ECONOMIC OPPORTUNITY COST OF LABOR: A SYNTHESIS

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ABSTRACT

In this article the economic opportunity cost of labor has been estimated using the supply price approach under a wide variety of labor market conditions and types of jobs. This approach is shown to be equivalent to the value of the marginal product of labor foregone approach, when the latter can be estimated accurately. The primary reliance of the supply price approach on the wage rates demanded under the labor conditions of the project greatly facilitates the estimation of this economic parameter for use in the economic valuation of projects.

A methodology has been outlined in detail to account for several adjustments that may need to be made to this supply price to reflect special labor market characteristics and distortions. Most of these factors, such as income taxes and unemployment insurance compensation, are straightforward and easy to estimate. Other issues dealing with the quality of the jobs and the nature of the unemployment present require a more detailed examination of the labor market. Once these values have been determined, they are used to adjust the supply price to arrive at an estimate of the economic opportunity cost of labor for a particular skill on a particular project.

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I. INTRODUCTION

The concept of economic opportunity cost is derived from the recognition that when resources are used for one project other opportunities to use these resources are sacrificed. Typically when workers are hired by a project, they are giving up one set of market and non-market activities for an alternative set. The economic opportunity cost of labor (EOCL) is the value to the economy of the set of activities given up by the workers including the non-market costs (or benefits) associated with the change in employment.[1]

When determining the EOCL, it is important to remember that labor is not a homogeneous input. It is perhaps the most diverse factor of production in any economy. In this article we will examine how the EOCL is estimated in an economy which contains different labor markets (unskilled and skilled) with regional variations (rural and urban) and distinct sectors (protected and unprotected). Additionally, we will analyze how the quality of employment opportunities (permanent and temporary) might affect the EOCL used by a project.

In the evaluation of the economic opportunity cost of labor we do not take into account the potential impact on national savings of changes in the amount of income received by labor. This decision is based on two observations. First, the overall level of national savings is fundamentally determined by the macroeconomic and the public sector budgetary conditions. Second, the level of uncertainty surrounding the quantitative estimates of the size of the distortion attributed to savings, and the impact on national savings from labor receiving more or less income in a project, warrants considerable caution. Adding adjustments to the estimation of the EOCL which are quantitatively highly uncertain can easily reduce rather than improve the accuracy of the final estimate.

The approach we recommend is that if it is clear quantitatively that the overall impact of a project is to increase or reduce national savings, and if there is a distortion in this market, then we estimate the value of the change in economic welfare arising in the market as a consequence of the project and the distortion. This value should then be included in the estimation of the project's flow of economic net benefits and its net present value.

In a similar manner, we do not take into consideration the indirect effects on distorted markets,

such as foreign exchange, due to the movements of labor from other activities to the project. This is not to deny that an impact on these distorted markets can occur. But the pursuit of these indirect effects requires us to make assumptions on the specific type of output foregone and the ultimate adjustment of specific production processes which are highly unreliable, even with respect to the direction of change. The attempts to measure such distortions in a general equilibrium context usually preclude the evaluation of the equalizing differences in the wage rates that arise as a result of the differences in the cost of living and in the working conditions between regions and jobs. These direct elements of the opportunity cost of labor tend to be quantitatively much more important and critical to the understanding of labor market behavior. Of course, if the quantitative impact of the indirect effects that occur via the foreign exchange market or any other distorted market is known, the value of this externality should be included in the evaluation of the economic costs of the project as either a part of the economic cost of labor or as a separate item in the determination of the net present value of the project.[2]

(A) Approaches to the Estimation of the EOCL

The first step in estimating the EOCL is to define what approach will be used to measure the initial cost of labor. Two alternative methods for determining the starting point of this analysis have been developed: i) value of marginal product of labor foregone approach,[3] and ii) supply price of labor approach.[4] Note that calculating the EOCL using either method will theoretically produce the same result. These two approaches, however, have different data requirements, levels of computational complexity and, hence, different degrees of operational usefulness.

(i) Value of Marginal Product of Labor Foregone Approach

The value of marginal product of labor foregone for labor hired by a project is determined by starting with the gross-of-tax alternative wage (W_a) from their previous employment of the labor hired for that project and then adding (subtracting) the additional (lower) costs of attracting those workers to the new position.[5] The factors which attract the workers could be monetary, i.e. higher wages, or non-monetary, such as increased satisfaction gained from improved working conditions. Also, if workers hired for a project need to incur additional transportation and living expenses, those additional costs must be added to the other components of the gross wage in order to determine the value of the marginal economic product foregone from the redeployment of labor. In theory, it is possible to build upon the alternative gross-of-tax wage of the workers and add a premium for the difference in working conditions

or other factors. In practice, however, many of those types of additional costs are either grossly underestimated or ignored due to difficulties of estimation. It is cumbersome to use the value of marginal product of labor foregone approach to estimate the EOCL in situations where information on prior wages, differential expenses, and changes in working or living conditions is not readily available.

Another potential problem with this methodology is the temptation to assume that the value of marginal product foregone when hiring unemployed workers is zero under the assumption that hiring them does not reduce output elsewhere in the economy.[6] Historically, some economists have argued that the value of marginal product of unskilled agricultural workers in developing countries was zero because it was believed that there was a large surplus of labor in the countryside.[7] However, empirical studies of subsistence farmers have demonstrated that their labor does have a positive marginal value both in farming and in a variety of other productive activities.[8] Consequently, using the assumption that the value of the marginal product foregone is zero when hiring unemployed workers leads to an underestimation of the EOCL and does not reflect the true economic costs of the project using the labor.

(ii) Supply Price of Labor Approach

The supply price of labor can be used to determine the EOCL in a manner which is relatively straightforward and easy to use under a wide variety of conditions.[9] The starting point of this analysis is the gross-of-tax wage (the supply price) required to attract sufficient people of the required skill level to work on the project.[10] The supply price of labor to a project is the minimum wage rate the project needs to pay to obtain sufficient supplies of labor with the appropriate skills. That wage accounts for the worker's preferences regarding the location, working conditions or any other factors that affect the desirability of working for the project. For example, if a very high local market wage is required to attract skilled labor to a project where the living conditions are bad, then that wage already includes both the value of the foregone wage and the compensation for the economic costs inflicted by the relatively bad living conditions. Of course, the supply price might have to be adjusted further to account for other distortions to derive the EOCL. Unlike the marginal product foregone which must measure both of these components separately, the local supply price directly measures the wage and non-wage costs of employment by the project as a combined package.

In practical terms, the supply price of labor can be determined in the field by asking the question - what is the minimum wage the project must pay to get the right number of applicants to work for this

project with an acceptable turnover rate? This can often be done by informally surveying workers at the location of the project or using a more formal assessment of the prevailing wage in that sector. A critical test of whether the wage rate being paid by a project is the minimum supply price is to compare the number of applications by qualified people with the number of positions available. If the number of acceptable applications per job available is very high, and the turnover rate for the project is low, then it is likely that the wage rate paid by the project is above the minimum supply price. However, if the ratio of qualified applicants to positions available is representative of a fairly tight labor market, and the turnover rate is normal for the sector, we can be quite sure that the project wage is close to the minimum supply price of labor.

Once the minimum supply price of labor has been determined, the EOCL is calculated by adjusting that value to account for distortions which may exist in the market wage rate such as income taxes or subsidies. Considerable care must be taken at this point to ensure that all of the market distortions which drive a wedge between the supply price and the economic opportunity cost of labor are properly accounted for when estimating the EOCL for the project. The evaluation of a number of these distortions is taken up in the following sections of this article.

Example 1: Comparing the Value of Marginal Product Foregone and Supply Price Methods

To demonstrate the equivalence of these two methods in calculating the EOCL, let us consider the example of unskilled farm workers who have decided to move from their previous jobs picking apples in a cold, rainy apple growing region (a) to work on a new project in a warmer, sunnier climate (o) harvesting oranges.

The starting point for calculating the EOCL using the marginal product foregone approach would be the prior wage on the apple farms (W_a), while the supply price approach would begin with the market wage for work in the orange groves (W_o). We can assume that they would not pay income taxes or face any other significant distortions in their labor market. Other factors, however, could influence their decision to relocate to the new project. For example, the warmer climate of the orange growing region might translate into a reduced cost of living (C), i.e. lower heating and clothing costs, which would allow the workers to maintain the same level of well-being with lower wages. Another factor might be a preference (S) of the workers to work in a warmer region.

For the purpose of this example, let us assume values of the wage and the other factors as follows;

W_o = \$ 15.00 per day W_a = \$ 20.00 per day

C_o = \$ 3.00 per day C_a = \$ 6.00 per day

S_o = \$ 2.00 per day (value of the preference for the warmer region)

Because we know the values of the externalities, we can use the marginal product foregone method to calculate the EOCL for the new project as follows;

EOCL = prior wage - change in cost of living - worker preferences

$= W_a - (C_a - C_o) - S_o$

$= 20 - (6 - 3) - 2$

EOCL = \$15.00 per day

With the supply price approach we can arrive at the same value directly because we know that the market wage necessary to induce the workers to move to the new project in the orange growing region (W_o) already accounts for the cost of living difference (C_a - C_o) and worker's preference for a warmer climate (S_o). Therefore, the EOCL is simply equal to the market wage in the region where the new job is;

EOCL = W_o = \$15.00 per day

This highly simplified example demonstrates that both methods for calculating the EOCL should produce the same result. However, in most circumstances it is difficult to place values upon complex factors such as cost of living differentials and worker preferences. Uncertainties in the value of those factors make the marginal product foregone approach cumbersome to use when information is scarce. Consequently, the more straightforward supply price approach is easier and is a more accurate way to determine the EOCL for a project under most circumstances.

(B) Structure of Analysis

The analysis of the EOCL is structured around four sets of factors that are primary determinants

in the economic opportunity cost of labor to the project. The EOCL can vary greatly from one project to the next, so we have developed the following classifications to help identify which determinants may affect the labor costs of the project being evaluated.

1. Type of Labor (Unskilled vs. Skilled)
2. Regional Variation (Rural vs. Urban)
3. Employment Sector (Unprotected vs. Protected)
4. Type of Job (Permanent vs. Temporary)

First, an analytical distinction is made between unskilled and skilled workers. Classifying workers into these two groups simplifies the analysis because on development projects the unskilled work force is primarily composed of day laborers while the skilled workers are technical and professional personnel. Estimating the economic opportunity cost of unskilled labor is relatively straightforward due to a lack of distortions such as taxation or unemployment insurance in that sector of the labor market. The skilled labor market, on the other hand, is frequently subject to multiple distortions which must be identified and accounted for in the estimation of the EOCL. Second, regional migration induced by differences in wages, cost of living, access to consumer goods, etc. also affects the EOCL for a project. Regional wage differentials are a key consideration in the labor market for workers who are likely to have to move, for example, between rural and urban areas to find improved economic opportunities. Distortions in the economy related to that migration must be accounted for when estimating the EOCL. Third, in labor markets we often encounter protected and unprotected employment sectors. Employees of state enterprises, large industries or multinational corporations often receive a wage and enjoy working conditions which are far above those required to induce them to work in these positions. The wages are set high for reasons, either legal or political, which do not allow the demand and supply of labor to set the wage rate and the quantity employed. Unprotected workers, on the other hand, are left to compete in the open market, and in this case, the wage is set by the forces of demand and supply. Fourth, the estimation of the EOCL for a project must consider whether permanent or temporary employment will be created. Temporary positions in sectors like tourism and construction lead to greater turnover in the labor market and create conditions for voluntary unemployment. This churning effect in the labor market results in additional costs to the economy which a project appraisal must account for. These four classifications within a labor market provide a framework for analyzing the complex concept

of EOCL. In the rest of this article, we will begin by analyzing the EOCL for the simplest cases, i.e. unskilled rural labor, and build upon each case to estimate the economic opportunity cost of labor for progressively more complex conditions which are likely to arise in practice.

II. THE ECONOMIC OPPORTUNITY COST OF UNSKILLED LABOR

(A) Introduction

Growth models of underdeveloped countries have often taken the most extreme interpretation of the "marginal product forgone" hypothesis of the economic opportunity cost of unskilled labor in rural areas.[11] As previously explained, those theories rely upon the assertion that because there is a large quantity of unskilled, rural workers, there is no economic opportunity cost to filling additional jobs.[12] However, empirical evidence has been lacking that would support the idea that a surplus of idle, rural labor generally exists. In fact, a persuasive body of evidence is provided by researchers of rural economies indicating that when unskilled labor is not employed in the formal agricultural sector, it spends a large proportion of its time on other productive household and family farming activities.[13] Even in India, historically it was found that the average landless agricultural laborer worked some 250 full-time equivalent days per year.[14]

It has also been suggested that in poor areas the extended family often absorbs unskilled workers, which leads to a situation of underemployment, i.e. the marginal product of labor is less than the average value of the goods and services consumed by the family member. As a result, these family members would be reluctant to seek employment at the prevailing wage rate.[15] In practical terms, however, it is unreasonable to expect an extended family with surplus labor to continue to hire unskilled non-family labor. Hence, unskilled day laborers will be released which will put downward pressure on the market wage rate. The productivity of the labor provided by the extended family on the margin is likely to be at least as large as the market wage rate. If not, it would make the extended family better off if some of the family's labor worked as daily labor. To the extent that underemployment exists within the family, there would be an incentive for the family to encourage the relative to work as a daily laborer while living within the household, even if the relative's consumption level was higher than the wage. In this circumstance, the prevailing wage rate W^U (the supply price of unskilled labor) is a reflection of the marginal productivity of this type of labor. The wage of the unskilled labor will tend to be pushed down to at least the level of the marginal productivity of the extended family's labor. Therefore, we

can utilize the market wage as an effective measure of the value of the marginal product foregone of unskilled labor.[16]

(B) Calculations - Supply Price Approach

When using the supply price of labor approach to calculate the EOCL, there is a series of steps which serves as a rough guide to the process. The first step is to determine the minimum gross-of-tax wage (W^U) needed to attract sufficient unskilled labor to the positions available on the project. Second, distortions in the labor market such as income taxes or unemployment insurance benefits must be identified. Finally, the EOCL can be determined by adjusting the market wage to compensate for the distortions caused by those factors.

To demonstrate this process, three cases will be used. In the first case, there are no seasonal variations in the wage rate or labor demand for unskilled workers. The second example examines how to estimate the EOCL when there are seasonal variations in the market wage rate. The final example addresses a more realistic situation where both the market wage rate and the project's demand for unskilled labor vary throughout the year. This is typically the case in rural areas where the availability and cost of unskilled labor is strongly influenced by the planting and harvesting cycle, and the project has a seasonal pattern to its demand for unskilled labor.

In the first case, we assume that there are no distortions in the unskilled labor market, i.e. there are no taxes paid by the employer (demand side) and no income taxes paid (supply side). We also assume that there are no fluctuations in wages or labor demand over time. It follows that the supply price of labor is always equal to the prevailing market wage (W^U). Since there are no distortions, there is no need to make further adjustments to the market wage when estimating the EOCL. Consequently, the market wage rate of unskilled labor is the supply price of labor, which in turn is the economic opportunity cost of labor as shown in Equation 1.

$$(1) \qquad EOCL^U = W^U = \text{Supply Price of Unskilled Labor}$$

Note that the EOCL is estimated using the market supply price (W^U) not the project wage (W_p^U). The project wage is the demand price and measures the financial cost of labor for a particular project

while the market wage measures the opportunity cost of the unskilled labor to the economy. If the demand price is higher the market wage, then the difference is an economic externality which arises from the employment of this type of labor by the project.

The second case considers a project which demands the same amount of unskilled labor throughout the year while the market wage varies due to external factors affecting the labor market. Using the supply price approach, we begin once again with the market wage for unskilled labor on the project. Again, there are no tax distortions. In this case, however, due to the seasonal fluctuations in the market wage the economic opportunity cost of labor for a period of time will be calculated by averaging the monthly or weekly market wage rates (W_i^U) for the duration of the project in the following manner;

$$(2) \qquad EOCL^U = 1/n \left(\sum_{i=1}^{n} W_i^U \right)$$

where; n = the number of months or weeks over which the EOCL is being estimated

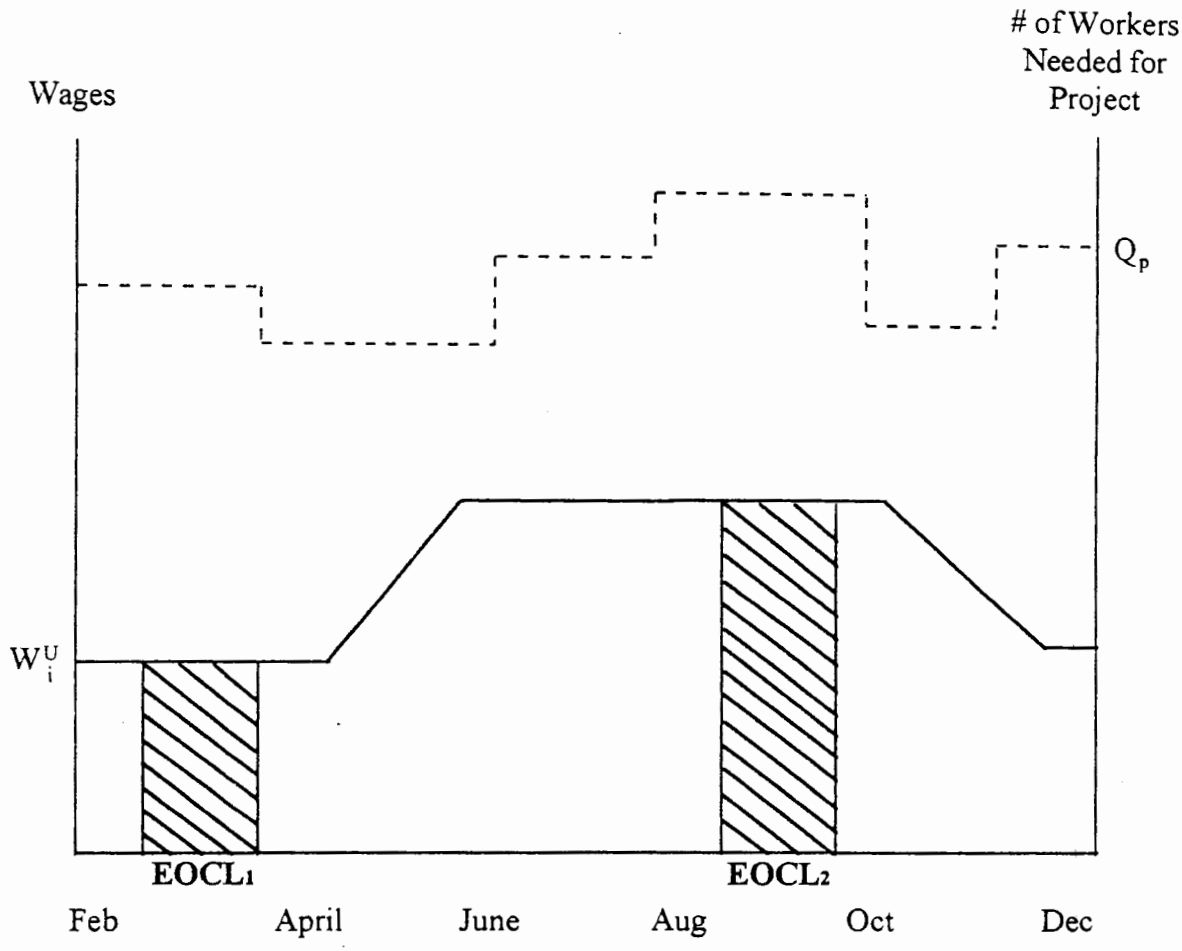
i = the period of time

For example, if a region growing rice and sugar cane has a wage rate of $3.00 U.S. per day during the off-season, it is possible that the wage could be five times higher during the harvesting seasons if they coincide. If a project is built based on the assumption that the average wage will be $3.00 U.S. per day, but instead it must compete for labor at a much higher rate during harvest season, then the financial and economic viability of the project may be endangered. These higher seasonal labor costs must be accounted for in arriving at an accurate estimate of the EOCL for the project.

In the third case both the quantity of unskilled labor employed by the project and the market wage for unskilled labor are expected to vary throughout the year. This is a common condition in rural areas where both the demand for unskilled labor and the market wage rate have pronounced seasonal patterns as illustrated in Figure 1. When there are seasonal variations in both the demand for rural labor and the wage rates, one can not use a simple annual average of the EOCL for a project. Instead, the yearly average economic opportunity cost of unskilled labor used by a project will be a weighted average of the different unskilled wage rates throughout the year. This is equal to the sum of the unskilled wage rate for each particular season or wage period (W_i^U) times the proportion (K_i) of the total amount of unskilled labor employed by the project in that period.

FIGURE 1

EFFECT ON THE ECONOMIC OPPORTUNITY COST OF LABOR
OF SEASONAL VARIATIONS IN
WAGES AND LABOR DEMAND IN RURAL REGIONS



- - - - - - - - Pattern of project's demand for labor during the year.

———— Pattern of wage rate for unskilled labor during the year.

This can be expressed as follows:

$$(3) \qquad EOCL^U = \sum_{i=1}^{n}(K_i W_i^U)$$

where; n = the total number of periods

i = the period of time

If the project's demand for labor is relatively high in the off-season, then the EOCL for unskilled labor will be lower than if the project's demand for labor coincides with the seasonal peak demand for this labor by other activities.

Example 2: Government Requires Unskilled Labor for Project in a Rural Area[17]

Consider the case of a government that is undertaking a labor-intensive sugar project. The project requires unskilled workers on a temporary basis and pays a wage of 170 rupees per month (W_p^U). The working conditions are identical to those prevailing in the labor market. The following table shows in column (3) the project's monthly requirements for person-months and in column (2) the monthly market wage rates (W_i^U) that agricultural labor would be willing to work for on this project.

TABLE 1

Month	Market Wage (W_i^U)(in Rupees)	Person-months required by project	Monthly share of annual person-months (K_i)
(1)	(2)	(3)	(4)
January	120	1,800	0.2
February	100	1,800	0.2
March	180	1,800	0.2
April	180	900	0.1
May	100	900	0.1
June	150	0	0.0
July	180	0	0.0
August	120	0	0.0
September	150	0	0.0
October	110	0	0.0
November	150	900	0.1
December	180	900	0.1
	Total	9,000	1.0

In this case, the monthly market wage rates are the supply prices of unskilled labor to the sugar project. To estimate the economic opportunity cost of unskilled labor to the project, we first need to calculate the monthly share (K_i) of the annual person-months required by the project. These values are shown in column (4).

Then using Equation 3 the EOCL is calculated as follows:

$$EOCL^U = \sum_{i=1}^{12} (K_i W_i^U)$$

$$= [120*0.2 + 100*0.2 + \ldots\ldots + 150*0.1 + 180*0.1]$$

$$= 141 \text{ rupees per month.}$$

The project wage (W_p^U) paid by the government does not play a role in the estimation of the economic opportunity cost of labor. When estimating the EOCL, we are solely concerned with the supply price of labor as reflected in the market wage (W_i^U). The wage paid by the project (170 rupees) is a financial cost to the project, and the difference between it and the economic opportunity cost of labor (141 rupees) is the labor externality (29 rupees) which labor receives as a distributional benefit from this project.

III. THE ECONOMIC OPPORTUNITY COST OF SKILLED LABOR

(A) Introduction

In developing countries, skilled labor is often in short supply. Even if the skilled workers can be found, it is typically more costly to attract and retain them due to their higher skill level. Past evaluations of development investments have demonstrated that projects are often seriously delayed or even abandoned because of an inadequate supply of skilled labor. Hence, the economic opportunity cost of skilled labor ($EOCL^S$) is an important factor to consider when evaluating a project.

To meet the project's requirements for skilled labor, it often must be induced with higher wages and improved benefits to migrate from other rural or urban areas where workers may be accustomed to better amenities and living conditions. Skilled workers in urban areas, for example, are able to obtain many goods and services, such as better education for their children, more readily in the city. Skilled

labor moving from an urban to a rural area will lose consumer surplus if the cost of consumer goods and services purchased by these relatively high-income workers is greater in the rural area. On the other hand, some items such as housing and food are likely to be cheaper in the rural areas than in the city. Hence, the increase or decrease in the supply price of labor as it moves from the city to the countryside will depend upon the magnitude of the consumer surplus lost or gained when labor migrates between regions.

(B) Calculations - Supply Price Approach

The supply price approach for determining the economic opportunity cost of skilled labor uses the same basic steps as outlined in the unskilled case. We begin by determining the market supply price of labor (W^s) needed to attract the skilled workers to the project. Then, distortions to that wage are identified and quantified. Finally, the $EOCL^s$ is estimated by adjusting W^s to account for those distortions.

To demonstrate this approach, we will estimate the $EOCL^s$ for three situations. The first example is simplified by using the somewhat unrealistic assumptions that there are no distortions in the market for skilled labor and the project provides jobs with the same working conditions as the other skilled employment in the area. Furthermore, no workers need to (or can) be attracted from outside the area. The second case drops those assumptions and considers a situation where skilled labor must be induced to move from alternative projects or regions where there are market distortions. Finally, we will examine a case which demonstrates how employment which lasts for less than the full year can be a factor in determining the value of the economic opportunity cost of skilled labor.

(i) Labor Market without Distortions or Regional Migration

In the first case, if there are no distortions in the market such as income tax on the wages for skilled labor and the employment provided by the project has identical working conditions to alternative employment in the region, then it does not matter whether the new hires come from other employment (reduced demand) or from non-market activities (new supply). In both cases the economic opportunity cost is equivalent to the local market wage (W^s), as shown in Equation 4;

$$EOCL^s = W^s \qquad (4)$$

Unfortunately, that condition rarely holds. It is more realistic to assume that we will have to pay a higher wage that attracts skilled labor away from alternative projects with different working conditions or other regions which have distorted labor markets. The differences between the supply price of labor to the project and the wages paid in alternative activities will tend to have two effects; 1) increase the quantity of skilled labor supplied, 2) reduce the quantity of skilled labor demanded by alternative employers.

(ii) Skilled Workers Migrate to Project from Distorted Labor Markets

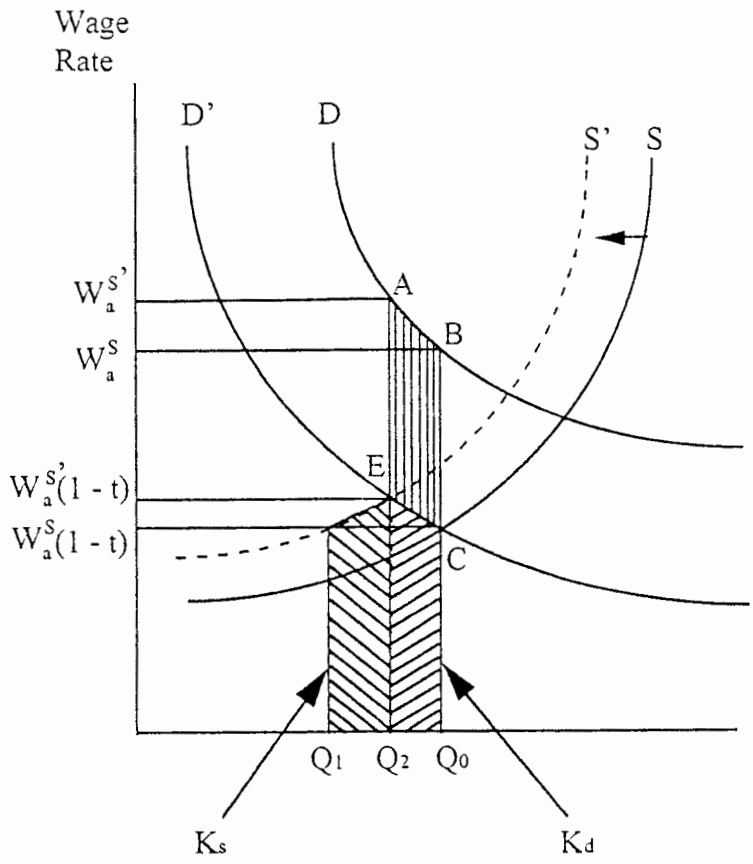
Next, let us examine a project requiring skilled labor that must be induced to migrate from an alternative labor market where it was previously employed in equivalent jobs. Figure 2 demonstrates this scenario using the urban and rural labor markets for skilled labor as examples though migration is also possible from other rural regions. At the project site, a wage (W_p^S) which is above the market supply price (W^S) would attract excess labor to the project. Hence, workers are induced to migrate to the project from other regions. The migration of workers from the region to the project causes the labor supply (S) in the urban (sending) region to decrease, shifting the labor supply curve leftward to the new position S'. This shift can be plotted along both gross-of-tax demand curve (D) and the net-of-tax demand curve (D').

At the original net-of-tax urban wage for skilled labor ($W_a^S(1 - t)$), the migration to the rural project caused a decrease in the supply of skilled labor from Q_0 to Q_1. In order to increase the quantity of skilled labor supplied to meet the existing demand in the urban market, the wage must increase to $W_a^{S'}(1 - t)$. This higher wage induces more skilled workers to enter the urban labor force, or more overtime hours to be worked, thereby increasing the quantity of skilled labor supplied in that region from Q_1 to Q_2. From the graph, we can see that a proportion of the skilled labor (K_S) for the rural project comes from the newly induced urban supply and a proportion (K_d) comes from the reduced urban demand for skilled workers. The reduction in the quantity of labor demanded results in a loss of taxes to the government from the urban region which is an economic distortion shown as the area bounded by ABCE.

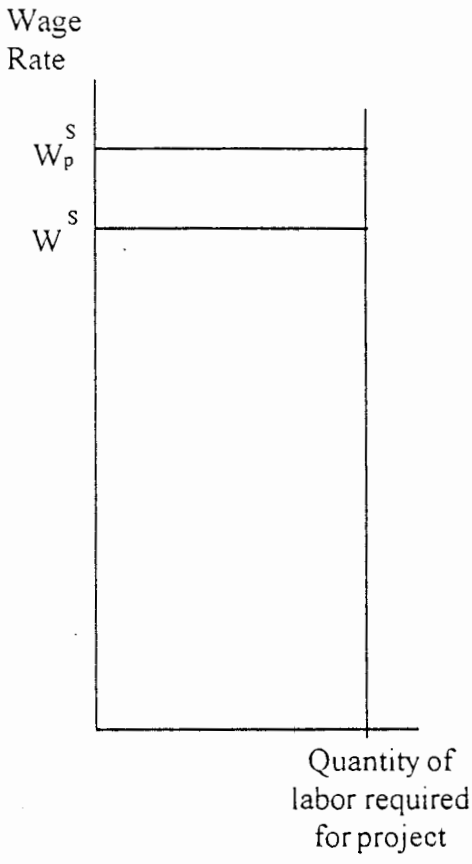
When calculating the $EOCL^S$, only the tax distortion resulting from the reduced demand (K_d) must be accounted for, because we assume that the increased supply (K_S) of labor is coming from market

FIGURE 2

REGIONAL INTERACTION BETWEEN SKILLED LABOR MARKETS



URBAN SKILLED
LABOR MARKET



RURAL SKILLED
LABOR MARKET

$$K_s = \frac{Q_2 - Q_1}{Q_0 - Q_1}$$

$$K_d = \frac{Q_0 - Q_2}{Q_0 - Q_1}$$

or non-market activities where there are no taxes or other distortions. The $EOCL^S$ for the project in such cases is the supply price (W^S) of workers induced to move to the rural area minus the difference between the income taxes the workers would pay on this supply price of labor ($W^S t$), which are gained by the government, and the income taxes previously paid by the workers in their alternative employment ($K_d W_a^S t$), which are lost by the government.

Thus, the economic cost of skilled labor hired by the project in the rural area is expressed as follows:

$$(5) \qquad EOCL^S = W^S - (W^S t - K_d W_a^S t)$$

where;

K_d = proportion of the project's demand for skilled labor obtained from taxed employment activities in the alternative labor market

W_a^S = gross-of-tax wage of skilled labor from alternative sources

t = income tax rate levied on skilled workers in all regions

The most difficult aspect of using this equation is estimating the proportion of the project's skilled labor requirements which will be sourced from alternative labor market activities in which a distortion exists. Local sources of labor market information should be consulted to estimate how tight the labor markets are and what the comparable wages are in the alternative market(s).

Example 3: Government Requires Skilled Labor for Project in a Rural Area

Consider the sugar project discussed in Example 2, above. In addition to the unskilled workers hired for the project, the government requires 1,000 person-months of skilled labor per year. Due to a shortage of skilled workers in this rural region, the project will have to attract them from the urban areas surrounding the region where the project is located. Despite the fact that these workers earn a monthly gross-of-tax salary (W_a^S) of 900 rupees in the urban area, they will not work for less than 1,200 rupees gross-of-tax in the rural area (W^S). These wage rates reflect the supply prices of the workers in the two markets respectively. The government has a policy of encouraging more skilled workers to

migrate to the rural areas, so the project is required to pay a higher salary (W_p^S) of 1,500 rupees per month for skilled labor, or 300 rupees more than the market supply price. All skilled workers pay 20% of their wages in income taxes.

Using Equation 5, we can estimate the economic opportunity cost of skilled labor to the project by determining; (1) the taxes to be paid on the supply price of skilled labor for the project, and (2) the taxes foregone by the skilled workers in their alternative employment.

(1) *Taxes on the Supply Price of Labor*

Taxes on the supply price of skilled labor are calculated as follows:

$$\text{Taxes on Supply Price} = W^S t$$
$$= 1{,}200(0.20)$$
$$= 240 \text{ rupees per month}$$

(2) *Taxes Foregone in Alternative Employment*

Let us assume that the supply of skilled labor in the economy is relatively inelastic as compared to the demand for that labor and let $K_d = 0.67$ and $K_S = 0.33$. Hence, we can anticipate that approximately two thirds of the project's skilled labor requirements will ultimately be sourced from the decrease in the quantity of labor demanded, while the remaining one third of the project's needs will be met through increased labor force participation due to the new project's higher wage. The foregone taxes from the previous employment of the skilled workers are calculated as follows:

$$\text{Taxes Foregone} = K_d W_a^S t$$
$$= 0.67 * 900 * 0.20$$
$$= 120.6 \text{ rupees/month}$$

Combining those two parts with the supply price, the economic opportunity cost of the skilled labor hired by the project in this rural area is calculated from Equation 5 as follows:

$$EOCL^S = W^S - (W^S t - K_d W_a^S t)$$
$$= 1200 - ((1200 * 0.20) - (0.67 * 900 * 0.20))$$
$$= 1{,}080.6 \text{ rupees/month}$$

The difference between the economic opportunity cost of skilled labor (1,080.6 rupees/mo) and the financial cost of that labor (W_p^s = 1,500 rupees/mo) is 419.4 rupees per month per skilled worker. This is the value of the project's labor externality per month of skilled labor employed.

Carrying this analysis one step further, we can determine how these labor externalities are distributed between the workers and the government. The benefits to each group can be calculated as follows;

$$\begin{aligned} \text{Labor benefits} &= W_p^s(1 - t) - W^s(1 - t) \\ &= 1500(1 - 0.20) - 1200(1 - 0.20) \\ &= 1200 - 960 = 240 \text{ rupees/month} \end{aligned}$$

$$\begin{aligned} \text{Government benefits} &= W_p^s\, t - K_d\, W_a^s\, t \\ &= 1500(0.20) - (0.67 * 900 * 0.20) \\ &= 300 - 120.6 = 179.4 \text{ rupees/month} \end{aligned}$$

Thus, of the 419.4 rupees per month per worker in benefits from this project, labor will gain an additional 240 rupees per month while the government will capture 179.4 rupees per month in additional taxes. The distributional analysis provides a means of evaluating the financial gains and losses affecting groups in the economy other than the owners of the project.

(iii) Skilled Labor Employed less than Full Year in Market Activities

Finally, we drop the assumption that if a person is employed she will be working for a full year. In this analysis, workers are not divided between those who are working in the formal labor market and those who are not. Instead, we postulate that each worker spends part of each year in non-market activities. This can be caused by the nature of the occupation, e.g. construction trades, or the nature of the sector, e.g. seasonal tourism activities. Workers now can expect to be employed in market activities only for a proportion (P_p) of the year if they work for the project and a different proportion (P_a) of the year if they are not associated with the project. When they are not working in the formal labor market, they will be engaged in non-market activities outside the project or in alternative regions, $(1 - P_p)$ and $(1 - P_a)$ proportions of their labor force time, respectively.

Let us again denote the supply price of skilled labor in the area of the project as W^s and the alternative wage which reflects skilled labor's other opportunities as W_a^s. From the supply price approach, the $EOCL^s$ is the expected supply price for skilled labor working a portion of the year in the local market (P_pW^s) that would induce her to work in the project area minus the additional tax payment that the worker has to make when working on this project. This additional tax is the difference between the tax paid on the project ($P_pW^s t$) and the tax previously paid in the alternative mix of market activities ($K_dP_aW_a^s t$). We assume that workers do not pay taxes on non-market activities. If they do, these would have to be added to ($K_dP_aW_a^s t$). Thus, using the supply price approach the economic opportunity cost of skilled workers is the expected supply price less the expected change in tax payments.

$$(6) \qquad EOCL^s = P_pW^s - (P_pW^s t - K_dP_aW_a^s t)$$

This measures the amount of compensation the worker needs in order to be willing to move to the project from the alternative mix of market and non-market activities.

Example 4: Skilled Labor Employed Less Than Full-Time in Market Activities

A brief example should help demonstrate how this equation can be applied to a practical situation. Suppose in this case the alternative wage rate for skilled labor is W_a^s = \$600/mo while the project wage is equal to the supply price paid to induce labor to move to the project area ($W^s = W_p^s$ = \$800/mo). The rural and urban tax rates on skilled labor are both 20%. All of the labor is supplied by from alternative regions ($K_d = 1$), and the proportion of time a skilled worker expects to be employed is $P_p = 0.9$ in the project area and in the alternative areas $P_a = 0.8$. Using that data in Equation 6, the economic opportunity cost of labor in this rural project would be;

$$\begin{aligned} EOCL^s &= 0.9(800) - (0.9(800)(0.20) - 1.0(0.8)(600)(0.20)) \\ &= 720 - (144 - 96) \\ EOCL^s &= \$672/mo \end{aligned}$$

While the financial cost of labor for this project is estimated on average to be ($P_pW_p^s$) or .9(800) = \$720 per period, we find that the economic opportunity cost of labor is only \$672/mo, or \$48 less than the financial cost. This difference, which is a net tax gain to the government, represents the labor externalities associated with the project.

(C) Calculations - Marginal Product Foregone Approach

The $EOCL^s$ can also be estimated in an equivalent manner using the marginal product foregone approach. As previously explained, this method of analysis starts with the alternative competitive gross-of-tax wage (W_a^s) of these skilled workers. This wage reflects the minimum value of the output that must be generated by the workers in order for them to be profitably employed. Then, this wage rate is adjusted to account for the distortions of taxes, other factors such as value of non-market activities (V), or the costs associated with employment (C), e.g. transportation cost, housing, etc.

We estimate the EOCL using the same conditions described in the three examples from the supply price section: a simplified case where labor is locally available and there are no distortions to the labor market; a situation where skilled labor has to be induced to move from alternative projects or other regions where there are market distortions; and lastly a labor market situation where people are normally employed less than full time while the project may or may not provide full time employment. These examples will facilitate the comparison of the two approaches to estimate EOCL in order to demonstrate their equivalence.

(i) Skilled Labor Market without Distortions or Regional Migration

We begin as before with the assumptions that there are no distortions in the market for skilled labor in the region and the project provides employment for those workers which is comparable to alternative opportunities. In addition, we will suppose that all of the workers come from alternative projects in the area and none need to be attracted from other regions. The marginal product foregone approach in this highly simplified case starts from the gross-of-tax wage of the skilled workers (W_a^s) at an alternative project. This, in turn, will also be the supply price of workers being employed by the project. It is quite simple to observe the equivalence of the results from marginal product foregone approach and the supply price approach in this case because there are no distortions in the market.

(ii) Skilled Workers Migrate to Project from Distorted Labor Markets

In the second case, when a proportion of the skilled workers needed for a project must be induced to migrate from other regions, we begin the analysis by calculating the product foregone by the workers leaving their alternative positions. The migration of labor out of the other regions, i.e. urban area, will have an impact on both the quantity of labor demanded and supplied in those markets. A

proportion (K_d) will be released from alternative employment because of the tighter market conditions. In this case the value of the output lost is the share from that source (K_d) times the gross-of-tax wage paid (W_a^s). The share (K_s) from the additional effort of labor will be reflected by the increase in quantity of labor supplied to the market. The value of non-market activities foregone in the alternative region will be equal to the net-of-tax wage rate ($W_a^s(1 - t)$) times the share of induced labor (K_s). Thus the value of the output foregone as measured in the alternative (sending) region is ($K_d W_a^s + K_s W_a^s(1 - t)$). However, to measure the value of output foregone from the perspective of someone working in the project region we must account for the difference in the cost of living as well as psychological costs incurred by the worker to be employed in the project area. This is measured by the difference between the equilibrium net-of-tax local supply price in the receiving region and the equilibrium net-of-tax alternative wage in the sending region, $[W^s(1 - t) - W_a^s(1 - t)]$. This is the amount of extra compensation required to induce labor to come to work for the new project. The resulting expression for the EOCL is;

$$(7) \qquad EOCL^s = K_d W_a^s + K_s W_a^s(1 - t) + [W^s(1 - t) - W_a^s(1 - t)]$$

We can demonstrate that this expression is equivalent to Equation 5 developed using the supply price as follows.

Given that;

$$K_d + K_s = 1$$

We know that;

$$W_a^s(1 - t) = [K_d W_a^s(1 - t) + K_s W_a^s(1 - t)]$$

Substituting that expression back into equation 13-7, we have;

$$EOCL^s = K_d W_a^s + K_s W_a^s(1 - t) + W^s(1 - t) - [K_d W_a^s(1 - t) + K_s W_a^s(1 - t)]$$

Which simplifies to;

$$EOCL^s = K_d W_a^s + W^s(1 - t) - K_d W_a^s(1 - t)$$

Reducing the first and third terms further;

$$K_d W_a^s - K_d W_a^s(1 - t) = K_d W_a^s - K_d W_a^s + K_d W_a^s t = K_d W_a^s t = \text{urban taxes lost}$$

Recombining the equation results in the expression;

$$EOCL^s = W^s(1 - t) + K_d W_a^s t$$

Distributing the factors and reversing the signs of two terms produces;

$$EOCL^s = W^s - (W^s t - K_d W_a^s t)$$

Which is equivalent to Equation 5 from the supply price approach.

Thus, we can use either the marginal product foregone or the supply price approach to calculate the economic opportunity cost of labor in this situation. As previously noted, the decision on which method to use will depend largely upon the availability of information. As we will see in the next example, without values for worker preferences and other non-monetary factors, the marginal product foregone will be difficult, if not impossible, to estimate. The supply price approach, on the other hand, measures most of the factors directly.

(iii) Skilled Labor Employed less than Full Year in Market Activities

Let us now drop the assumption of full year employment, so skilled, rural workers can expect to be employed for a proportion (P_p) of the time if they work for the project and a different proportion (P_a) of the time if they are not associated with the project or residing in another region. Each worker spends part of each year ($1 - P_a$) in non-market activities. Let us denote the wage paid by the project as W_p^s and the alternative supply price which reflects skilled labor's other opportunities as W_a^s. Additionally, when they are not working in the formal labor market, they will be engaged in non-market activities which yields a value (V) to the workers. Finally, the monetary and non-monetary costs associated with the specific working conditions of the alternative activities and borne by the workers are denoted by C_a, and while working in the project they are shown as C_p.

The marginal product foregone analysis begins with the foregone wage (W_a^s) times the proportion (P_a) of the project's skilled labor sourced from alternative projects or other regions. To this amount, the value of non-market activities from the alternative situation ($(1 - P_a)V$) is added, and the associated costs of alternative employment (C_a) are subtracted to arrive at labor's alternative economic opportunity costs. To find the economic opportunity cost of labor for a job on the project, the value of the non-market activities ($(1 - P_p)V$) of labor associated with the project must be subtracted, and the costs borne by labor associated with employment at the project (C_p) added. This produces an estimate of the economic opportunity cost of skilled labor for the project equivalent to;

$$(8) \qquad EOCL^s = P_aW_a^s + (1 - P_a)V - C_a - (1 - P_p)V + C_p$$

where;
$P_aW_a^s$ = the value of product foregone on alternative projects
$(1 - P_a)$ = the proportion of time labor is not working before the project
$(1 - P_p)$ = the proportion of time labor is not working after the project begins

In Equation 8 the differences in working conditions and associated costs between the alternative employment and the project is measured by $[(1 - P_a)V - C_a - (1 - P_p)V + C_p]$. In order for a worker to be willing to work for the project he/she must receive additional compensation equal to this amount.

Hence, on the margin;

$$[P_p W^s (1 - t) - P_a W_a^s (1 - t)] = [(1 - P_a)V - C_a - (1 - P_p)V + C_p]$$

Substituting for the last four terms of Equation 8 we have;

$$EOCL^s = P_a W_a^s + [P_p W^s (1 - t) - P_a W_a^s (1 - t)]$$

Which simplifies to;

$$EOCL^s = P_p W^s - (P_p W^s t - P_a W_a^s t)$$

Which is the same expression as given by the supply price approach in Equation 6.

Comparing Equations 6 with 8 we find that the variables $(P_p W^s)$ and $(P_p W^s t - P_a W_a^s t)$ are usually directly observable and easy to measure. For the marginal product foregone approach, however, we need to determine the value of output foregone $(P_a W_a^s)$, plus the difference between the value of non-market time $[(1 - P_a)V - (1 - P_p)V]$, plus the difference in other costs associated with the two positions $[C_p - C_a]$. Those factors are often difficult to estimate directly with any degree of accuracy. Hence, the supply price approach tends to provide fewer opportunities for error in measurement and is usually a much more direct approach to the estimation of the economic opportunity cost of labor.

IV. THE EFFECTS OF A PROTECTED SECTOR ON THE EOCL

(A) Introduction

Until now our analysis has focused on estimating the EOCL for projects requiring unskilled and skilled workers from rural and open urban labor markets which have relatively low barriers to entry. In many developing countries, however, there is a two-tiered market for urban labor -- protected sector and open sector. The relationship between these labor markets (protected, open) and the rural market is hierarchical with employment changes in the protected sector cascading down and affecting the supply and demand for labor in the other two sectors. Likewise, changes in the open sector cascade down to affect the supply and demand for workers in the rural labor markets. Consequently, when calculating the EOCL it is necessary to consider how a project in a more restricted sector will affect the supply and

demand for labor in less restricted labor markets.

The protected sector is usually made up of the government agencies, foreign companies, and large local firms which provide protected sector wages (W^{Pr}) above the market clearing wage (supply price). Higher wages offered by these types of employers are often the result of the stricter enforcement of minimum wage laws, powerful unions which are able to demand and get significantly higher wages, government policies that give higher wages to civil servants for political reasons, or foreign companies which pay high wages to decrease possible resentment by workers and politicians in the host country. Consequently, entry into the protected urban labor force is highly desired, with a variety of rationing methods used to select the people to fill the limited number of positions.

The open labor market is typically affected by fewer distortions to the supply price of labor (W^{O}). Wages are determined competitively in the open marketplace where there are fewer barriers to entry, lower wages and less employment security. Thus, while rural, unskilled workers may be initially attracted to a region by the hope of a job in the protected sector, they often work in the open labor market. As they develop more skills and contacts, those workers may eventually gain access to the more lucrative protected sector jobs which they initially aspired to obtain.

Finally, changes in either the protected or open sectors will often affect the rural labor market as well. For example, if a new project is introduced in the urban area, it will increase the demand for labor and, hence, will encourage the migration of labor from the rural sector. These new workers might be looking for a protected sector job, but because of the tight labor market they may have to work in the open market. Only when the wage differential between the open urban market and the rural (or sending) areas decreases below the additional cost of living in the city, will the unskilled workers consider moving back to the countryside. Analyzing the interrelationships between these three labor markets helps us understand how the creation of jobs in one sector might affect the economic opportunity cost of labor overall.

(B) EOCL for a Protected Sector Project

When estimating the economic opportunity cost of labor for a project in the protected sector ($EOCL^{Pr}$), we need to understand the impact which additional protected sector jobs may have on both

the open and rural labor markets. To start, the supply of labor to the open sector is equal to the total supply of labor to the urban economy, less the quantity of labor employed in the protected sector. Now consider the measurement of the economic opportunity cost of labor for a new project which pays protected sector wage rates. This is illustrated in Figure 3(A) as a shift in the demand for protected-sector labor from D^{Pr} to $D^{Pr} + P$. As a result, more workers will now be employed ($Q_1^{Pr} - Q_0^{Pr}$) at the protected sector wage (W^{Pr}). However, this wage does not represent the economic opportunity cost of the labor for this project because many of the new protected sector workers would have left open sector jobs to take these positions. Hence, in order to estimate the $EOCL^{Pr}$ we need to consider what effects the new project will have on the rest of the economy.

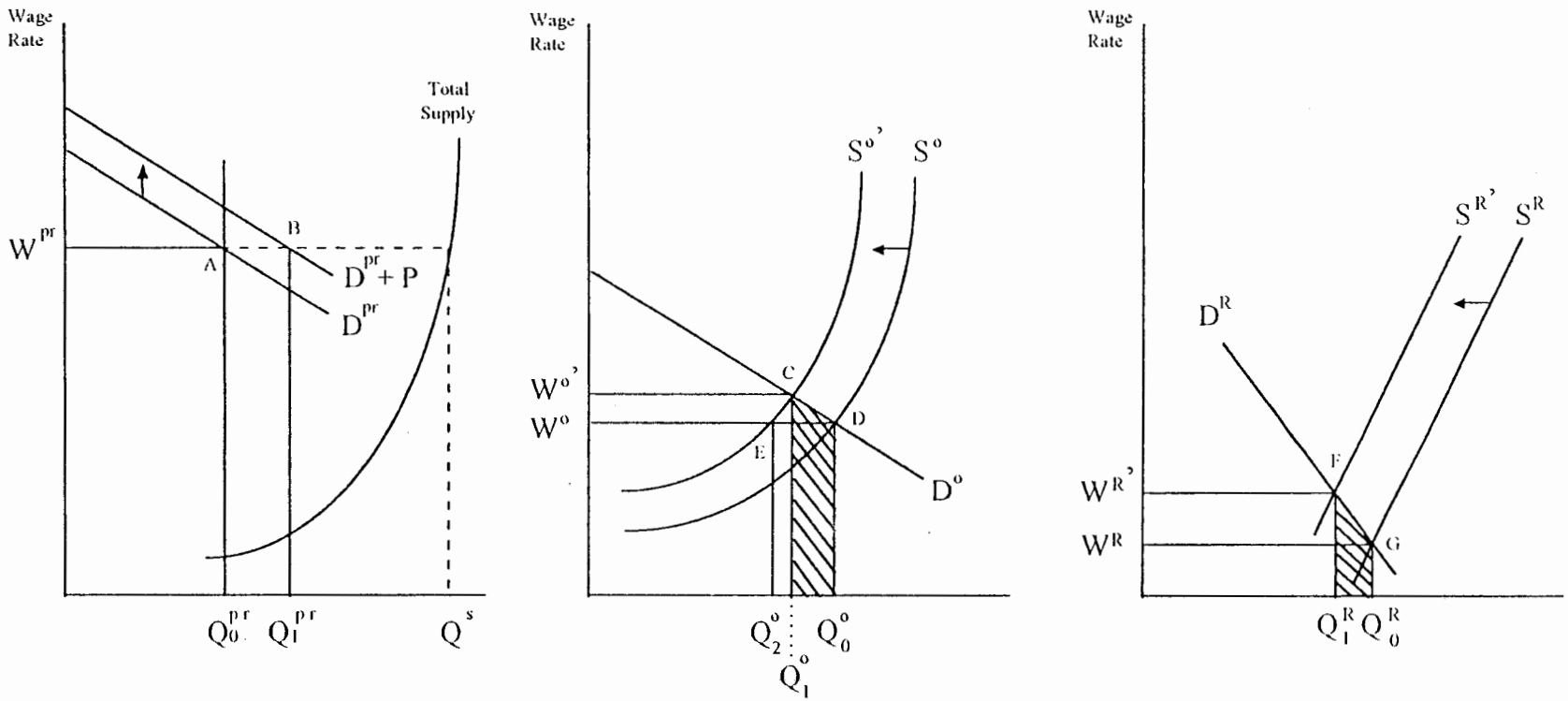
Examining the effects of this protected sector project on the open labor market (Figure 3(B)), we can see that the increase in protected sector employment will decrease the residual supply of labor available to the open sector causing a shift to the left in the supply curve from S^O to $S^{O'}$. This will cause the open market wage rate to rise from W^O to $W^{O'}$, hence, reducing the quantity of workers demanded in the open sector from Q_0^O to Q_1^O. The economic value of the output lost because of this new protected sector project is given by the area $Q_1^OCDQ_0^O$, or the change in labor utilized ($Q_0^O - Q_1^O$) times the open sector gross-of-tax wage rate (W^O).

The reduction in the supply of open sector labor and the increase in the open sector wage rate will cause an increase in the quantity of labor supplied to the open sector from Q_2^O to Q_1^O. This increase in the quantity of labor supplied will come partially from additional effort being made by the workers already living in the urban area and partially from a new supply of rural labor who are attracted into the open sector economy of the city. This can be shown as a decrease in the rural labor supply from S^R to $S^{R'}$, reducing the rural workforce from Q_0^R to Q_1^R (Figure 3(C)). The wage of those new urban immigrants would be equal to the prevailing market wage in the open sector (W^O), as it is this wage rate which is their supply price in the urban area. Therefore, for any increase in protected sector jobs, the measure of the economic opportunity cost of labor from all sources is the private supply price (market wage) for a job of the same skill level in the open sector of the economy. In algebraic terms, it is expressed as;

$$(9) \qquad EOCL^{Pr} = W^O$$

FIGURE 3

ESTIMATING THE ECONOMIC OPPORTUNITY COST OF LABOR FOR PROTECTED SECTOR JOBS



3 (A)
PROTECTED

3 (B)
OPEN

3 (C)
RURAL

If there are income tax distortions on the open sector wages (t), the $EOCL^{Pr}$ is measured by the gross-of-tax wage in the open sector minus the difference between the taxes paid by the new workers and the government's loss of tax revenues from workers who lost their jobs when the alternative open sector employers reduced their labor demand. Taxes in this case reflect part of the value of the product lost as employment is reduced by other open sector firms. The equation for estimating the $EOCL^{Pr}$ becomes;

$$(10) \qquad EOCL^{Pr} = W^{O} - (W^{O} t - K_d W^{O} t)$$

where; K_d = proportion of the new jobs which are sourced from decreased demand by open sector firms

Example 5: A Multinational Corporation Seeks Labor for a Project in an Urban Area

A multinational corporation is considering a project to produce integrated circuits in an urban area. The project's staffing requirements are 3,000 person-months per year and they will be hired from the urban labor pool. The project is being developed by a multinational firm, and the jobs are considered to be in the protected sector because the wages paid are substantially higher and job security is greater than in the open sector. This type of labor normally earns a gross-of-tax monthly salary of 800 pesos (W^{O}) in the open sector, but the project is offering wages of 1,000 pesos per month (W_p^{Pr}). Labor in the area is expected to pay 20% of its wages in income taxes (t).

To estimate the economic opportunity cost of labor to the project in the protected sector, we need to apply Equation 10 to calculate: (1) the taxes on the open sector wage for this type of labor, and (2) the taxes foregone by the workers from alternative employment. This, in turn requires the estimation of the relative demand and supply weights (K_d and K_S) for that labor in this marketplace.

(1) *Taxes on Open Sector Wage*

The prevailing gross-of-tax wage (W^{O}) in the open sector for this type of labor is 800 pesos per month. Taxes in the open sector would therefore be:

$$\begin{aligned} \text{Taxes} &= W^{O} t \\ &= 800\ (0.20) \\ &= 160 \text{ pesos per month} \end{aligned}$$

(2) *Taxes Foregone from Alternative Employment*

It is plausible to assume that the type of labor needed for this project is in relatively short supply, so the project's labor requirements will be accommodated more from the demand side of the market than from its supply side. We are projecting that two-thirds of the project's labor will be provided by other employers reducing their labor demand due to higher wage rates. The remaining one-third of the project's labor requirements will be met through an increased supply in the labor force. Therefore, let $K_d = 0.67$ and $K_s = 0.33$.

Foregone taxes from the previous employment of the skilled workers are calculated as follows:

$$\begin{aligned} \text{Taxes Foregone} &= K_d W^o t \\ &= 0.67 * 800 * 0.20 \\ &= 107.2 \text{ pesos per month} \end{aligned}$$

Now, the economic opportunity cost of the labor hired for the protected sector project can be calculated using Equation 10 as follows:

$$\begin{aligned} EOCL^{Pr} &= W^o - (W^o t - K_d W^o t) \\ &= 800 - ((800 * 0.20) - (0.67 * 0.20 * 800)) \\ &= 747.2 \text{ pesos per month} \end{aligned}$$

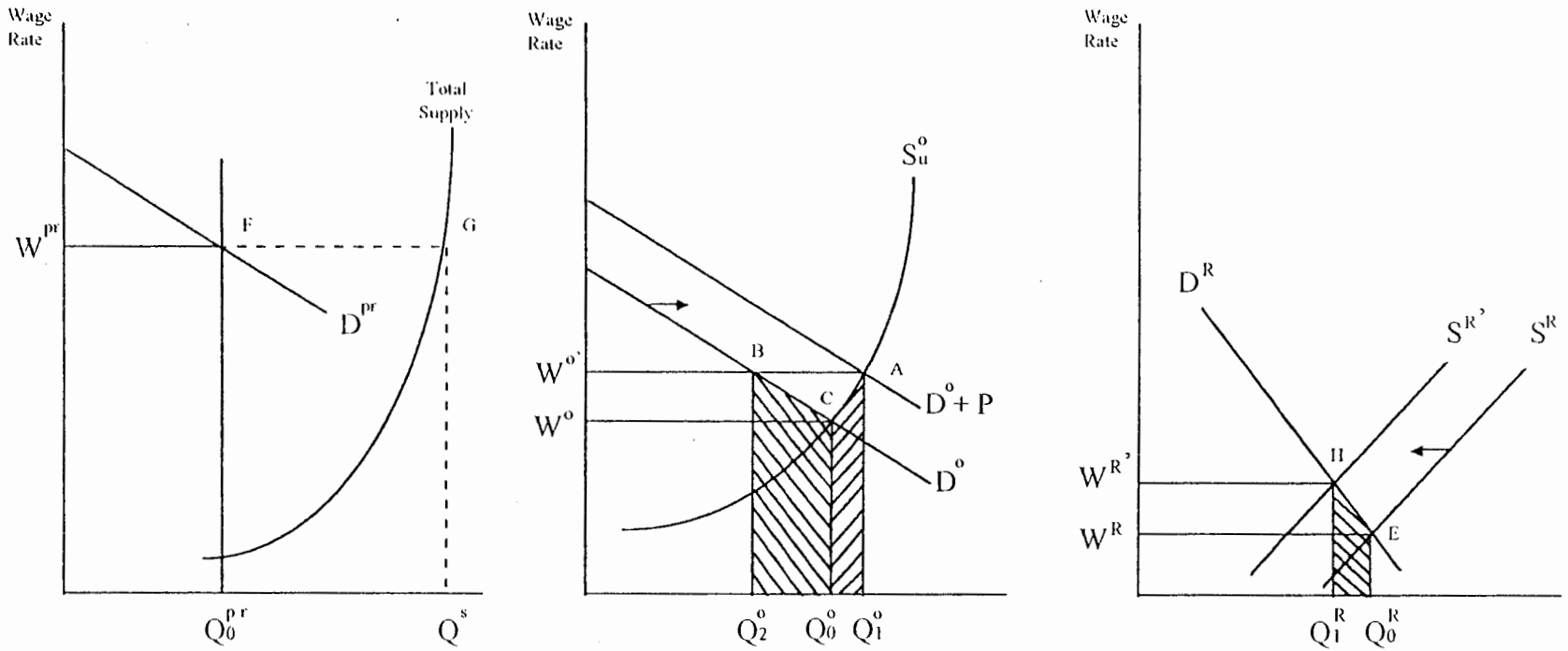
The financial cost of labor would be equal to the project wage (W_p^{Pr}) of 1000 pesos per month while the economic opportunity cost of labor would be 747.2 pesos per month, or 252.8 pesos per month less. This represents the economic externalities generated from employing labor by this project at the protected sector wage. Of this amount, the government gains 92.8 pesos/mo [(1000*0.2) - (0.67*800*0.2)], while labor gains 160 pesos/mo [(1000 - 800)*(1.0 - 0.2)].

(C) EOCL for a Project in the Open Sector

The process of calculating the economic opportunity cost of labor for a project in the open sector of the urban economy ($EOCL^o$) is illustrated using Figures 4(A), (B) and (C) to show the interactions between the three sectors of the labor market. Recall, the supply of labor in the open sector is equal to the total supply of labor in Figure 4(A) minus the quantity working in the protected sector (Q_0^{Pr}).

FIGURE 4

ESTIMATING THE ECONOMIC OPPORTUNITY COST OF LABOR FOR OPEN SECTOR JOBS



4 (A)
PROTECTED

4 (B)
OPEN

4(C)
RURAL

Suppose that a project (P) located in the open sector hires new workers. This will cause the demand for open sector labor to shift from D^o to $D^o + P$ as shown in Figure 4(B). The wage in that sector rises from W^o to $W^{o'}$ which induces an increased effort from the open sector labor force and a migration of rural labor into the open sector, increasing the open market labor quantity from Q_0^o to Q_1^o. The increase in supply from rural migration is also shown in Figure 4(C) as a movement along the supply curve in the urban area open labor market and a shift in the supply curve of rural labor from S^R to $S^{R'}$. At the same time, however, the higher open sector wage will lead to a decrease in the quantity of labor demanded by open sector firms, reducing the quantity of labor employed from Q_0^o to Q_2^o. The relative size of each of those labor movements will depend upon the relative elasticities of supply and demand for labor in the open sector.

We can observe from the open sector diagram that the economic opportunity cost attributable to the lost output of other producers in the open sector is equal to $Q_2^oBCQ_0^o$. The economic opportunity cost of adding to the supply of labor in the open sector is $Q_0^oCAQ_1^o$. Although the economic output lost in the rural sector due to the migration of labor to the urban sector is $Q_1^RHEQ_0^R$, in Figure 4(C) this measure of output lost is not relevant because the project is not located in the rural area. The relevant $EOCL^o$ for these workers is the area under the supply curve of the open urban sector ($Q_0^oCAQ_1^o$) which measures opportunity costs where the project is located. When there are no tax distortions, we find that both the foregone output in the open sector and the supply price of labor are equal to the open sector wage (W^o). Therefore, we can say;

$$(11) \qquad EOCL^o = W^o$$

If income taxes are levied on the open sector wages, the $EOCL^o$ is measured by the gross-of-tax wage in the open sector minus the difference between the taxes paid in the new position and the government's loss of tax revenues from workers who lost their jobs when the other employers reduced their labor demand. The equation for estimating the $EOCL^o$ again becomes;

$$(12) \qquad EOCL^o = W^o - (W^o t - K_d W^o t)$$

where; K_d = proportion of the new jobs sourced from decreased demand of alternative open sector firms

In summary, projects in either the protected or open market have an economic opportunity cost equal to the open sector wage adjusted for distortions.

(D) EOCL if there is no Open Sector

In some circumstances we find that no open sector has been allowed to develop. Either because of the strict enforcement of minimum wage laws or the nature of the development in the area, e.g. one company towns, the only sources of employment available are protected sector jobs. Workers will be attracted to the region because the protected sector wage is greater than their supply price of labor for that place. Not all potential workers will find employment, some who come to the area in search of a protected sector job will end up being unemployed.

In this case we must differentiate between the supply price of an additional potential worker (a migrant) and the economic opportunity cost of labor required to fill a job. The potential migrant evaluates her prospects in the region where there are protected sector jobs with the opportunities available around her. If she migrates, there is a probability of finding a protected sector job (P^{Pr}), and also a probability ($1 - P^{Pr}$) of being unemployed. Hence, from the perspective of a potential migrant, if the protected sector wage is W^{Pr}, the expected wage from migrating E(W) is equal to the product of the protected sector wage (W^{Pr}) and the probability of being employed in the protected sector (P^{Pr}).

$$E(W) = P^{Pr} W^{Pr} \tag{13}$$

When there is no open sector, then it is the unemployment rate, ($1 - P^{Pr}$) which brings about the equilibrium between the supply price of a migrant and the protected sector wage. Suppose the supply price for a migrant to move to the region where there are protected sector jobs is W^m. As this supply price is less than the protected sector wage of W^{Pr}, there is incentive for more migrants to move to seek protected sector employment than there are jobs available. This migration process will continue until the probability of finding a job (P^{Pr}) falls to the point where;

$$P^{Pr} = (W^m / W^{Pr}) \text{ and } W^m = E(W) \tag{14}$$

At this point the potential migrant's expected wage from moving to the protected sector is just equal to her supply price. It means also that when more protected sector jobs are created, the number of migrants to the region in pursuit of these jobs will always be greater than the number of jobs. Hence,

when the full adjustment has taken place, the equilibrium unemployment rate will be maintained and the number in the pool of unemployed labor will be increased.

To estimate the EOCL for permanent sector jobs, we need to account for the opportunity cost of all migrants, both employed and unemployed, who were induced to move in pursuit of these new jobs. If the equilibrium unemployment rate is $(1 - P^{Pr})$, then for every new protected sector job created there will have to be $1/P^{Pr}$ migrants. The economic opportunity cost of each of these migrants is equal to $W^{Pr}P^{Pr}$ when the labor market is in equilibrium. Hence, the economic opportunity cost of labor to fill a protected sector job is expressed as;

$$(15) \qquad EOCL^{Pr} = W^{Pr}(P^{Pr})(1/P^{Pr}) = W^{Pr}$$

In this case where it is the unemployment rate which is the equilibrating force between the protected sector and the rest of the economy, the $EOCL^{Pr}$ is equal to the protected sector wage. There is no net economic externality from the creation of protected sector jobs. The additional unemployment created by those searching for a protected sector job inflicts an economic cost on society equal to the difference between the supply price of a migrant and the protected sector wage. As a consequence, when there is no open sector and no other distortions such as taxes, the economic opportunity cost of labor for protected sector jobs is the protected sector wage.

When there are taxes levied on the protected sector wage, and taxes are levied on the wages paid in the sending region, then the $EOCL^{Pr}$ will need to be adjusted to reflect the net change in tax revenues. If we denote the wage rate in alternative employment as W_a and the proportion of migrants from the sending region which would have been employed in that region as K_a, and t is the tax rate, then the $EOCL^{Pr}$ can be expressed as;

$$(16) \qquad EOCL^{Pr} = W^{Pr}(1 - t) + K_a W_a t (1/(1 - P^{Pr}))$$

In this situation the amount of taxes lost from reduced activities in the sending regions must account for the fact that not all the adjustment comes from reduced employment, and that for every new protected sector job there will be more than one migrant moving to the labor market where the protected

sector jobs are located.

(E) Quasi-voluntary and Search Unemployment

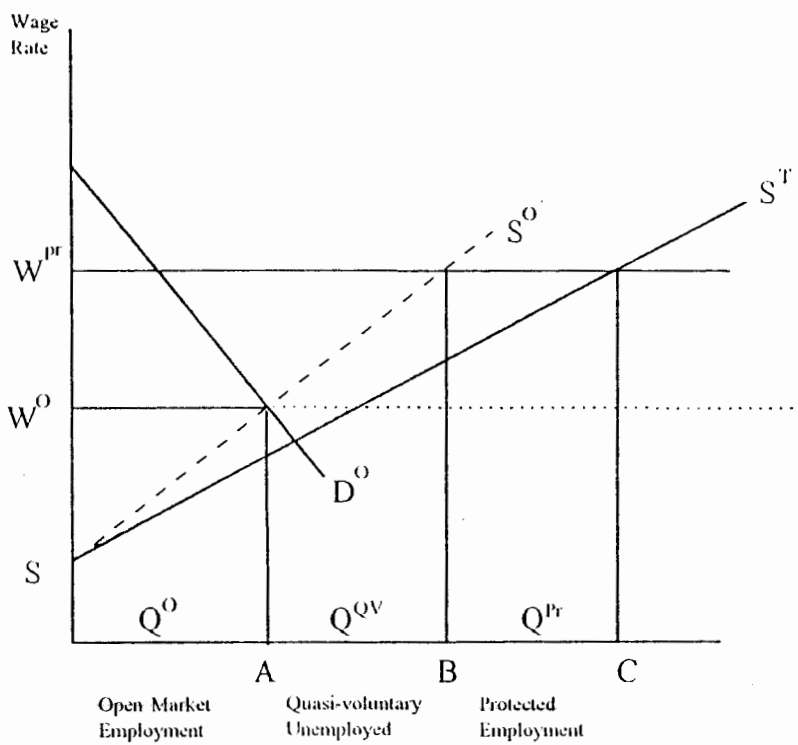
The phenomenon of chronic unemployment, at rates far in excess of what might be explained in terms of normal friction in the economy, has been attributed, in part, to the existence of a protected labor market as described in the previous section. A portion of those chronically unemployed workers are attempting to gain access to the protected sector, but at the same time are unwilling to work for the lower wages offered in the open labor market. This unwillingness to work at the open market supply price creates subsectors in the labor market where quasi-voluntary and search unemployment exist.[18]

The characteristics of quasi-voluntary unemployment can be explained using in Figure 5(A). If the overall supply of labor to the market is given by the supply curve (S^T), the total number of workers making themselves available for work at the protected sector wage will be given at point C. Within that labor supply, some of the workers will be employed in the protected sector (Q^{Pr}) (a fixed number of jobs), and a portion will be working in the open sector (Q^O). Because of the excess supply of labor available at the protected sector wage, the selection of workers for employment in the protected sector needs to be done in a way independent of their supply prices. It follows that the supply curve facing the open market will be S^O, represented by the dotted line in the diagram, if those employed in the protected sector are chosen in a random fashion from those willing to work. The intersection of this supply curve with the open market demand curve (D^O) determines the open market wage (W^O) at which the labor demand will be Q^O. The quantity of labor classified as quasi-voluntary unemployed (Q^{QV}) is determined from the difference between points A and B. Quasi-voluntary unemployed are those workers that do not choose to take jobs in the open market sector because their basic supply price of labor is above the open market wage (W^O). In general, they will actively seek jobs in the protected sector, and will consider themselves involuntarily unemployed because they are seeking work which will pay the protected sector wage (W^{Pr}), but are unable to find it.

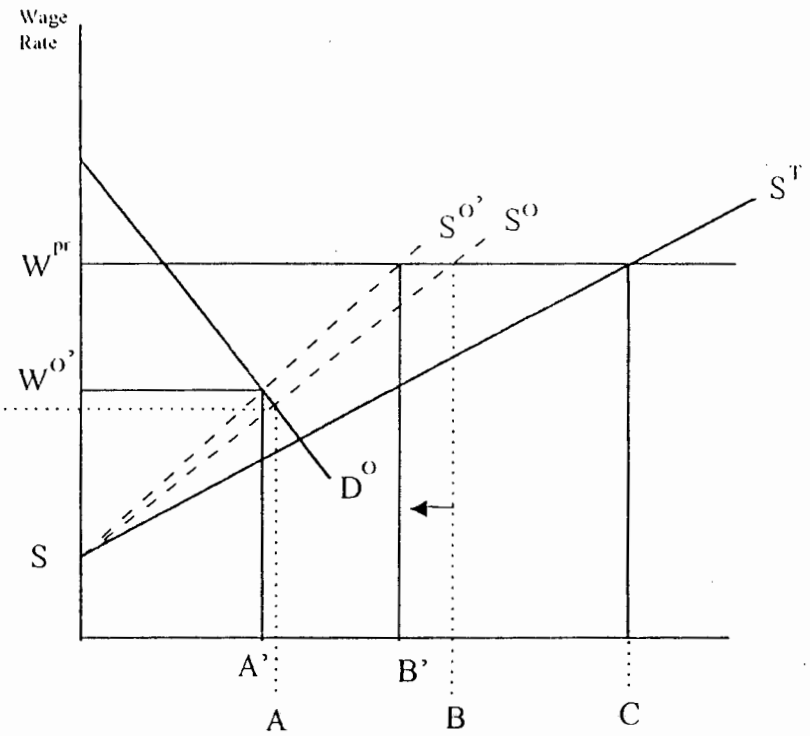
If we add a project to the protected sector, then we can see in Figure 5(B) that the higher wage will induce quasi-voluntary and open sector workers to move into the protected sector positions. The quantity of employment in the protected sector will increase from B to B', and the supply curve for labor in the open market will shift from S^O to $S^{O'}$, reducing the quantity of labor employed by the open sector from A to A'. If we attract workers from the unemployed and open sectors in proportion to their

FIGURE 5

ESTIMATING THE ECONOMIC OPPORTUNITY COST OF LABOR
WITH QUASI-VOLUNTARY UNEMPLOYMENT



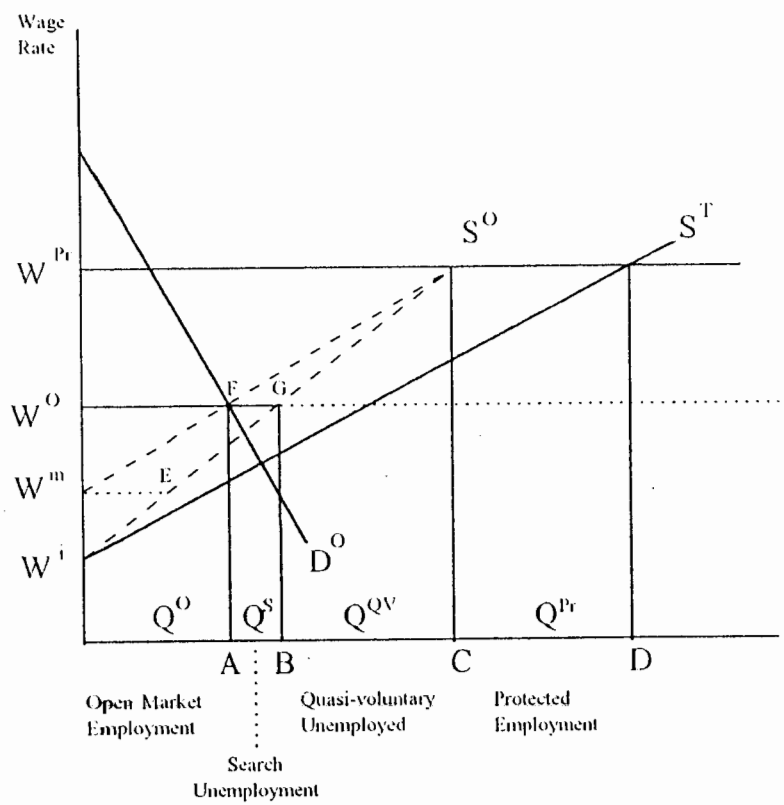
5(A)



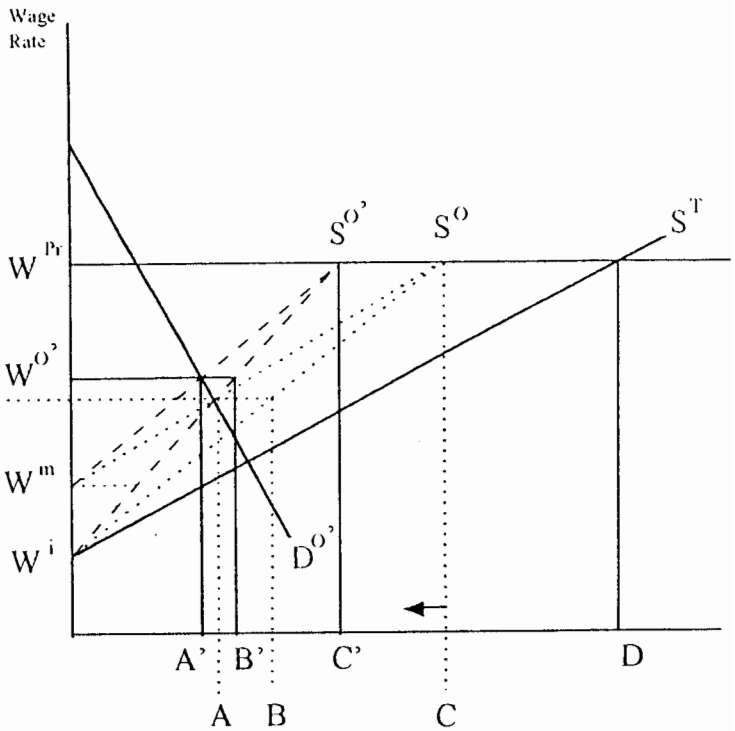
5(B)

FIGURE 6

ESTIMATING THE ECONOMIC OPPORTUNITY COST OF LABOR
WITH QUASI-VOLUNTARY AND SEARCH UNEMPLOYMENT



6 (A)



6 (B)

existence in the labor pool, then absent any distortions such as income tax, the economic opportunity cost of labor to this project is a weighted average of the open sector wage (W^O), and the average supply price of the quasi-voluntary unemployed [$(W^O + W^{Pr})/2$]. The relevant weights are the probabilities that workers in each of those categories will be chosen for the protected sector jobs. Under the assumption that the criterion of choice is unrelated to supply price, these weights are the fractions [$Q^O/(Q^O + Q^{QV})$] and [$Q^{QV}/(Q^O + Q^{QV})$] respectively, where Q^O is the quantity employed in the open market and Q^{QV} is the amount of quasi-voluntary unemployment as shown in Figure 5(A). Hence, the EOCL for this project is given by the expression;

$$(17) \qquad EOCL^P = W^O[Q^O/(Q^O + Q^{QV})] + [(W^O + W^P)/2][Q^{QV}/(Q^O + Q^{QV})]$$

This analysis of unemployment assumes that all of the workers, whether employed in the open market or quasi-voluntarily unemployed, have an equal chance of obtaining the protected sector job. However, in practice some workers will have more to gain (by their own assessment) from the protected sector job than others and, therefore, can be expected to go to greater lengths to obtain those positions. A part of this extra effort is likely to be reflected in the form of search unemployment, which is a particular form of voluntary unemployment. Search unemployment can be thought of as a category where the worker voluntarily accepts unemployment with the intention of enhancing the probability of getting a protected sector job.

Figure 6(A) depicts a labor market in which both search unemployment and the standard type of quasi-voluntary unemployment coexist. The curve $W^m S^O$ is the supply curve facing the open market while the lateral distance between the two supply curves, W^mS^O and $W^i S^O$ is the quantity of search unemployment corresponding to a given open market wage. When the wage is W^m the number of workers who opt for search unemployment is equal to the distance W^mE, whereas it is the difference between F and G at the open market wage W^O. This distance is at a maximum at the wage W^m, the wage at which all those not working for the protected sector would prefer to remain unemployed while searching for protected sector jobs instead of accepting open sector jobs. As the open market wage rises, fewer and fewer workers are willing to forego open market earnings in order to seek protected sector jobs, until, finally, as the open market wage approaches W^{Pr}, the quantity of search unemployment approaches zero.

When a project is introduced into the protected sector under these conditions, a proportion of the new positions will be filled from each of the three labor pools: search unemployed, quasi-voluntary unemployed and those currently employed in the open sector. The EOCL will be the sum of the supply price times the proportions (K_i) of the new hires that come from each of those sectors. Workers who opt for search unemployment are voluntarily accepting a gamble, in which one outcome is to be unemployed, and the other is to have a protected sector job. The value of that gamble to them is precisely the open market wage (W^O) at which they would willingly withdraw from the search process. Therefore the supply price of the search unemployed workers (W^S) will be given by Equation 18;

$$W^S = W^O = P_1 (0) + P_2 (W^{Pr}) \tag{18}$$

where; P_1 = the probability of getting zero income

P_2 = the probability of getting a protected sector job

The quasi-voluntary unemployed are unwilling under any circumstances to work at the wage W^O, requiring a higher wage (given their respective supply prices) in order to reenter the workforce. Workers drawn from quasi-voluntary unemployment to take jobs at the protected sector wage (W^{Pr}) will (with linear supply curves) have a supply price averaging $((W^O + W^{Pr})/2)$. Finally, the supply price for workers already employed in the open sector will simply be the open market wage because they have already shown a willingness to accept work at that wage rate. Hence, we estimate the economic opportunity cost of labor for the protected sector project by combining those supply prices and the proportions of labor from each sector as follows;

$$EOCL^{Pr} = W^O K^S + ((W^O + W^{Pr})/2) K^{QV} + W^O K^O \tag{19}$$

where; K = proportion of labor sourced from each sector (S - search; QV - quasi-voluntary; O - open)

If the people obtain the permanent jobs in a manner unrelated to their supply prices, then;

$$K^S = Q^S/(Q^S + Q^{QV} + Q^O);\ K^{QV} = Q^{QV}/(Q^S + Q^{QV} + Q^O);\ K^O = Q^O/(Q^S + Q^{QV} + Q^O)$$

Comparing this value with the EOCL when there is only quasi-voluntary unemployment, the

addition of the economic cost of search unemployment ($W^{O}K^{S}$) will tend to raise the open sector's wage (W^{O}) and, hence, raise the economic opportunity cost of labor for the project in the protected sector.

(V) PERMANENT AND TEMPORARY JOBS WITH AN UNEMPLOYMENT INSURANCE SYSTEM

When evaluating projects, one question we want to consider is, what is the quality of the jobs being created?[19] Are the jobs full-time for the entire year (i.e. permanent sector) or will they employ a given worker for only part of the year (i.e. temporary jobs). People in the permanent employment sector, because of their choice of occupation or seniority, are almost never unemployed. On the other hand, workers employed by temporary sectors such as tourism or construction are in jobs that are not expected to provide continuous employment. For this analysis, individuals expected to experience periodic spells of unemployment are included in the temporary sector, both when they are working and when they are unemployed. In this section we wish to extend the analysis presented in Section III-B-(iii) which considered the case when workers were employed less than full time in market activities during a typical year. In terms of the type of jobs people hold, we classify these jobs as temporary, as they do not retain the workers for a full year.

The type of employment being created is important because temporary jobs can have a high economic cost when unemployment insurance payments are made to these workers when they are engaged in non-market activities including being unemployed.[20] Those support payments affect the EOCL associated with a job and need to be accounted for in the appraisal of a project which creates these jobs. Hence, the quality of the employment being created by a project should be considered, and the different economic costs for permanent and temporary employment should be included in the overall assessment of the effects of a project.

Let us consider first the creation of permanent jobs. When a project creates new permanent jobs they will generally be filled by hiring from the ranks of the unemployed or from individuals in alternative positions. If workers are hired away from other projects, their jobs will ultimately be filled by the unemployed who, by definition, are members of the temporary labor force. This process will cause an increase in the permanent workforce and a decrease in the pool of temporary workers. If the

demand for temporary labor on alternative projects does not change, the proportion of time (P) the total labor force spends unemployed (non-market activities) will fall. This will induce more temporary workers to stay in the area, thereby decreasing the flow of out-migration or increasing the flow of in-migration. In this case it is the unemployment rate of the temporary part of the labor force which determines the equilibrium in the inter-regional labor markets. In order for the unemployment rate of the temporary sector to return to its previous equilibrium level, the number of migrants who would come into the region will have to be the same as the number of permanent sector jobs created. This is because one member of the temporary sector has been moved to the permanent sector. Thus, when the labor market has reached its final equilibrium the economic opportunity cost of labor associated with filling a permanent job is equal to the economic opportunity cost of labor of one migrant ($EOCL^M$). When unemployment insurance is being paid to the temporary sector worker when she is unemployed, there will be a savings if the amount paid to workers in the project region is less than the amount that the worker would have been collecting $[(1 - P_a)f_aU_a(1 - t_a)]$ in the alternative region. Therefore;

$$(20) \qquad EOCL^M = P_pW_p(1- t_p) + (1-P_p)fU_p(1 - t_p) + P_aW_at_a - (1 - P_a)f_aU_a(1 - t_a)$$

where;
W_P = before tax supply price of labor for the temporary sector in the project's region
W_a = before tax wage earned in the temporary sector of the alternative region
P_a = proportion of time a particular project job employs a person during a year
P_P = proportion of the time working on average in the temporary labor force
t = personal income tax rate
f = proportion of time unemployed a worker expects to collect unemployment benefits
U = unemployment benefits

On the other hand, when additional employment is created in the temporary sector, the members of the temporary labor force will now have a greater expectation of obtaining work for more than a proportion (P) of the time. In this situation, P is the proportion of time that potential migrants to the project region must find work in order to move to the region. As temporary jobs are created, the increase in the net in-migration will cause the labor force in the temporary sector to increase. In order for the expectation of employment to eventually return to its initial level P, it will require 1/P potential immigrants to be retained for every year's worth of temporary employment created. As a result of the temporary sector jobs, the total number of unemployed workers is increased, leading to a rise in the consumption of non-market (unemployed) time equal to the proportion of time each retained immigrant spends unemployed times the number of new migrants. Therefore, the economic opportunity cost of

labor related to the creation of a year's worth of temporary sector jobs will be equal to;

$$EOCL^T = EOCL^M / P \quad (21)$$

where; $EOCL^M$ is given by Equation 20

The economic cost of a year's worth of temporary employment is greater than the opportunity cost of one person for one year.

Example 6: Comparing the EOCL for Permanent versus Temporary Jobs[21]

Suppose 1,000 jobs are created in the permanent sector and filled by temporary sector workers. As shown in Table 2, the unemployment rate in the temporary sector will have decreased from 40% to 29%, and people who would have migrated out of the region will now not move while others who had not intended to return to the region will do so. When migration is determined by the unemployment rate in the temporary sector, it will stop when the 1,000 workers who moved to the permanent jobs from the temporary labor market are replaced and the labor force in that sector has returned to its previous level of 6,250. Thus, the EOCL of creating those 1,000 permanent jobs is the cost of retaining 1,000 potential migrants in the region or inducing 1,000 migrants to the region.

TABLE 2

	1000 Permanent jobs created			1000 Temporary jobs created	
	Initial state (1)	Immediate response (2)	Final state (3)	Immediate response (4)	Final state (5)
Total labor force	16,250	16,250	17,250	16,250	17,917
Permanent sector:					
Individuals/jobs	10,000	11,000	11,000	10,000	10,000
Temporary sector:					
Individuals	6,250	5,250	6,250	6,250	7,917
Jobs	3,750	3,750	3,750	4,750	4,750
Unemployed workers	2,500	1,500	2,500	1,500	3,167
Unemployment rate(%)	40	29	40	24	40
Total unemployment rate (%)	15.4	9.2	14.5	9.2	17.7

On the other hand, suppose that 1,000 person years worth of temporary jobs are created in the

region as shown on the right side of the table. Those jobs attract migrants to the region. The unemployment rate in the temporary sector will initially be lowered to 24%, but will rise gradually because of induced migration. When the equilibrium is reestablished with a temporary sector unemployment rate of 40%, the unemployment rate for the entire labor market will have increased from the original value of 15.4% to 17.7% because the number of net-immigrants is larger than the number of new jobs created. The economic opportunity cost of 1,000 person years of new temporary jobs would be the cost of 1,667 migrants to the region. It is clear that the creation of temporary jobs results in a significantly larger economic cost than the creation of an equal number of permanent positions within that economy.

This example suggests that the creation of permanent jobs will reduce the overall unemployment rate in the country, while the creation of temporary jobs will tend to lead to higher unemployment rates. While this complex process is difficult to analyze in many situations due to the lack of data, the lesson is clear -- the creation of temporary sector jobs for the purpose of absorbing unemployment could be counterproductive to the overall economic development of the country.

VI. CONCLUSIONS

In this article the economic opportunity cost of labor has been estimated using the supply price approach under a wide variety of labor market conditions and types of jobs. This approach is shown to be equivalent to the value of the marginal product of labor foregone approach, when the latter can be estimated accurately. The primary reliance of the supply price approach on the wage rates demanded under the labor conditions of the project greatly facilitates the estimation of this economic parameter for use in the economic valuation of projects.

A methodology has been outlined in detail to account for several adjustments that may need to be made to this supply price to reflect special labor market characteristics and distortions. Most of these factors, such as income taxes and unemployment insurance compensation, are straightforward and easy to estimate. Other issues dealing with the quality of the jobs and the nature of the unemployment present require a more detailed examination of the labor market. Once these values have been determined, they are used to adjust the supply price to arrive at an estimate of the economic opportunity cost of labor for a particular skill on a particular project.

ENDNOTES

1. A.C. Harberger, "The Social Opportunity Cost of Labor: Problems of Concept and Measurement as Seen from a Canadian Perspective," mimeo of Report for the Canadian Immigration and Employment Commission, Task Force on Labor Markets (Ottawa, 1980).

2. For an excellent study of the measurement of the economic opportunity cost of labor is a general equilibrium framework see: J. C. Evans, On Estimating the Opportunity Cost of Labor in Canada,. Ph.D. Dissertation (Department of Economics, University of Chicago, 1975).

3. I.M.D. Little and J.A. Mirrlees, Project Appraisal and Planning for Developing Countries (London: Heinemann Educational Books, 1974).

4. A.C. Harberger, Project Evaluation: Collected Papers (Chicago: University of Chicago Press, 1972, reprinted 1976), Ch. 7.

5. I.M.D. Little and J.A. Mirrlees, op. cit., ch. 14.

6. ibid., pp 279.

7. For a summary of this debate see S.A. Marglin, Value and Price in the Labour-Surplus Economy, (Oxford: Clarendon Press, 1979), pp. 10-23.

8. C. Bailey, "The Myth of Subsistence Agriculture in Malaysia," mimeo, 1979.

9. A.C. Edwards, "Labor Supply Price, Market Wage, and the Social Opportunity Cost of Labor," Economic Development and Cultural Change (Chicago: University of Chicago Press, October 1989) V. 38, No. 1, pp. 31-43.

10. A.C. Harberger, Project Evaluation, op.cit., Ch. 7.

    M. Todaro, "A Model of Labor Migration and Urban Employment in Less Developed Countries," American Economic Review (1969) LIX, No. 1, pp. 138-148.

11. M.P. Todaro, Economic Development in the Third World, (New York: Longman, 1989, fourth edition), pp. 62-113.

12. S.A. Marglin, op. cit., pp. 10-23.

13. C. Bailey, op. cit.

    A.C. Harberger, Project Evaluation, op. cit.

14. See Government of India: The Cabinet Secretariat, The National Sample Survey, No. 33: Wages, Employment and Indebtedness of Agricultural Labor Households in Rural Areas, (Delhi, 1960) pp. 18, 23, 61.

15. S.A. Marglin, op. cit., pp. 10-23.

16. A.C. Harberger, Project Evaluation, op. cit., p. 160.

17. Several of the examples are based upon work done by G.P. Jenkins and M.B. El-Hifnawi in Economic Parameters for the Appraisal of Investment Projects: Bangladesh, Indonesia and the Philippines (Manila: Asian Development Bank, 1993).

18. A.C. Harberger, "The Social Opportunity Cost of Labor," op.cit..

19. G.P. Jenkins and C.Y. Kuo, "On Measuring the Social Opportunity Cost of Permanent and Temporary Employment," Canadian Journal of Economics, (1978) XI, No. 2, pp. 220-239.

    G.P. Jenkins and C. Montmarquette, "Estimating the Private and Social Opportunity Cost of Displaced Workers," The Review of Economics and Statistics, (1979) LXI, No. 3, pp. 342-353.

20. R. Broadway and F. Flatters, "The Efficiency Basis for Regional Employment Policy," Canadian Journal of Economics, (1981) XIV, No. 1, pp. 58-77.

21. This example is explained in greater detail in G.P. Jenkins and C.Y. Kuo, op. cit., pp 225-227.

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