants who are in the process of seeking jobs and finance themselves while searching by participation in the informal sector.

4) The empirical study done by Thavornjit [1977] shows that there is evidence that "pull" factors such as the accessibility of high income are positively associated with number of migrants. This is consistent with Harberger's migration model [1971] which states that the individual will migrate from rural to city only if his/her marginal product in rural employment is less than or equal to expected income in alternative activity in the city. This implies that creation of additional job in urban formal sector increases the probability of getting a job in this sector and hence expected income. Therefore, shadow wage should reflect this migration effect attached to the creation of a urban public project.

5) Many scholars feel that the low-income laborers have marginal propensity to save (m.p.s.) equal to or very close to zero. McCleary, et al. [1976] shows that this hypothesis is not supported when applied to the case of low income urban and rural households in Thailand. However, if the formula fails to reflect nonzero marginal propensity to save of the worker

class, it is considered as a minor deficiency since the marginal propensity to save, if not equal to zero, may be very small.

III. Reviews of Existing Methodologies and Formulas.

Generally the formula for the shadow wage rate is an estimate of the total effects on social welfare of employing an additional worker. The level of social welfare is based on the consumption level of the society. No saturation point is assumed for society's consumption. Therefore, maximization of society's welfare is the same as maximization of consumption.

In line with this, Dasgupta, Sen and Marglin [1975] developed a formula for UNIDO to use as a guideline for project evaluation. Little and Mirrlees [1969, 1976] also developed their own formula for industrial project evaluation for the OECD Development Center. These two methodologies are essentially the same, with only differences in the assumption about foregone capitalist consumption that results from taxing the capitalist.

The basic UNIDO formula is

$$SWR_1 = Z + (1 - s^c)W + P^I s^c W - W \qquad (1)$$
$$= Z + s^c(P^I - 1)W$$

where SWR_1 = shadow wage rate

Z = marginal product of labor in agricultural sector

s^c = marginal propensity to save (m.p.s.) of capitalists

W = wage rate in urban formal sector of wage paid in the project

P^I = shadow price of saving in term of consumption, i.e. the present value of the aggregate consumption stream generated by $1 of marginal investment. (See Appendix for derivation of P^I)

Assumptions behind this formula are:

i) marginal propensity to save (m.p.s.) of workers participating in the project is zero;

ii) project finance and hence wage paid to the workers come from taxes on capitalists;

iii) the estimate of P^I does not take into account who the benefit recipients are from the $1 investment; the formula treats $1 of capitalists' consumption equal to $1 of workers' consumption.

iv) an additional job created by the project can be filled and/or replaced by workers from rural agricultural sector. This does not conform with the migration theory that relates the number of migrants to the expected earnings and the probability of getting a job. The migration theory says that a person would change occupations only if the expected income from the new job is greater than the sacrifice from taking the job. In other words, the opportunity costs of adding a new worker to the project includes the person's subjective probability of getting the new job and costs other than the agricultural output foregone.

Equation (1) can be interpreted as follows. The first term on the right hand side is the measure of agricultural production foregone as a result of the worker's change of employment. If the employed worker in the project does not come directly from the agricultural sector, he must come from another job which will be filled by a worker from the agricultural sector. The second term reflects the immediate fall in capitalist's consumption when W of his income are taxed and transferred to the worker. The third term is difficult to perceive. This P^I is the present value of

consumption that a unit of investment creates. Therefore $P^I s^c W$ is the foregone capitalist's consumption when $s^c W$ is given to the worker and the net earnings of the capital that would have been invested are lost. The last term is the increase in worker's consumption. Therefore, equation (1) measures the aggregate consumption loss by the society from employing one project worker at wage W.

The Little-Mirrlees formula [1969, p. 167] in our notation is

$$SWR_2 = W - \frac{1}{P^I}(W - Z) \qquad (2)$$

The first term, W, is equivalent to the reduced savings due to employing another person (the increase in consumption, W - Z, plus the reduction in agricultural production, Z). The second term $\frac{1}{P^I}(W - Z)$ is the increase in consumption adjusted so that it has the same value as investment that will generate P^I more future consumption. For example, if \$1 invested today will generate \$5 of future consumption, current consumption is worth only 1/5 as much as investment. [Little and Mirrlees, 1969, p. 160]

By rearranging the expression (2), we have

$$SWR_2 = \frac{1}{P^I}[Z + (P^I - 1)W]$$

If it is assumed further in (1) that all of the project finances come from capitalists' saving, $s^c = 1$ in (1), then

$$SWR_2 = \frac{1}{P^I} SWR_1$$

Only if P^I is unity do the two formulas give the same result. But P^I is likely to be greater than one, and $SWR_2 < SWR_1$. If $s^c = 1$ and $P^I > 1$, the total labor costs of using SWR_2 are always less than the costs using SWR_1. The value of the foregone consumption under the UNIDO formulation is $\frac{1}{P^I}$ times as great as in the Little-Mirrlees formulation. However, $SWR_2 < SWR_1$ because

of a different assumption about the marginal return to investment by capitalists. In SWR_2 no immediate reduction is assumed in capitalist's consumption whereas the SWR_1 does include a loss in the present value of consumption, WP^I, that would have resulted from the returns on the investment the capitalist would have made if the wage, W, had not been taxed away from him.

These two formulas have two common deficiencies which would be very crucial if they are to be used in project appraisal in the Thai economy. The first is that it is assumed that only capitalists can save. McCleary [1974] found that m.p.s. of low income Thai households in rural and urban areas are not equal to zero. As a result of this finding, McCleary proposed the shadow wage rate formula for project evaluation in the Thai economy, and called it the Generalized UNIDO formula as follows.

$$SWR_3 = Z[(1 - s^w) + s^w P^I] + W[1 - s^c) + s^c P^I] - W[(1 - s^w) + s^w P^I] \quad (3)$$

which can be written as

$$SWR_3 = Z[(1 - s^w) + s^w P^I] + W[(s^c - s^w)\ (P^I - 1)]$$

where s^w is the marginal propensity to save of worker class. It is easy to see that if $s^w = 0$, SWR_3 will be collapsed to SWR_1 in (1).

The second deficiency results from the implicit assumption that there are no other direct costs to agricultural worker or society from the employment other than agricultural output foregone or loss in savings. In fact when new jobs are created in urban areas such that workers migrate from rural agricultural sector, there are several kinds of costs which occur--travel costs, foregone leisure time where longer working hours are involved, greater food consumption necessitated by greater work effort in project employment, psychic costs arising from being far from families and relatives, etc. As McCleary states [1974]:

> ... the correct expression for direct cost to society from employing an additional worker is the marginal supply price of labor (call it L) ... L is the maximum payment sufficient to induce the worker to accept employment on the project, or put differently, it is the output foregone in alternative employment plus that compensating variation sufficient to induce him to shift his employment to the project.

Let d stand for the "other" costs of employment aside from foregone output, then L = d + Z and the more generalized UNIDO formula of shadow wage rate becomes

$$SWR_4 = [Z + d]\,[(1 - s^w) + s^w P^I] + W[s^c - s^w)(P^I - 1)] \qquad (4)$$

If urban wage rate W in the formal sector does represent the supply price of labor, i.e. L = W where W = Z + d, then SWR_4 becomes

$$SWR_4 = [(1 - s^c) + s^c P^I]W$$

that is, the capitalist's aggregate consumption foregone is the social opportunity cost of employing an additional worker.

The formula of SWR_4 in equation (4) is still inappropriate for our purposes in two aspects.

i) It fails to take account of the redistribution of benefits deriving from the investment on the project.

ii) It fails to incorporate the migration theory.

The increase in project employment may change the potential migrant's subjective estimate of the probability of getting a job so that creating a job in the project not only withdraws one worker from the rural agricultural sector but also some potential migrants attached to it. So the agricultural output foregone is greater than indicated in the formula SWR_4 in (4).

IV. Derivation of Shadow Wage Rate for Large Urban Public Project in Thailand.

A. Shadow wage and the migration effects.

Let us assume that the rural worker's objective of migrating is to be employed in the urban protected sector, but he participates in the urban unprotected sector of employment first from whence he can shift to the protected sector if a position becomes available. He would obtain the wage rate gW in the unprotected sector, where $0 < g < 1$ and W is the fixed minimum wage rate in the protected sector (or wage rate paid in the project). His marginal product in rural agricultural sector is Z which is dependent on the number of workers employed in the agricultural sector, N_A; $\frac{\partial Z}{\partial N_A} \leq 0$. He is assumed to bear the other fixed net costs of d Baht in moving from rural to urban employment.

At equilibrium where there is no migratory movement the expected (real) income in urban protected sector must be equal to agricultural real wage plus the other net costs of transfer. That is

$$W^e = Z + d \tag{5}$$

where W^e is expected real income defined by

$$W^e = pW \tag{6}$$

The p is the probability of getting a job in the urban protected sector and is simply defined by

$$p = \frac{N_u}{F} = \frac{N_u}{N_u + U}$$

where N_u = number of employed workers in the urban protected sector.

U = number of urban unemployed and underemployed workers, literally urban workers not employed in the protected sector.

F = total labor force in urban area $(N_u + U)$.

Thus (5) can be rewritten as

$$\frac{N_u}{F}(W) = Z + d \tag{7}$$

Differentiate (7) totally to determine change in migration due to an additional job in the urban protected sector, and we get

$$W\, dN_u = (Z + d)dF + F\, dZ \text{ or}$$

$$W + F\frac{dZ}{dN_u} + (Z + d)\frac{dF}{dN_u}$$

Noting that

(i) $N_A + N_u + U = \bar{N}$, total labor force, which is fixed, implies

$$\frac{dU}{dN_u} = -1 - \frac{dN_A}{dN_u}$$

(ii) $$\frac{dF}{dN_u} = 1 + \frac{dU}{dN_u}$$

(iii) $$\frac{dZ}{dN_u} = \left(\frac{\partial Z}{\partial N_A}\right) \cdot \left(\frac{dN_A}{dN_u}\right),$$

we substitute

$$\frac{dZ}{dN_u} = \frac{\partial Z}{\partial N_A}\frac{dN_A}{dN_u} = -\frac{\partial Z}{\partial N_A}\frac{dF}{dN_u}$$

we have

$$W = -F\frac{\partial Z}{\partial N_A}\frac{dF}{dN_u} + (Z + d)\frac{dF}{dN_u}$$

we obtain*

$$\frac{dF}{dN_u} = \frac{W}{Z + d - F\frac{\partial Z}{\partial N_A}} = B \tag{8}$$

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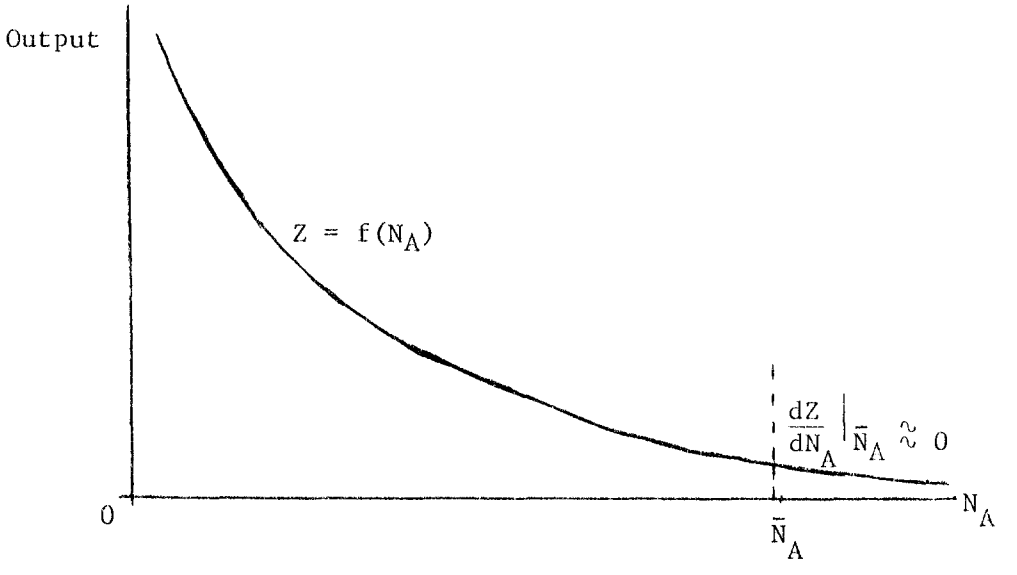
* A more rigorous derivation of $\frac{dF}{dN_u}$ from a two-sector model can be found in Harris and Todaro [1970].

Since p is likely to be less than one, then W is greater than Z + d at equilibrium. However B may be less than unity because $\frac{dZ}{dN_A}$, the slope of marginal product curve is negative, and hence causes the sum of the denominator to be greater than the numerator. The actual situation may be represented in the diagram below. The actual $N_A = \bar{N}_A$ gives the value of the estimated slope $\frac{dZ}{dN_A}\Big|_{\bar{N}_A}$ very close to zero. Therefore it is



reasonable to believe that B is greater than unity. Our interpretation of (8) is that the creation of an additional job in the urban protected sector would induce B migrants from rural sector to join the urban labor force. From this result, the shadow wage rate formula can be constructed.

The social opportunity cost (the total consumption foregone) of employing an additional worker on the public project consists of the following components.

a) Since B migrants result from the creation of one new job in the urban protected sector, then BZ is the total agricultural output foregone, equivalent to consumption of $[(1 - s^w) + s^w P^I]BZ$.

b) There are other net costs of d Baht per migrant, so the amounts of consumption foregone due to these costs are

$$[(1 - s^w) + s^w P^I]Bd$$

c) When migrants are able to find employment in the urban unprotected sector, they obtain wage gW, so that their new consumption, immediate and future, is

$$[(1 - s^w) + s^w P^I]BgW$$

d) Since a new job in the public project pays wage W, so that the increase in consumption level of this worker is

$$[(1 - s^w) + s^w P^I][W - gW]$$

e) Since project's finances come from taxing capitalists, their consumption, immediate and future, is reduced by

$$[1 - s^c) + s^c P^I]W$$

Items (a), (b), and (e) are the losses; items (c) and (d) are gains to the society, and the net costs or shadow wage rate is

$$SWR_5 = (a) + (b) + (e) - (c) - (d)$$

$$SWR_5 = [1-s^w + s^w P^I](BZ + Bd - BgW - W + gW) + (1-s^c + s^c P^I)W$$

$$= [1+s^w(P^I - 1)]\ [B(Z+d-gW) - W(1-g)] + [1+s^c(P^I-1)]W \qquad (9)$$

$$\frac{\partial(SWR_5)}{\partial(P^I-1)} = s^w[B\ (Z + d - gW) - W(1-g)] + s^c W$$

An increase in $P^I - 1$ (net return to additional investment of \$1) will increase SWR_5 (shadow wage rate) if $s^c W > s^W[B(g\,W - Z - d) + W\,(1-g)]$. That is, if what the capitalists would have saved is greater than the sum of the savings of the B rural migrants out of their income gains from transferring to the urban unprotected sector and the savings from the income gain of the one worker who moves from the urban unprotected to the urban protected sector, then a decrease in $P^I - 1$ will decrease SWR_5 (shadow wage rate). This seems likely since $Z + d - gW$ seems very likely to be < 0.

$$\frac{\partial(SWR_5)}{\partial s^W} = (P^I - 1)\,[B(Z + d - gW) - W(1-g)]. \tag{10}$$

An increase in s^W will decrease SWR_5 if $B(Z + d) < W[1+g(B-1)]$.

$$\frac{\partial(SWR_5)}{\partial s^c} = +(P^I - 1)W \tag{11}$$

An increase in s^c (savings rate of capitalists) will increase SWR_5.

$$\frac{\partial(SWR_5)}{\partial Z} = B[1 + s^W(P^I - 1)] \tag{12}$$

An increase in Z (marginal productivity of rural workers) seems certain to increase SWR_5. The same would be true for a increase in d (other costs of migration).

$$\frac{\partial(SWR_5)}{\partial g} = -\,[1+s^W(P^I-1)]\;(B-1)W \tag{13}$$

Increasing g (making the improtected wage rate gW approach the protected wage rate W) would reduce SWR_5 if more than one rural worker migrated $(B-1 > 0)$.

The careful reader may have noted that the effect of B migrants on the urban unprotected market wage is being ignored, although it is quite clear that for $B > 1$, $(B-1)$ migrants cannot be absorbed into that market without

reducing gW, or by making g smaller than it would otherwise have been. That is,

$$\frac{\partial g}{\partial N_u} \leq 0.$$

If g becomes smaller the differential between gW and Z+d will become smaller and presumably the attraction of the unprotected market for rural workers will become less. As the relation above for $\partial(SWR_5)/\partial g$ shows, a decrease in g would increase SWR_5 if B-1 > 0.

The crucial relationship is what happens to B.

$$B = \frac{dF}{dN_u} = \frac{W}{Z+d - \frac{FdZ}{dN_A}} \tag{14}$$

If the effect on rural workers' marginal productivity of the outmigration of one rural worker dZ/dN_A is very small (although negative), as seems likely, then B is a function of W/(Z+d). The empirical relationship between migration B and the difference between the urban protected wage W and the sum of rural workers' marginal productivity W and other costs of migration d, W-(Z+d), would be very important.

It is trivial to note that if $P^I = 1$ (net return to \$1 invested = 0) and (9) becomes B(Z+d = gW) + gW, then SWR_5 is approximately equivalent to SWR_4.

However, the result in (9) is not the final formulation needed since the redistributional objective is not yet incorporated.

B. Shadow Wage Rate and Redistributional Objective.

Our assumption is that workers' consumption should be given more value than capitalists' since the average level of the former is far below that of the latter. If it is possible to obtain some premium or penalty which can be used to evaluate the value of consumption, a shadow wage

rate that takes into account the problem of redistribution can be formulated. It is assumed at this stage that such weights can be found from some source: majority votes, dictatorship, or others.

When the recipient of the benefit must be distinguished, P^I in the earlier analysis is no longer relevant since it measures the present value of consumption generated by a unit of investment without regard to recipients. Now we have to distinguish between workers' and capitalists' consumption. Therefore, without losing generality, let's introduce P^W and P^C to represent the present value of workers' consumption and capitalists' consumption from $1 in marginal investment, respectively. Their derivations are summarized in the Appendix along with the derivation of P^I.

The procedure to incorporate the redistributional premium is as follows. Returning to the SWR_5 in (9) and recalling that it is the sum of capitalists' and workers' consumption lost by employing a worker in the project. Since we believe that workers' and capitalists' consumption should be given different values, the problem becomes one of finding some amounts, positive or negative, that will be added to the "modified" SWR_5. The final results will be the workers' consumption plus some premium and also capitalists' consumption plus some premium or penalty.

The modified SWR_5 can be written as

$$SWR_6 = [1+s^W(P^W-1)][B(Z+d-gW) - W(1-g)] + [1+s^C(P^C-1)]W \qquad (15)$$

The premium amounts to be added to (15) can be obtained as follows. Because one worker is employed on the project and B workers migrate to the urban area, the gains and losses in this year's consumption to workers and capitalists are respectively:

$(1-s^W)[B(Z+d-gW) + W(1-g)]$, gain in workers' consumption, and (16)

$(1-s^C)W$, loss in capitalists' consumption. (17)

Against these gains and losses, future consumption changes due to a reduction in investment today must be counted. These present values of future consumption due to today's change in savings and investment are

$s^W[B(Z+d - gW) - W(1-g)]P^W$, migrants' savings reduction in the rural sector, (18)

$s^W gW\ B\ P^W$, migrants' additional consumption due to savings in the unprotected sector (19)

$s^W[W(1-g)]P^W$, workers' additional consumption due to savings in the protected sector (20)

$s^C W\ P^C$, capitalists' consumption foregone due to taxation of savings. (21)

Net gains to workers are (16) - (18) + (19) + (20) =

$$[1+s^W(P^W-1)][B(Z+D-gW) + W(1-g)] + s^W[W\{1+g(B-1)\}]P^W \quad (22)$$

Net losses to capitalists are (17) + (21) =

$$W[1+s^C(P^C-1)]$$

Now let us assign premium factors v^W and v^C to workers' and capitalists' consumption, respectively. The v^W and v^C can take on any value from minus infinity to plus infinity, but if the notion that workers' consumption is more valuable than capitalists' is accepted, then, $v^W > v^C$. Therefore, the premiums to be added to workers' and capitalists' consumptions are respectively

$v^W\{[1+s^W(P^W-1)][B(Z+d-gW) + W(1-g)] + s^W[W(1-g+Bg)]\ P^W\}$ and (23)

$v^C W[1 + s^C(P^C-1)]$ (24)

$SWR_7 = SWR_6 +$ workers' and capitalists' premiums

$$= (1+v^W)\{[1+s^W(P^W-1)]\ [B(Z+d-gW) + W(1-g)] + s^W[W(1-g + Bg)]P^W\}$$

$$+ (1+v^C)W\ [1+s^C(P^C-1)] \quad (25)$$

As stated above the actual values of v^c or v^w are determined politically. The possibility that v^c will be negative is very small due to the fact that many politicians are supported financially by capitalists. However, pressure from farmers or workers may cause trouble, so that a high positive value of v^c is unlikely. At best, v^c may be zero.

$$\frac{\partial(SWR_7)}{\partial v^w} = [1+s^w(P^w-1)][B(Z+d-gW) + W(1-g)] + s^w[W(1-g + Bg)]P^w \qquad (26)$$

If s^w is quite small, $\frac{\partial(SWR_7)}{\partial v^w} = B(Z+d-gW) + W(1-g)$

Unless $Z+d-gW < 0$ no migration is likely to take place. $W(1-g) > 0$.

If $W(1-g) + B(Z+d-gW) < 0$ and $s^w = 0$, then $\frac{\partial(SWR_7)}{\partial v^w} < 0$.

In this case, an increase in v^w will lead to a decrease in SWR_7.

If $W(1-g) + B(Z+d-gW) > 0$ and $s^w = 0$, then $\frac{\partial(SWR_7)}{\partial v^w} > 0$ and an increase in v^w will lead to an increase in SWR_7.

$$\frac{\partial(SWR_7)}{\partial v^c} = W[1+s^c(P^c-1)] > 0 \qquad (27)$$

A decrease in v^c is certain to lead to a decrease in SWR_7.

V. Conclusion.

Under conditions and characteristics outlined in section II, equation (25) is considered to be the most suitable for estimating labor costs in urban public projects. It takes into account explicitly what existing formulas fail to show such as the redistribution goal and induced migration effects. However, equation (25) still has some deficiencies.

First of all, to treat all taxpayers as "one group" called capitalists and assign a single weight to it seems to be unfair to skilled workers and

middle class households, whose consumption weights should be different and higher than the weight assigned to "pure" capitalists. Although, distinguishing among social classes is theoretically desirable, empirical work seems to be very difficult. A related question is how the parameter s^c can be obtained even if the social class can be distinguished. For practical purposes, s^c can be estimated as following:

i) specifying the income classes into lower, middle and upper by some statistical procedures such as percentiles. The data on income, consumption and saving can be obtained from the Expenditures Survey in Metropolitan Areas.

ii) s^c is computed from $\frac{1}{n} \sum_{i=1}^{n} \left(\frac{\Delta s}{\Delta y}\right)_i$ where n is the number of upper income classes and Δs, Δy are the differences in saving and income between classes.

The estimate of s^w is more difficult to obtain since there is no expenditure survey in the rural area like the one cited above. A wild guess might be provided by using the estimated s^w from the lower income classes in the survey above. Statistical tests should be made to determine whether s^w is significantly different from zero. However, before dropping s^w from the formula, it may be more appropriate to do sensitivity analysis on this parameter to see how much it affects the final result. If it has a significant influence on the results, it would be worthwhile to try and improve the estimate.

Due to occupational and regional differences, it will be very hard to obtain reliable estimates of Z, g and d. First, wages paid in the unprotected sector are not unique since the sector is comprised of various activities. Second, at the time of project evaluation, we do not know from which part of the country the workers will migrate. Third, the estimate of d concerns

not only cash costs but also nonpecuniary costs and each individual will have a different value of the same experience. However, a survey might be used to obtain the appropriate range of values. Fourth, regional differences in labor productivity cause the estimate of Z to be unreliable. This can be improved with regional studies of labor productivity.

The estimate of g may be approximated by using the percentage that the average wage rate of lower income classes is of the minimum wage rate. A more reliable estimate could be obtained by an extensive survey of the wage rate structure in this unprotected sector.

The estimate of Z may be approximated by first specifying the distance from the urban area from which workers might migrate, if the project were undertaken. Then average the average income per capita from those specified rural regions. Using "average" income rather than "marginal" productivity will cause some discrepancy but they are believed to be very large.

The estimates of d could be taken to be the average traveling costs between the urban area and the specified zone.

The parameters P^W and P^C, as shown in Appendix, are functions of social rate of discount. Different social rates of discount give different pairs of P^W and P^C estimates, and hence different SWRs. However, it is suggested that P^W and P^C should be estimated from varying discount rates to see how sensitive they are to changes in the discount rate. This can be used as a signal to be careful in selecting the discount rate if it turns out that the estimates P^W and P^C are very sensitive.

Finally, one may ask, given some sets of parameters, how much SWR calculated from formula (25) would differ from SWR calculated from existing methodologies. Limited time and resources prevented experiments on this

problem. Theoretically sound methodology need not be an economically good one. However, this study presents a formula for computing a shadow wage rate that conforms to Thai economic development goals. If the results are not much different from those of the existing methodologies, the author still urges project evaluators to use this formula, as long as the cost of estimating shadow prices is not greatly increased.

Appendix

A. Derivation of P^I (for more detail see Dasgupta, Sen and Marglin [1972])

Notation:

s^W, s^C = the marginal propensity to save of workers and capitalists, respectively.

n = number of jobs created by one Baht of marginal investment.

y = output-capital ratio ($\equiv \frac{Y}{K}$)

i = social rate of discount

t = time

W = wage rate in urban area

Z = marginal product of rural workers

d = other net costs of moving from rural to urban

q = profit rate.

Since a marginal investment of one Baht adds the same amount to capital stocks, then the output is increased by $(\frac{Y}{K}) \cdot \Delta K = y \cdot 1 = y$

And this one Baht investment creates n jobs, so that the total wage bill is equal to Wn. Deduct the wage bill from the increase in output leaves the return to the one dollar investment, i.e.,

$$q = y - Wn$$

If the capitalist saves s^C of his income and consumes the rest, the aggregate consumption value per year of his annual income from one Baht of marginal investment is

$$(1 - s^C)q + P^I s^C q \qquad (A.1)$$

The last term is saving that can be used to reinvest and must be valued at its shadow price P^I.

By the same procedure, the worker's aggregate consumption per year is

$$(1 - s^w)[W - (Z + d)]\, n + P^I s^w [W - (Z + d)]n \qquad (A.2)$$

By definition of P^I given in the text, it is the present value of aggregate consumption derived from one Baht of marginal investment, i.e.

$$P^I = \sum_{t=0}^{\infty} \frac{(1-s^c)q + P^I s^c q + (1-s^w)[W - (Z + d)]n + P^I s^w [W-(Z+d)]\, n}{(1+i)^t} \qquad (A.3)$$

If the two expressions in (A.1) and (A.2) for annual capitalist consumption per year from one Baht of investment and for annual additional worker consumption from one Baht of additional investment are constant over time, then

$$P^I = \{(1-s^c)q + P^I s^c q + (1-s^w)[W-(Z + d)]n + P^I s^w [W-(Z+d)]n\}$$

$$\{1 + \frac{1}{1+i} + \frac{1}{(1+i)^2} + \ldots \frac{1}{(1+i)^t}\}$$

As t becomes very large, $\sum_{i=0}^{\infty} \frac{1}{(1+i)^t} = \frac{1}{i}$, and

$$iP^I = (1-s^c)q + P^I s^c q + (1-s^w)[W - (Z+d)]n + P^I s^w [W - (Z+d)]n$$

$$P^I = \frac{(1-s^c)q + (1-s^w)\,[W - (Z+d)]n}{i - s^c q - s^w [W - (Z+d)]n} \qquad (A.4)$$

If $s^w = 0$ and $s^c = s$,

$$P^I = \frac{(1-s)q + [W - (Z+d)]n}{i - sq}$$

If, furthermore, $d = 0$, then P^I reduces to the formula given in UNIDO Guidelines for Project Evaluation [Dasgupta, Sen and Marglin, 1972].

$$P^I = \frac{(1-s)q + (W - Z)n}{i - sq}$$

Looking back at (A.4), we can observe three possibilities:

i) $P^I = 1$ if and only if $i = q + [W - (Z+d)]n$. Since $[W - (Z+d)] \geq 0$, then $i \geq q$. This is the case that the society values present consumption very highly and postponement of consumption today to invest one Baht is very costly. This is unlikely to be the case.

ii) $P^I < 1$ if and only if $i > q + [W - (Z+d)]n$. This is an even stronger case than i) above, and even more unlikely.

iii) $P^I > 1$ if and only if $i < q + [W - (Z+d)]n$. This is the most likely case because in a world where capital stock is growing (net investment is positive), i is likely to be smaller than q, hence the condition $i < q + [W - (Z+d)]n$ is always true. If i were not less than q, there would not be any incentive for investors to invest.

B. Derivation of P^C and P^W.

Apart from the aggregate consumption of capitalists shown by (A.1), we must add the contribution to capitalists' consumption from workers' saving which will be valued at shadow price P^C. So that the capitalists' consumption per year is $(1-s^C)q + P^C s^C q + P^C s^W [W - (Z+d)]n$, and the present value of this consumption stream is the shadow price P^C, i.e.

$$P^C = \sum_{t=0}^{\infty} (1+i)^{-t} [(1-s^C)q + P^C s^C q + P^C s^W \{W - (Z+d)\}n]$$

Solving as before, $iP^C = (1-s^C)q + P^C s^C q + P^C s^W \quad [W - (Z+d)]n$

$$\text{or } P^C = \frac{(1 - s^C)q}{i - s^C q - s^W [W - (Z+d)]n} \qquad (A.5)$$

We must add $s^C q$, valued at its shadow price P^W to (A.2) to obtain the workers' additional consumption per year which becomes $(1-s^W)[W - (Z+d)]n + P^W s^W [W - (Z+d)]n + P^W s^C q$. The present value of this consumption stream,

$$P^W = \sum_{t=0}^{\infty} \frac{(1-s^W)[W-(Z+d)]n + P^W s^W [W-(Z+d)]n + P^W s^W q}{(1+i)^t}$$

$$iP^W = (1-s^W)[W-(Z+d)]n + P^W s^W [W-(Z+d)]n + P^W s^W q$$

or

$$P^W = \frac{(1-s^W)[W-(Z+d)]n}{i-s^c q - s^W [W-(Z+d)]n} \qquad (A.6)$$

It should be noted from (A.4), (A.5) and (A.6) that $P^W + P^c = P^I$ as expected.

REFERENCES

Arrow, Kenneth J. (1967): "Discounting and Public Investment Criteria," Water Research, ed. A.V. Kneese and S.C. Smith. Baltimore, John Hopkins Press.

Balassa, Bela (1973): "Estimating the Shadow Price of Foreign Exchange in Project Appraisal," IBRD Economic Staff Working Paper No. 142.

Baumol, William J. (1968): "On the Social Rate of Discount," Amer. Econ.Rev. 58:788-802.

Beyer, John C. (1975): "Estimating the Shadow Price of Foreign Exchange: An Illustration from India," Journal of Development Studies 2:302-304.

Bradford, David F. (1975): "Constraints on Government Investment Opportunities and the Choice of Discount Rate," Amer. Econ. Rev. 65:887-899.

Bruno, Michael (1965): "The Optimal Selection of Export-Promoting and Import-Substituting Projects," Planning the External Sector: Techniques, Problem and Policies. New York, United Nations, pp. 88-136.

Dasgupta, Partha, Amartya Sen, and Stephen Marglin (1972): Guidelines for Project Evaluation, New York, UNIDO Project Formulation and Evaluation Series, No. 2.

Harberger, Arnold C. (1968): "The Social Opportunity Cost of Public Funds", in Water Resources and Economic Development of the West Report No. 17, The Discount Rate of Public Investment Evaluation. Western Agricultural Economics Research Council, Denver.

Harberger, Arnold C. (1971): "On Measuring the Social Opportunity Cost of Labour," International Labour Review 103(6), June.

Harris, J. R. and Michael P. Todaro (1970): "Migration, Unemployment and Development: A Two-Sector Analysis," Amer. Econ. Rev. 60:126-142.

Little, I. M. D. and James A. Mirrlees (1969): Manual of Industrial Project Analysis in Developing Countries, Vol. II, Paris Development Center of the OECD.

Little, I. M. D. and James A. Mirrlees (1976): Project Appraisal and Planning for Developing Countries, HEB Ltd., London.

McCleary, W. A. (1974): "On the Shadow Wage of Labor: An Extension of Some Recent Theoretical Contributions," Discussion Paper Series No. 43, Economics Faculty, Thammasat University, Bangkok.

McLeary, W. A., M. Allal and B. Nilsson (1976): Equipment Versus Employment: A Social Cost-Benefit Analysis of Alternative Techniques of Feeder Road Construction in Thailand. International Labour Office, World Employment Program Study.

Meyers, William H. (1974): The Measurement of the Social Opportunity Cost of Labor in a Labor Surplus Economy, Staff Paper P74-9c, Department of Agricultural and Applied Economics, Univ. of Minnesota.

Sunkul, Somchai (1973): Methodology of Measuring Underemployment: With Special Reference to the Agricultural Economy of Thailand, 1969-1970, M.A. thesis submitted to the Economics Faculty, Thammasat Univ., Bangkok.

Thavornjit, Rachanewan (1977): "Thailand: Regional Migration and Development: A Regression Analysis," Discussion Paper No. 57, Economics Faculty, Thammasat Univ., Bangkok.

Warr, Peter G. (1974): The Economics of Shadow Pricing: Market Distortion and Public Investment, Staff Paper P74-22, Department of Agricultural and Applied Economics, Univ. of Minnesota.