COST-BENEFIT ANALYSIS FOR INVESTMENT DECISIONS, CHAPTER 12:

THE ECONOMIC OPPORTUNITY COST OF LABOR

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ABSTRACT

The concept of economic opportunity cost is derived from the recognition that when resources are used for one project, opportunities to use these resources are sacrificed elsewhere. 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. 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 chapter we will examine how the EOCL is estimated in an economy that contains markets for many different types of labor occupations, with variations by region, by quality of employment opportunities (e.g., pleasant, unpleasant, permanent, temporary, etc.) that affect the EOCL used by a project.

CHAPTER 12

THE ECONOMIC OPPORTUNITY COST OF LABOR

12.1   Introduction

The concept of economic opportunity cost is derived from the recognition that when resources are used for one project, opportunities to use these resources are sacrificed elsewhere. 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 chapter we will examine how the EOCL is estimated in an economy that contains markets for many different types of labor occupations, with variations by region, by quality of employment opportunities (e.g., pleasant, unpleasant, permanent, temporary, etc.) that affect the EOCL used by a project. We focus primarily on the conditions and distortions in the labor market and do not at this point bring into the discussion the potential impacts which employment of domestic labor might have on the market for savings or foreign exchange.[2]

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

[2] 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 three observations. First, most of the labor hired by our project would have been employed elsewhere in the absence of the project. Second, the overall level of national savings is fundamentally determined by macroeconomic and the public sector budgetary conditions. Third, 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 from a project, warrants considerable caution. If, however, a particular project is deemed to have a measurable impact on savings, and there is an externality associated with this impact, then the value of this externality should be included in the evaluation of the economic NPV of that project. 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. 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 benefits and costs of the project.

A labor externality (LE_i) is created for any project, when the economic opportunity cost of labor ($EOCL_i$) differs from the wage rate (Wp_i) paid to the labor by the project. This externality can be expressed for a specific type of labor (i) as:

$$LE_i = Wp_i - EOCL_i \qquad\qquad (12.1)$$

When LE_i is positive, then the financial cost of labor will be greater than its economic cost, and vice versa. As we will see from this analysis, the magnitude of this externality is a function of more variables than just the rate of unemployment in the relevant labor market for this class of workers. It will also depend on other distortions in the labor market such as taxes, unemployment insurance and protected labor market segments. We also find that it will be affected by the quality of the job created. The magnitude of this externality is one factor causing the economic performance of a project to diverge from its expected financial outcome.

12.2 Alternative Approaches to Estimating the Economic Opportunity Cost of Labor

In estimating the EOCL two alternative starting points for the analysis of this variable may be chosen: (i) value of marginal product of labor forgone, and (ii) supply price of labor. 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 Forgone Approach

The value of marginal product of labor forgone for labor hired by a project is determined by starting with the gross-of-tax alternative wage (W_a) that the labor hired for that project would have earned in its absence. In most cases, there will be at any future point in time an estimated distribution of the labor activities in the presence of the project, and an alternative distribution in its absence. Normally, the differences between these two allocations will sum to zero, especially if leisure and involuntary unemployment are counted among the relevant activities.

This means that the net reductions in labor allocated to other activities must add up to the amount of employment provided by the project. If one works strictly with Forgone marginal product, the opportunity cost of labor for the project would simply be the weighted sum of the Forgone marginal products of labor of all different types sourced from the various activities.

This method is not well adapted to taking differences in the underlying working living and conditions that do not directly reduce output elsewhere in the economy.[3] Historically, some economists have argued that the value of the 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. 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. Using the assumption that the value of the marginal product Forgone is zero when hiring unemployed workers, this approach leads to an underestimation of the EOCL and the estimate does not reflect the true economic costs of the project using the labor.[4]

(ii)   Supply Price of Labor Approach

An alternative method, based on the supply price of labor is more straightforward and easier to use under a wide variety of conditions.[5] The starting point of this analysis is the market wage (the supply price) required to attract sufficient people of the required skill level to work on the project. 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 will account 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 forgone wage and the compensation for the economic costs inflicted by the relatively bad living conditions. Of course, the supply

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

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

price should be adjusted further to account for other distortions, such as taxes, to arrive at the EOCL. But unlike the marginal product Forgone approach where one must measure both of these components separately, the local supply price directly captures in a combined package the wage and the non-wage costs of employing labor on the project.

In practical terms, the supply price of labor can be determined by asking the question - what is the minimum wage the project must pay to get an adequate number of applicants to work for this project with an acceptable turnover rate? This can often be done by informally surveying workers near the location of the project or using a more formal assessment of the prevailing wage in that activity. To test whether the wage rate being paid by a project is the minimum supply price one should 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 abnormally 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 low, it indicates a fairly tight labor market and the turnover rate is high for the type of skill required; 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 relevant distortions (such as income taxes or subsidies). 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 chapter.

To compare these two methods in calculating the EOCL, let us consider the example of unskilled farm workers who have decided to move from their alternative jobs of cutting sugar cane (c) to work on a new project in a more pleasant place (o) harvesting oranges.

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[5] Harberger, A.C., "On Measuring the Social Opportunity Cost of Labor", *International Labor Review*, (June 1971).

The starting point for calculating the EOCL using the marginal product Forgone approach would be the alternative wage on the sugar cane plantation farms (W_c), while the supply price approach would begin with the market wage for work in the orange groves (W_o). We can assume that they do 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 more pleasant climate of the orange growing region might translate into a reduced cost of living (C), 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 more pleasant 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_c = \$20.00 per day,

C_o = \$3.00 per day, C_c = \$6.00 per day,

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

Using marginal product approach, we can calculate the EOCL for the new project as follows:

$$\text{EOCL} = \text{prior wage - change in cost of living - worker preferences}$$
$$= W_C - (C_C - C_O) - S_O$$
$$= \$20 - (\$6 - \$3) - \$2$$
$$= \$15.00 \text{ per day}$$

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 ($C_C - C_O$) and worker's regional preference for the better climate (S_O). Therefore, the EOCL is simply equal to the market wage in the region where the new job is located:

$$\text{EOCL} = W_O = \$15.00 \text{ per day}$$

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's regional preferences. Uncertainties in the value of those factors make the marginal product Forgone approach cumbersome to use when information is scarce. Consequently, the straightforward supply price approach usually is an easier way to determine the EOCL.

12.3   Structure of Analysis in the Labor Market

The analysis of the EOCL presented here is structured around five sets of factors that are primary determinants in the cost of labor to the project. Labor prices can vary greatly from one project to the next, so we use the following classifications to help identify which of the determinants may have an effect on the labor costs of the project being evaluated.

1. Type of Labor (Skilled vs. Unskilled)
2. Regional Variations and Domestic Migration
3. Type of Job (Permanent vs. Temporary)
4. International Migration
5. Type of Labor Market (Protected vs. Unprotected)

First, an analytical distinction is made among skills and occupations. Classifying workers into relevant occupational categories is essential because of the enormous heterogeneity of the labor factor. In general, the lower the skill, the greater the likely homogeneity of labor within the skill or occupation category. Estimating the economic opportunity cost of unskilled labor is also made more straightforward by the frequent absence of distortions such as taxation or unemployment insurance in that part of the labor market. The skilled labor market, on the other hand, displays much greater heterogeneity and 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, and access to consumer goods and amenities also affects the EOCL for a project. Regional wage

differentials are a key consideration in the labor market where a rise in project employment in an urban setting has as its counterpart reductions of employment in rural areas that are traditional sources of migration. In such cases, distortions in the economy related to that migration must be accounted for when estimating the EOCL.

Third, one may also have to take international migration into account. This includes the case where the creation of jobs will retain workers who would have otherwise gone abroad or alternatively the case where foreign skilled workers are brought into the country to perform certain services.

Fourth, the estimation of the EOCL for a project must consider whether permanent or temporary employment will be created. Temporary positions in sectors such as 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 the EOCL should take into account.

Fifth, the rigidities imposed on the labor market through minimum wage laws, restrictive labor practices, high wage policies of state and multinational enterprises in some countries tend to create "protected sectors" in the labor market. In such a situation quasi voluntary unemployment and seasonal unemployment are common. In such situations the evaluations of the EOCL used by a project should reflect these special labor market conditions.

These five classifications within a labor market provide a framework for analyzing the complex concept of EOCL. In the rest of this chapter, we will begin by analyzing the EOCL for the simplest cases, i.e., unskilled rural labor, and then bring additional elements into account as they are needed in order to estimate the economic opportunity cost of labor for progressively more complex types encountered in the appraisal of actual projects.

12.4   The Economic Opportunity Cost of Unskilled Rural Labor

Some well-known growth models of underdeveloped countries have often taken the most extreme interpretation of the "marginal product forgone" hypothesis by placing a value of zero on the economic opportunity cost of unskilled labor in rural areas.[6] As previously explained, those theories rely upon the assertion that because of a large quantity of unskilled rural workers, there is no economic opportunity cost to filling additional jobs.[7] 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. In this circumstance, the prevailing daily or weekly wage rate (the supply price of unskilled labor) is a reflection of the marginal productivity of this type of activity. Therefore, we can utilize the market wage as an effective measure of the value of the forgone marginal product of unskilled labor.[8]

When using the supply price of labor approach to calculate the EOCL, there is a series of steps which serves as a guide to the estimation process. The first step is to determine the minimum gross-of-tax wage (W) 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 such distortions.

To demonstrate this process, two cases will be considered. In the first case, there are no seasonal variations in either the market wage rate or the demand for unskilled workers. The second example demonstrates how to estimate the EOCL when there are seasonal variations in the market wage rate and in the project's demand for unskilled labor over the year.

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

[7] Marglin, S.A., op.cit. pp. 10-23.

[8] Harberger, A.C., "On Measuring the Social Opportunity Cost of Labor", *International Labor Review*, (June 1971).

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 by the worker (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 (W^s) is always equal to the prevailing market wage (W). Since there are no distortions, there is no need to make further adjustments to the market wage to estimate the EOCL. Consequently, the market wage rate for unskilled labor is the supply price of labor, which in turn is the economic opportunity cost of labor as shown in equation (12.2).

$$\text{EOCL} = W = W^s \tag{12.2}$$

Note that the EOCL is estimated using the market supply price (W^s) not the project wage (W_p). 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 than the market wage, then the difference is an economic externality which arises from the employment of this type of labor.

In the second case, the estimation of the EOCL of unskilled labor is done for a project which demands workers throughout the year while the market wage varies due to demand and supply factors affecting the local labor market. Using the supply price approach, we begin again with the market wage of unskilled labor for this type of project. There are no tax distortions. Due to the seasonal fluctuations in the market wage the economic opportunity cost of labor at any point in time will be calculated by the market wage rate (W_t) that corresponds to the period of time in which labor is hired by the project.

For example, if a region growing rice and sugar cane has a wage rate of $5 per day during the off-season, it is possible that the wage could be many times higher during the harvesting seasons if they coincide. If a project is built based on the assumption that labor will be steadily available at $5 per day, but instead it must compete for labor at a much higher rate during the harvest season, then the financial and economic viability of the project may be endangered.

These higher seasonal labor costs must be accounted for to arrive at an accurate estimate of the EOCL for the project. So too, seasonal variations in the size of the employed work force should be reflected in the calculation of the wage. It is a common condition in rural areas that both the demand for unskilled labor and the market wage rate have pronounced seasonal patterns as illustrated in Figure 12.1. Equation (12.2) deals with this situation by defining the total economic cost of labor used by a project over a year as the product of the quantity of labor hired in each season or wage period times the corresponding market wage rate (supply price) for the period. This is equal to the sum of the unskilled wage rate for each particular season or wage period (W_t) times the total amount of unskilled labor employed by the project in that period (L_t):

$$\text{EOCL} = \sum_{t=1}^{n} (L_t W_t) \tag{12.3}$$

where 't' denotes the period of time and 'n' denotes the total number of periods.

Figure 12.1: Effect on the Economic Opportunity Cost of Labor of Seasonal Variations in Wages and Labor Demand in Rural Regions
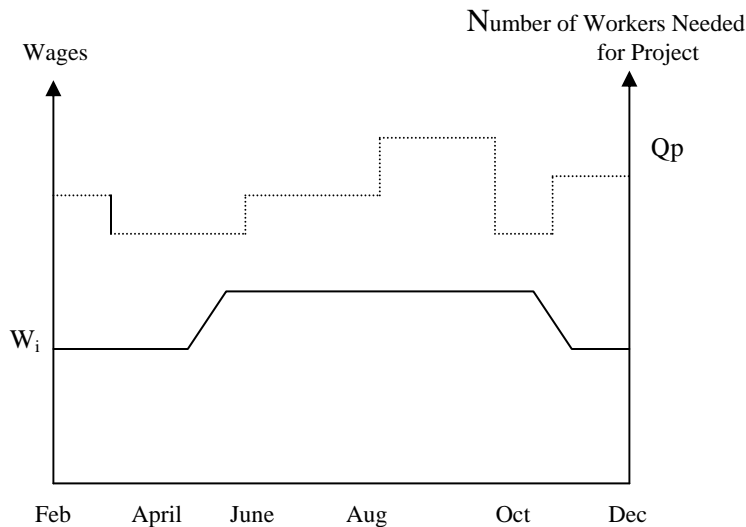
Where

.... Pattern of project's demand for labor during the year
———————— Pattern of wage rate for unskilled labor during the year

If the project's demand for labor is relatively high in the off-season, then the total economic cost of labor will be lower than if the project's demand for labor coincides with the seasonal peak demand for this labor.

Consider the case of undertaking a labor-intensive sugar project.[9] The project requires unskilled workers on a temporary basis and pays a wage of $180 per month ($W_p$). The working conditions are identical to those prevailing in the labor market. Table 12.1 shows the project's monthly requirements for people in column (3) and the monthly market wage rates in column (2) that labor would be willing to work for on this project.

Table 12.1

Market Wages and Project Demand for Seasonal Labor

Month	Market Wage ($/month)	Person-months Required by project	EOCL for Period ($)
(1)	(2)	(3)	(4)
January	120	18	2,160
February	100	18	1,800
March	180	18	3,240
April	180	9	1,620
May	100	9	900
June	150	0	0
July	180	0	0
August	120	0	0
September	150	0	0
October	110	0	0
November	150	9	1,350
December	180	9	1,620
Total	-	90	12,690

In this case, the monthly market wage rates are the supply prices of unskilled labor to the sugar project. Then using equation (12.3) the EOCL is calculated as follows:

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[9] Examples are based upon work done by Jenkins, G.P. and El-Hifnawi, M.B. in *Economic Parameters for the Appraisal of Investment Projects: Bangladesh, Indonesia and the Philippine*, Manila: Asian Development Bank, (1993).

$$\text{EOCL} = \sum_{t=1}^{n=12} (L_tW_t)$$

$$= 120*18 + 100*18 +\dots + 150*9 + 180*9$$

$$= \$ \ 12,690$$

The project wage (W_p) paid does not play a direct role in the estimation of the economic opportunity cost of labor. The wage paid by the project is the financial cost to the project. The difference between the financial cost and the economic opportunity cost is the value of the labor externality.

12.5   The Economic Opportunity Cost of Skilled Labor

Skilled labor is not a homogeneous factor, nor is the financial cost and economic opportunity cost going to be the same for all types of such labor. There is no doubt that securing adequate supplies of labor with the appropriate skills is a key determinant of the success of most projects. Post-evaluations of development investments have demonstrated that projects are often seriously delayed or even abandoned because of an inadequate supply of labor with specific skills. Hence, special attention needs to be paid to the determination of the sources of supply, levels of compensation, and potential distortions in these labor markets.

To meet a project's requirements, labor are often induced (with higher wages and better living environment) to migrate from other areas. For example, skilled workers in urban areas are able to obtain many goods and services, such as better education for their children that are more readily available in the city. If called up to move from an urban to a rural area, they may well require a wage premium to be paid, in spite of the fact that simple food items are cheaper in the countryside.

The supply price approach for determining the economic opportunity cost of labor for skilled occupations 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 workers to the project.

Then, distortions to that wage are identified and quantified. The EOCL can be estimated by adjusting W^s to account for those distortions.

To demonstrate this approach, we will estimate the EOCL for three situations. The first example is simplified by using the somewhat unrealistic assumptions that there are no distortions in the market for labor and that the project provides jobs with the same working conditions as other employers of these occupations 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 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 any particular type of skilled labor.

(i)   Labor Market without Distortions or Regional Migration

If there are no distortions in the market such as income tax on the wages for a given occupation, and if the employment provided by the project has the same working conditions as 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) which is the supply price (W^s).

This is exactly the same result as in the case of the unskilled rural labor. In fact, the analysis of the EOCL is not differentiated so much by the skill level of the worker as by the nature of the distortions in the labor market. In the case of skilled occupations it is more realistic to assume that we will have to pay a higher wage to attract such labor away from other jobs that have different working conditions and/or are located in other regions which have distorted labor markets.

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

Suppose a project hires labor, and some of the workers are induced to migrate from alternative employment in other labor markets. For each occupational type the project pays a wage equal or higher than the gross-of-tax supply price (W_g^S) to attract adequate numbers of workers. As demonstrated by Figure 12.2, the migration of workers from the other regions to the project will shift the labor supply curve leftward to the new position S'S' from SS. This shift intersects the demand curve (DD) at a higher equilibrium wage rate at B from A, causing a decrease in the demand for the current employment from Q_0 to Q_1.

Figure 12.2: Regional Interaction between Skilled Labor Markets
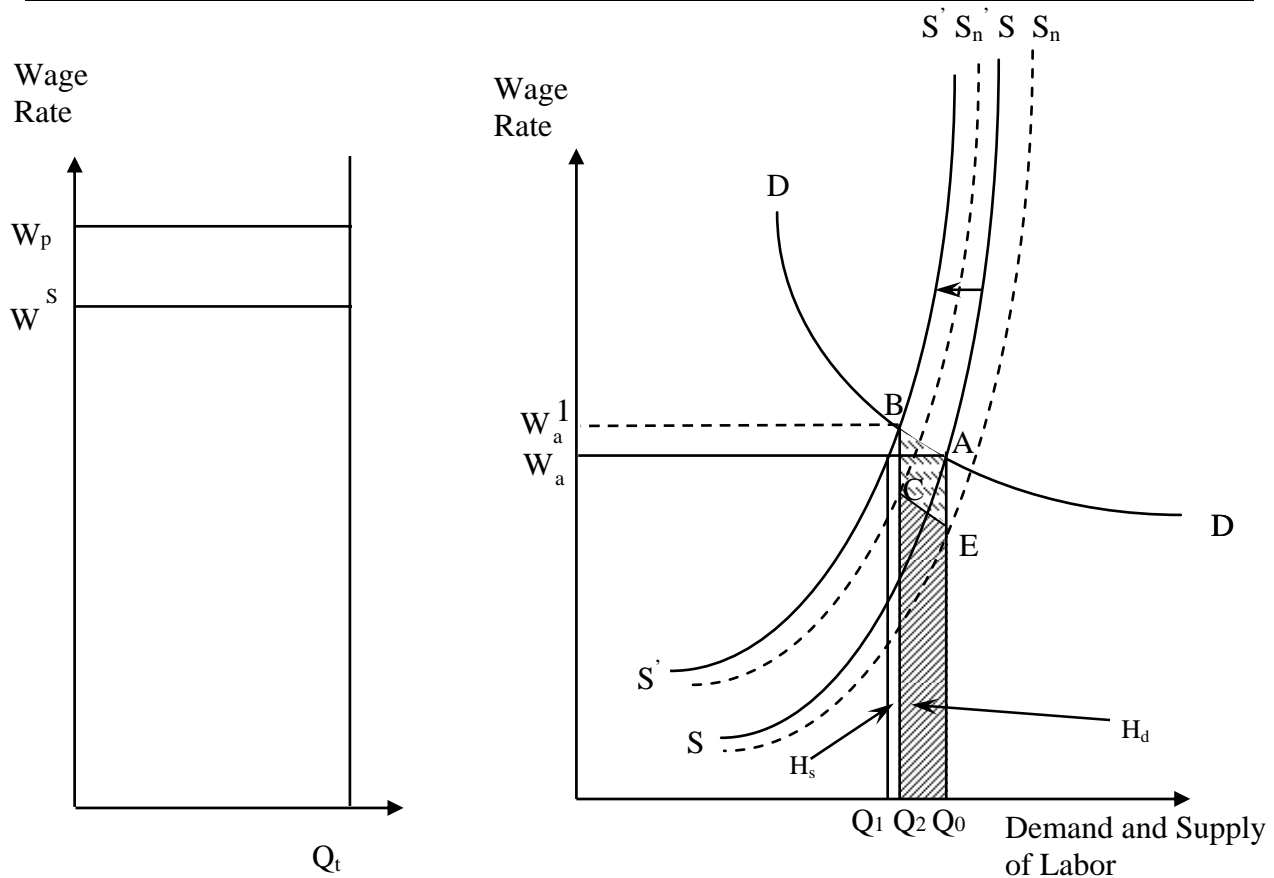
Quantity of Labor Required for Project

Market for a Type of Skilled Labor in Sending Region

$$H_s = \frac{Q_2 - Q_1}{Q_0 - Q_1} \qquad H_d = \frac{Q_0 - Q_2}{Q_0 - Q_1}$$

At the same time, the higher wage rate may induce some skilled workers to enter the formal labor force, or more overtime to be worked, thereby increasing the quantity of skilled labor supplied from Q_1 to Q_2. The net effect is that even if all of the labor for the project migrates from the sending regions, a proportion of the labor (H_S) ultimately comes from the newly induced supply and a proportion (H_d) comes from the reduced demand for workers elsewhere.[10]

The reduction in the quantity of labor employed elsewhere (i.e., $Q_0 - Q_2$) results in a loss of personal income taxes to the government, which is shown as the area bounded by ABCE that is also the same as the area measured by the vertical difference between the gross-of-tax supply curve, SS, and the net-of-tax supply curve, $S_n S_n$, multiplied by the change in employment ($Q_0 - Q_2$). When calculating the EOCL, only the tax loss resulting from the reduced demand (H_d) need to be accounted for, because we assumed that the increased supply (H_S) of labor is coming from market or non-market activities where there are no taxes or other distortions. Thus the EOCL for the project in such cases is the gross-of-tax supply price (W_g^S) of workers induced to move to the area minus the difference between the income taxes the workers would pay on this gross-of-tax supply price of labor ($W_g^S T$), which are gained by the government, and the income taxes previously paid by the workers in their alternative employment ($H_d W_a T$), which are lost by the government. For simplicity, we assume the tax rates this worker pays on the supply price and alternative wage in the sending region are the same although they don't have to.

The economic cost of skilled labor hired by the project in the area can be expressed as follows:

$$EOCL = W_g^S - (W_g^S T - H_d W_a T) \tag{12.4}$$

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[10] For a further development of some of these issues, see Bell, Clive, "Regional Heterogeneity, migration, and shadow prices", *Journal of Public Economics*, North-Holland, Vol. 46, (October 1991); and Gemmel, N. and Papps, I., "The Shadow Wage in Economies with Migrant Labor: The case of Labor as a Traded Good", *The Manchester School*, Vol.60, No. 1, (1991).

where H_d denotes the proportion of the project's demand for labor obtained from taxed employment activities in the alternative labor market;

W_a denotes the gross-of-tax wage of labor from alternative sources;

W_g^s denotes the gross-of-tax supply price of labor; and

T denotes the income tax rate levied on workers in all regions.

In this situation, $H_S = (1 - H_d)$ includes both the supply of labor coming to the region from untaxed market and non-market activities, as well as increases in the labor force participation and the number of hours worked. While it is theoretically possible for a project to change the level of labor force participation or the number of hours worked, this effect over the lifetime of a project is likely to be small, depending upon the type of skill and the market at the time of project recruiting.

Consider again the sugar project discussed above. In addition to the unskilled workers hired for the project, the government requires each year 1,000 person-months of labor with skilled occupations. Due to a shortage of such workers in this region, the project will have to attract them from the urban areas surrounding the region where the project is located. Let us assume that despite the fact that these workers earn a monthly gross-of-tax salary (W_a) of $900 in the urban area, they will not work for less than $1,200 gross-of-tax for the project (W_g^s). These wage rates reflect the gross-of-tax supply prices of the workers in the two markets, respectively. Suppose there is a policy of encouraging more workers in these occupations to migrate to the rural areas, so the project is required to pay a higher salary (W_p) of $1,500 per month for such labor, or $300 more than the supply price. All skilled workers pay 20% of their wages in income taxes.

Using equation (12.4), we can estimate the economic opportunity cost of this 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 Forgone by the workers in their alternative employment.

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

$$W_g^s T = 1,200 \cdot (0.20) = \$240/\text{month}$$

(2) *Taxes Forgone in Alternative Employment*

Let us assume that the supply of labor in these occupations in the economy is relatively inelastic as compared to the demand for that labor and let $H_d = 0.90$ and $H_s = 0.10$. Hence, we can anticipate that approximately ninety percent of the project's labor requirements will ultimately be sourced from the decrease in the quantity of labor employed elsewhere, while the remaining ten percent of the project's needs will be met through increased labor force participation due to the new project's higher wage. The forgone taxes from the previous employment of the workers are calculated as follows:

$$H_d W_a T = 0.90 * 900 * 0.20 = \$162/\text{month}$$

Combining those two parts with the supply price, the economic opportunity cost of the labor used by the project in this rural area is calculated from equation (12.4) as follows:

$$\begin{aligned}
\text{EOCL} &= W_g^s - (W_g^s T - H_d W_a T) \\
&= 1,200 - [(1,200 * 0.20) - (0.90 * 900 * 0.20)] \\
&= \$1,122/\text{month}
\end{aligned}$$

The difference between the economic opportunity cost of labor and the project wage represents the value of the project's labor externality per month of labor employed. Following equation (12.1), the labor externality for the above case can be expressed as:

$$\begin{aligned}
\text{LE}_i &= W_p - W_g^s + (W_g^s T - H_d W_a T) \\
&= W_p(1 - T) - W_g^s(1 - T) + W_p T - H_d W_a T
\end{aligned}$$

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 can be calculated as follows:

$$\text{Labor benefits} = W_p(1 - T) - W_g^s(1 - T)$$
$$= 1{,}500 \cdot (1 - 0.20) - 1{,}200 \cdot (1 - 0.20)$$
$$= \$240/\text{month}$$

$$\text{Government benefits} = W_p T - H_d W_a T$$
$$= 1{,}500 \cdot (0.20) - (0.90 * 900 * 0.20)$$
$$= \$138/\text{month}$$

Thus, of the total of externalities created per month by the employment of workers by a project, labor will gain an additional $240 per month while the government will capture $138 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.

12.6   The Economic Opportunity Cost of Labor When Labor is not Employed Full Time

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 could spend part of each year in non-market activities or unemployment. Workers now can expect to be employed in market activities for a proportion (P_p) of the year if they work for the project. If they are not associated with the project, they will be employed a different proportion (P_a) of the year. 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, i.e., $(1 - P_p)$ and $(1 - P_a)$ proportions of their labor force time, respectively.

Let us again denote the gross-of-tax supply price of skilled labor in the area of the project as W_g^S and the alternative wage, which reflects this labor's other opportunities as W_a. From the supply price approach, the EOCL is equal to the gross-of-tax expected supply price for labor (W_g^S), but only working a portion of the year on the project (P_p), minus the additional tax payments that the worker would incur if earning her supply price wage W_g^S on this project.

This additional tax is the difference between the tax paid on the project $(P_pW_g^sT)$ and the tax previously paid in the alternative mix of market activities $(H_dP_aW_aT)$. The taxes lost in alternative market activities arise because there is a net reduction in employment of this type of worker elsewhere. We assume that workers do not pay taxes on non-market activities. Using the supply price approach, the economic opportunity cost of these workers is the expected gross-of-tax supply price less the expected net change in tax payments. It can be expressed as equation (12.5):

$$EOCL = P_pW_g^S - (P_pW_g^sT - H_dP_aW_aT) \tag{12.5}$$

Suppose in this case the alternative wage rate for skilled labor is W_a = \$600/month, and the project wage is equal to the gross-of-tax supply price paid to induce labor to move to the project area $(W_g^S = W_p = \$800/month)$. The tax rate on skilled labor in all locations is 20%. All of the labor is obtained from alternative employment $(H_d = 1)$ with the proportion of time employed in the alternative areas (say, P_a = 0.8). Assuming that a skilled worker expects to be employed in the project and the project region is P_p = 0.9, the economic opportunity cost of labor in this rural project would be:

$$EOCL = 0.9 \cdot (800) - [0.9 \cdot (800) \cdot (0.20) - 1.0 \cdot (0.8) \cdot (600) \cdot (0.20)]$$
$$= 720 - (144 - 96)$$
$$= \$672/month$$

While the financial cost of labor to fill a job (which employs someone for 90 percent of the year) is estimated on average to be \$720 (= P_pW_p) per period, we find that the economic

opportunity cost of labor is only $672 per month, or $48 less than the financial cost. This difference is the net tax gain to the government.

We now extend from the analysis when workers were employed less than full time in market activities during a typical year. This is especially important in the case of countries with high unemployment compensation payments, such as Canada and the countries of Northern Europe.[11] We differentiate between those engaged in full-time employment and those who have a work history characterized by a succession of work experiences interspersed with unemployment. Because of their choice of occupation or their level of seniority, people in the permanent (or full-time) employment sector are almost never unemployed. On the other hand, workers employed by temporary sectors such as tourism and construction are in jobs that are not expected to be associated with continuous employment. For this analysis, individuals expected to experience periodic spells of unemployment or non-market time are included in the temporary labor force, both when they are working and when they are unemployed.

When evaluating projects, one further question we want to consider is what is the quality of the jobs being created?[12] We need to classify the type of job by the type of employment they provide. 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)? Temporary jobs are those that do not retain the workers for a full year but intersperse spells of unemployment or non-market activities with employment. Permanent jobs provide full-time employment year round.

The type of employment being created is important because temporary jobs can have a high economic cost when unemployment insurance payments (or other forms of social security) are paid to these workers when they are engaged in non-market activities, including being unemployed.[13] Hence, unemployment insurance needs to be accounted for in the appraisal of a project that creates these jobs.

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[11] In those countries, the unemployment benefits vary from 55% and 75% of lost wage in Canada and Sweden, respectively, to as high as 90% of the previous daily wage in Finland.

[12] Jenkins, G.P. and Kuo, C.Y., "On Measuring the Social Opportunity Cost of Permanent and Temporary Employment", *Canadian Journal of Economics*, Vol. 9, No. 2, (May 1978).

[13] Broadway, R.W. and Flatters, F., "The Efficiency Basis for Regional Employment Policy", *Canadian Journal of Economics*, Vol. 14, No. 1, (February 1981).

Let us consider first the creation of permanent jobs. When a project creates new permanent jobs, they will generally be filled by individuals already working in alternative permanent sector jobs, other temporary sector jobs, or some being hired who are currently out of the labor force. We denote these proportions as $H_d{}^p$, $H_d{}^t$ and H^s, respectively, where $H_d{}^p + H_d{}^t + H^s = 1$. For those being sourced from alternative jobs in the permanent sector, there will be an externality arising from the loss in income tax receipts from the reduction of employment in these activities. For those sourced from the temporary sector there will be a savings in the unemployment insurance now being paid to the temporary sector worker when he is unemployed. At the same time, there is a loss of any taxes he would have paid while working. For the proportion of the jobs that are filled from people who were previously out of the labor force there will be no externalities that need to be included. Therefore, the EOCL of a permanent job can be expressed as follows:

$$EOCL^P = W_g{}^S(1- T) + H_d{}^P W_p T + H_d{}^t[P_t W_t T - (1-P_t)\, fU(1 - T)] \qquad (12.6)$$

where $W_g{}^S$ denotes gross-of-tax supply price of labor to the project;

         W_p denotes gross-of-tax wage earned in alternative jobs in the permanent sector;

         W_t denotes gross-of-tax wage earned in the temporary sector;

         P_t denotes proportion of time a member of the temporary sector worker expects to be employed during a calendar year;

         T   denotes personal income tax rate;

         f   denotes proportion of time an unemployed worker expects to collect unemployment benefits; and

         U   denotes unemployment insurance benefits.

If there is no unemployment insurance (like in Indonesia or Vietnam), then $f = 0$. Equation (12.6a) will then measure the opportunity cost of labor to fill a permanent job as:

$$EOCL^P = W_g{}^S(1 - T) + H_d{}^P W_p T + H_d{}^t P_t W_t T \qquad (12.6a)$$

On the other hand, when a year's worth of additional employment is created in the temporary sector of a labor market, these workers will be sourced from the permanent sector, the temporary sector and from those previously out of the labor force, in the proportions H_d^p, H_d^t and H^s, respectively. In this situation, suppose P_t is the proportion of time that any one person actually works in a temporary sector job during a year. As temporary jobs are created, and people are attracted to them from the permanent sector, these people will now experience periods of unemployment and collect unemployment insurance. For each period of labor services sourced from the permanent sector, there will be associated with it $1/P_t$ individuals and $(1-P_t)/P_t$ periods of unemployment. This will give rise to $(1-P_t)/P_t$ periods of paid unemployment insurance compensation. For labor services sourced from those already in the temporary sector then the loss in taxes will be for the same length of time as the time working on the project, and the amount of unemployed time and unemployment insurance compensation will also be the same as before. The economic opportunity cost of labor related for a year's worth of temporary sector jobs will then be equal to:

$$EOCL^T = W_g^s(1-T) + (H_d^p/P_t)[W_pT+(1-P_t)fU(1-T)] + H_d^tW_t(T) + H^s[(1-P_t)/P_t]fU(1-T) \quad (12.7)$$

In the case where the wage rates paid for both temporary and permanent jobs were the same, then the economic cost of (12 months) of temporary jobs would be greater than for a year of a permanent job because of the greater amount of taxes that would be lost and the greater amount of unemployment insurance payments associated with these jobs.

12.7 International Migration and the Economic Opportunity Cost of Labor

Until recently, labor has been considered a non-internationally traded service. However, this is changing as more and more workers are relocating to other countries to sell their skills and services. There are two such cases, one is retention or returned migrants and another is foreign workers.

(i) Retained or Returned Migrants

This is particularly true for countries such as the Philippines, Egypt and Sri Lanka where large numbers of skilled and semi-skilled workers are regularly employed abroad for substantial periods of time. In such a situation when a project is created inside the country and additional labor of certain occupations is hired, we would expect to find a part of this labor to be sourced from a reduction in the outflow of international migration. When this occurs the economic opportunity cost of labor must not only take into consideration the adjustment of the demand and supply of labor in the local markets, but also any distortions associated with the retention or return of migrants who would have been employed abroad.

It is quite common when a country's citizens work abroad for them to send back a stream of payments in the form of personal savings or remittances to relatives. Following the supply price approach to the EOCL, the reduction in remittances is not an economic cost, as they will be factored into the worker's supply price to the project. However, adjustments need to be made to the supply price, as the foreign remittances are spent locally to generate additional consumption taxes such as VAT and also the remittances are made in foreign exchange in which a foreign exchange premium exists in most countries. Taking both the local and international labor markets adjustment into account the expression for the EOCL becomes,

$$\text{EOCL} = W_g^s(1 - T) + H_d W_a T - H_f R t_{VAT} + H_f R \left(\frac{Ee}{Em} - 1\right) \tag{12.8}$$

where H_d denotes proportion of the project's demand for a given type of labor obtained from taxed employment activities in the domestic market;

H_f denotes proportion of the project's demand for a given type of labor sourced from reduced international out-migration;

t_{VAT} denotes value-added tax rate levied on consumption;

R denotes the average amount of remittances (measured in local currency) that would have been made per period if this type of worker had been employed abroad; and

$\left(\frac{Ee}{Em} - 1\right)$ denotes rate of the foreign exchange premium as a fraction of the value of amount that would otherwise have been remitted.

When we recognize that part of the sourcing of the workers for a project is through an adjustment in the international migration of workers, we recognize that there are the share of workers being sourced from alternative domestic activities (H_d = 0.6), and the proportion sourced from changes in international flows of labor H_f = 0.3. Let us consider the same example in Section 12.5 and the VAT rate is 15%. Also assume that on average these workers would have remitted $500 per period, and the foreign exchange premium is 6 percent. Applying equation (12.8) we find that the EOCL is as follows:

$$\text{EOCL} = W_g^S (1 - T) + H_d W_a T - H_f R t_{VAT} + H_f R \left(\frac{Ee}{Em} - 1 \right)$$

$$= 1{,}200 \cdot (1 - 0.2) + 0.6 \cdot (900) \cdot 0.2 - 0.3 \cdot (500) \cdot (0.15) + 0.3 \cdot (500) \cdot (0.06)$$

$$= \$1{,}054.5$$

The EOCL of $1,054.5 is less than it was previously, both because it is assumed that the potential migrant labor would not remit to the project country as much as they would have earned domestically, and the rate of foreign exchange premium is less than the assumed rate of domestic personal income tax.

(ii)   Foreign Labor

In countries where the labor shortage is particularly acute, it may be necessary to import foreign labor to work on projects. Examples of this practice can be seen in both developing and developed countries where the demand for labor exceeds the supply. Often foreign workers are brought into the country by corporations or governments to work on projects requiring their skills. In developing countries this often takes the form of skilled advisors or technical staff, while in developed countries guest workers or unskilled laborers are imported to fill gaps in the labor pool. There is an economic opportunity cost associated with this foreign labor ($EOCL^f$) which should be included in the project assessment.

The $EOCL^f$ is the net-of-tax wage paid to the foreign worker plus adjustments to the amount of foreign exchange associated with the repatriated portion, and adjustments to the amount of value-added tax (VAT) associated with consumption by the foreign workers using the non-

repatriated portion of that wage, plus any subsidies the foreign workers may benefit from while in the country. The repatriated portion of the wage should be adjusted to account for the true cost of the foreign exchange to the economy rather than just its market value. This is necessary because the value of the foreign exchange may be distorted. While living in the country, foreign workers have to use a portion of their wage for consumption. The incremental amount of VAT revenue paid due to the foreign workers' consumption in the country should be accounted for as an economic benefit to the country as the country gains from the local consumption of the foreign workers. At the same time, foreign workers may benefit from government subsidies on a variety of items such as food, fuel, housing or health care. The amount of benefit foreign labor gets from those subsidies should be accounted for as an economic cost to the country. Algebraically, the economic opportunity cost of foreign labor can be expressed as:

$$EOCL^f = W^f(1 - T_h) - W^f(1 - T_h)(1-R)t_{VAT} + W^f(1 - T_h)R\left(\frac{Ee}{Em} - 1\right) + N \qquad (12.9)$$

where W^f denotes gross-of-tax wage of foreign labor;

T_h denotes personal income tax levied by the host country on foreign labor;

t_{VAT} denotes value-added tax rate levied on consumption;

R denotes proportion of the net-of-tax income repatriated by foreign labor;

E^e denotes the economic cost of foreign exchange;

E^m denotes market exchange rate; and

N denotes value of benefits gained by foreign workers from subsidies.

If the $EOCL^f$ is greater than the financial cost of labor to the project, then the second term must be smaller than the sum of the third and fourth terms implying that the economic benefit created by foreign consumption in the country can not offset the foreign exchange premium related to the remitted portion of their wage and the cost of government's subsidies. In this case, the economic opportunity cost of hiring foreign labor will be greater than the project wage. If the second term is greater than the third and fourth terms, however, the economic opportunity cost of foreign labor will actually be lower than the market wage, which means that the country is benefiting economically from the presence of foreign labor.

Suppose a multinational corporation considers an electronic assembly project in an urban area and discovers that there is insufficient local labor. It decides to import skilled workers from a nearby country to operate the project until enough local workers could be trained for the production requirements. The shortfall estimated to be equivalent to 50 workers who will be paid $200 per month. That wage will be subject to a 25% personal income tax. Each worker is expected to repatriate 30% of her net-of-tax income to support family members at home. The VAT rate is 15%. The market exchange rate is held constant by the government while the economic exchange rate is estimated to be 6% higher than the market value. In this case, we assume that there are no subsidies paid by the government with respect to these workers, i.e., $N = 0$.

Applying those values to the equation (12.9), we estimate the economic opportunity cost of foreign labor to be:

$$EOCL^f = 200 \cdot (1 - 0.25) - 200 \cdot (1 - 0.25) \cdot (1-0.30) \cdot (0.15) + 200 \cdot (1 - 0.25) \cdot (0.30) \cdot (0.06)$$
$$= \$136.95/month$$

This analysis shows that the economic opportunity cost of each worker will be $63.05 less than the gross-of-tax wage of $200. Hence, a substantial external benefit is generated by this use of foreign labor.

12.8   Effects of a Protected Sector on the Economic Opportunity Cost of Labor

Until now our analysis has focused on estimating the EOCL in competitive labor markets. In many countries, however, there is a segmentation of the urban labor market between a protected sector and an unprotected or open sector.[14]

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[14] In the discussion of the EOCL for the protected sector we begin with the approach followed by Edwards, A.C., "Labor Supply Price, Market Wage, and the Social Opportunity Cost of Labor", *Economic Development and Cultural Change*, Vol. 38, No.1, (October 1989). See also, Bicak, H.A., Jenkins, G.P., Kuo, C.Y. and Mphahlete, M. B., "An Operational Guide to the Estimation of the Economic Opportunity Cost of Labour in South Africa", *South African Journal of economics*, Vol. 72:5, (December 2004).

The protected sector is usually made up of the government agencies, foreign companies, and large local firms which provide wages (W^P) above the market clearing wage. The higher wages offered by these types of employers are often the result of stricter compliance with minimum wage laws, powerful unions which are able to demand and get significantly higher wages, government policies that give higher wages to civil servants, or foreign companies which pay high wages to decrease possible resentment by workers and politicians in the host country. Consequently, employment in 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 market place where there are fewer barriers to entry, lower wages and less security of employment. While workers may be initially attracted to this labor market by the hope of finding a job in the protected sector, they often end up working in the open labor market.

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. 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 by the open labor market. This unwillingness to work at the open market wage creates sub-sectors in the labor market where quasi-voluntary and search unemployment exists.

(i)   *EOCL in the Protected Sector and No Migration*

The characteristics of unemployment in this situation are shown in Figure 12.3A. If the overall supply of labor to the market is given by the supply curve (SS^T), the total number of workers making themselves available for work at the protected sector wage of W_1^P is shown as point C. The number of protected sector jobs available is much more limited at Q^P (i.e., BC). Hence, there is an excess supply of labor available at the protected sector wage, as shown by the quantity B. If the selection of workers for employment in the protected sector is

done in a random fashion from the available workers, independent of their supply prices, it follows that the supply of labor available to the open market will be a fraction (B/C) of the total labor supply SS^T at each wage rate. This labor supply is shown as the curve SS^O.

To simplify our analysis for this case, we assume that the demand for labor in the open sector is perfectly elastic at a wage rate of W^O, intersection of the demand for labor in the open sector ($W^O D^O$) with the supply (SS^O) determines the quantity employed in the open market. This quantity is indicated by point A^1. The quantity of labor classified as unemployed (Q^{QV}) is determined from the difference between points A^1 and B. These quasi-voluntary unemployed are those workers that will 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). They actively seek jobs in the protected sector, and will consider themselves involuntarily unemployed. They are seeking work which will pay the protected sector wage (W_1^P), but are unable to find it.

If we add a project to the protected sector, then as shown in Figure 12.3B, the size of the protected sector increases from (C-B) to (C-B^1). If again these additional workers (B-B^1) are selected randomly from those remaining who want to work in the protected sector, the supply of labor to the open market will now shift to the left from SS^O to SS^1. The number of workers willing to take jobs in the open sector will fall from A^1 to E. When we attract workers from the unemployed and open sectors in proportion to their numbers in the labor pool, in the absence of any distortions, then 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 [($W^O + W_1^P$)/2]. The relevant weights are the proportions that people in each of those categories will be chosen for the protected sector jobs. Under a random selection method, the weights are the fraction that the open sector employment is of the total supply of labor not working in the protected sector (A^1/B), and the fraction that the quasi-voluntary unemployed is of the total labor force not working in protected sector, (B-A^1)/B. Hence, the EOCL for protected sector jobs is given by the expression:

$$EOCL^P = (W^O)*(A^1/B) + [(W^O + W_1^P)/2] * [(B - A^1)/B] \qquad (12.10)$$

Figure 12.3: Estimating the Economic Opportunity Cost of Labor for Protected Sector Jobs
(One Protected Sector and $\eta = \infty$)

A

B
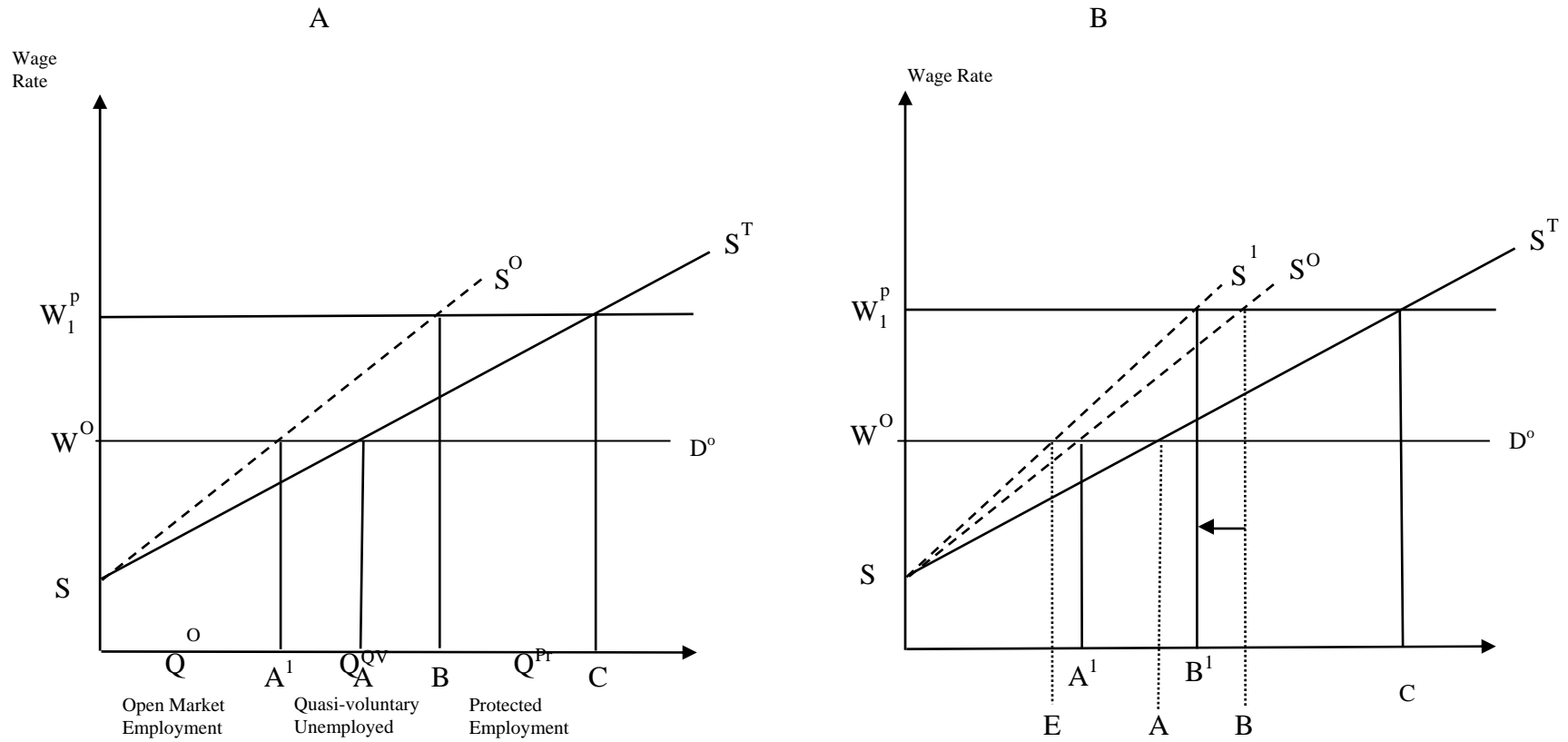
If we denote Q^O as the quantity employed in the open market, and Q^{QV} as the amount of quasi-voluntary unemployment before the creation of these additional protected sector jobs, we can write the expression for the economic opportunity cost of protected sector jobs as:

$$EOCL^P = W^O * [Q^O/(Q^O + Q^{QV})] + [(W^O + W_1^P)/2] * [Q^{QV}/(Q^O + Q^{QV})] \qquad (12.10a)$$

When income taxes are levied on wages in both the protected and open sectors, the economic cost of hiring workers from the open sector is the gross-of-tax wage they were earning in the open sector W^O, because the taxes on this labor will now be lost. For the quasi-voluntary unemployed hired by the protected sector, their economic opportunity cost is still the average of the net-of-tax open and protected sector wages because they pay no taxes when unemployed. To account for these lost taxes, equation (12.10a) can be rewritten as follows:

$$EOCL^P = W^O [Q^O/(Q^O + Q^{QV})] + [((W^O + W_1^P)/2)(1-T)][Q^{QV}/(Q^O + Q^{QV})] \qquad (12.10b)$$

(ii)   EOCL with Two Protected Sectors

More realistically, one can think of the protected sector as containing a series of segmented markets, with different protected sector wages, W_1^P, W_2^P, .. , W_i^P. Figure 12.4A portrays the same labor market that we dealt with above with one protected sector. To simplify the analyses somewhat, we assume that the demand for labor in the open sector is perfectly elastic. Furthermore, we assume that there are no distortions in the labor market (i.e. taxes and subsidies).

As we have seen previously, when the first protected sector is introduced at a wage of W_1^P the total number of workers making themselves available for work at the protected sector wage will be given at point C. After the jobs in the first protected jobs are filled, the total number of workers employed in the open sector is given by point A^1 in Figure 12.4B. Suppose now additional protected sector jobs are created where the wage (W_2^P) paid is higher than the open wage, but below that of the first protected sector. For the moment also assume that there are

no income taxes. Given the existence of (C-B) jobs in the first protected sector, now a total of G workers would be willing to work in the second protected sector. This is shown in Figure 12.4B, by the intersection of the labor supply curve SS^O and the wage of W_2^P.

The quantities of labor working, respectively, in the first and second protected sectors are given by C-B and G-F. With the introduction of the second protected sector, which hires workers in a random fashion from those willing to work at the wage offered, the quantity of workers employed in the open sector falls from A^1 to H. This contraction comes about because some open sector workers are fortunate enough to be selected for a protected sector job. Similarly, the amount of quasi-voluntarily unemployed falls from $(B-A^1)$ to $(B-G) + (F-H)$. The quantity (B-G) would be willing to work for the protected wage of W_1^P, but none of this group would be willing to work for anything less than W_2^P. Thus, the quantity (F-H) would be willing to work for a wage of W_2^P, but none would work for the open market wage W^O.

In these circumstances the economic opportunity cost of labor in the second protected sector is the weighted average of the open wage (W^O) for those sourced from the open sector, and the average of the open sector wage and the second protected sector wage $(W_2^P + W^O)/2$ for those sourced from the quasi-voluntarily unemployed who are willing to work in this sector. The weights are the shares of the quantity of open sector workers to the total quantity of labor available at a wage of W_2^P (i.e., A^1/G), and the quantity of quasi-voluntarily unemployed to the same total quantity available, (i.e., $(G- A^1)/G$). Hence, the economic opportunity cost of the second protected sector jobs can be expressed as:

$$EOCL_2^P = W^O(A^1/G) + [(W_2^P + W^O)/2]\ [(G- A^1)/G] \tag{12.11}$$

Figure 12.4: Estimating the Economic Opportunity Cost Of Labor for Protected Sector Jobs
(Two Protected Sectors and $\eta = \infty$)
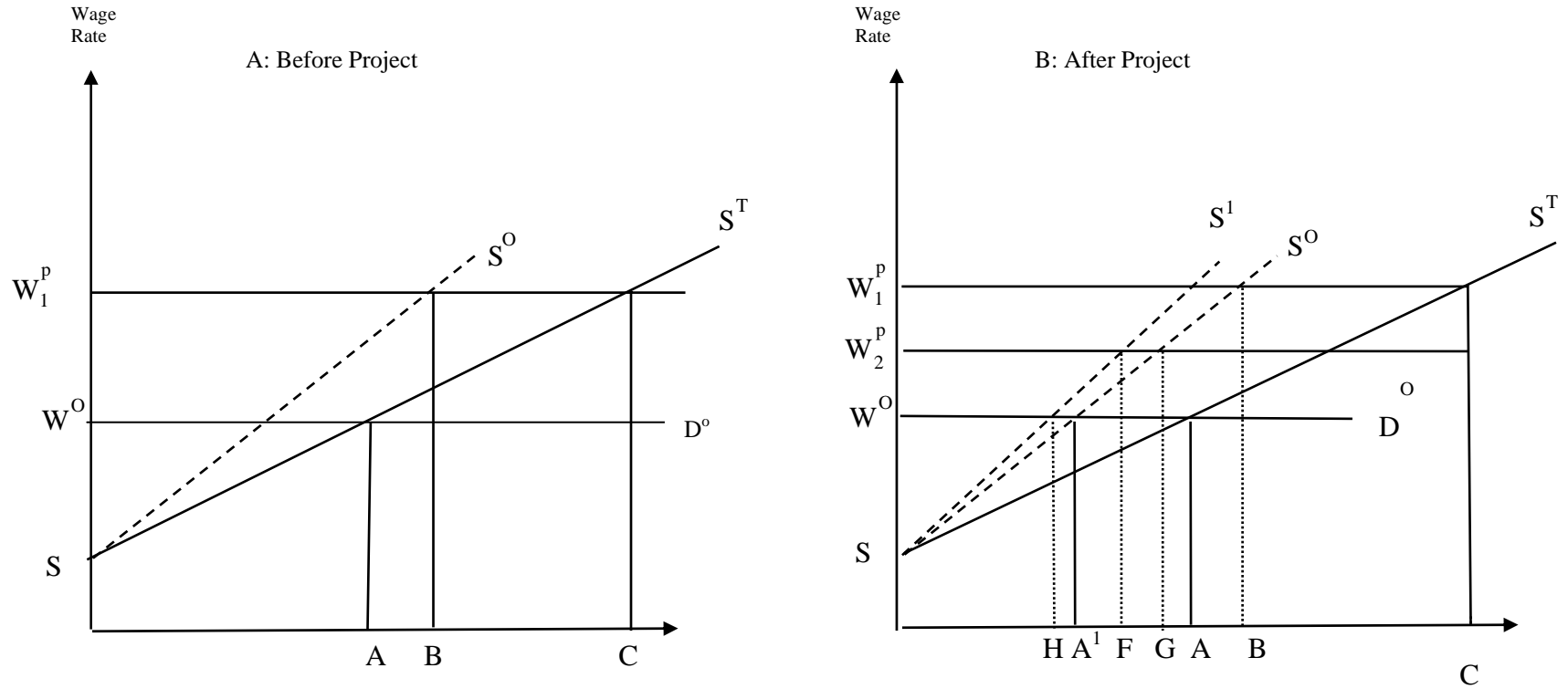
When income taxes are levied on wages in both the protected and open sectors, the same adjustment as made in equation (12.10b) is needed to recognize the loss of income tax revenue from the net reduction in employment in the open sector when protected sector jobs are created. Hence, equation (12.11) becomes:

$$\text{EOCL}_2^P = W^O(A^1/G) + [((W_2^P + W^O)/2)(1-T)][(G - A^1)/G] \tag{12.11a}$$

Under the assumptions used in the above example, similar expressions can be derived to measure the economic opportunity of labor for any number of protected sector, each with their own wage rate. If the total supply function of labor to the market is a linear function of the wage rate, (i.e. the quantity of labor supplied at a given wage is $Q_i = S^T\{W_i\}$, then from Figure 12-4B we can define the following relationship:

$$A/C = S^T\{W^O\}/S^T\{W_1^P\} \text{ and } A^1/G = S^O\{W^O\}/S^O\{W_2^P\}$$

As $(C - A)/C = [S^T\{W_1^P\} - S^T\{W^O\}]/S^T\{W_1^P\}$, it follows from the geometric properties of similar triangles and parallel lines that:

$$(G - A^1)/G = [S^O\{W_2^P\} - S^O\{W^O\}]/S^O\{W_2^P\}$$

The economic opportunity cost of labor in the first protected sector can be calculated as follows:

$$\text{EOCL}_1^P = W^O[S^T\{W^O\}/S^T\{W_1^P\}] + (W_1^P + W^O)/2[(S^T\{W_1^P\} - S^T\{W^O\})/S^T\{W_1^P\}] \tag{12.12}$$

Likewise, the economic opportunity cost of labor in the second protected sector can also be expressed as follows:

$$\text{EOCL}_2^P = W^O[S^O\{W^O\}/S^O\{W_2^P\}] + [(W_2^P + W^O)/2][(S^O\{W_2^P\} - S^O\{W^O\})/S^O\{W_2^P\}] \tag{12.13}$$

In general, it follows that under these conditions (i.e. linear supply curve and a perfectly elastic demand for labor at the open wage of W^O), the EOCL for any protected sector paying a wage, W_i^P, can be expressed as:

$$\text{EOCL}_i^P = W^O\,[S^T\{W^O\}/S^T\{W_i^P\}] + [(W_i^P + W^O)/2]\,[(S^T\{W_i^P\} - S^T\{W^O\})/S^T\{W_i^P\}] \qquad (12.14)$$

The economic opportunity cost of labor for any protected sector is simply a weighted average of (a) the open sector wage, W^O, and (b) the average of the specific protected sector wage and the open sector wage. The weights can all be expressed as functions of the original total market supply of labor $S^T\{W_i\}$.

When income taxes are levied on wages in both the protected and open sectors, the same adjustment as made in equation (12.10b) is needed to recognize the loss of income tax revenue from the net reduction in employment in the open sector when protected sector jobs are created. Hence equation (12.15) becomes:

$$\text{EOCL}_i^P$$
$$= (W^O)\,[S^T\{W^O\}/S^T\{W_i^P\}] + [(W_i^P + W^O)/2]\,(1-T)\,[(S^T\{W_i^P\} - S^T\{W^O\})/S^T\{W_i^P\}] \qquad (12.15)$$

(iii) EOCL in the Case of Search Unemployment with No Migration

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 12.5A depicts a labor market in which both search unemployment and the standard type of quasi-voluntary unemployment coexist. We also introduce a less than infinite elastic demand for labor in the open sector LD^o. The curve $W^m S^o$ is the supply curve of all those

willing to work in the open market. This supply curve has been adjusted for the effect that searching has on the supply of labor available to the open market. The interaction of the demand function for open market workers LD^o with that supply of open market workers W^mS^o determines the initial open market wage W^o. The lateral distance between this new supply curve, W^mS^o, and the prior supply curve, SS^o, is the quantity of search unemployment corresponding to any 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 greatest at the wage W^m. At this wage all those not working for the protected sector would prefer to remain unemployed to search for protected sector jobs instead of accepting jobs in the open market. As the open market wage rises, fewer and fewer workers are willing to forgo open market earnings in order to seek protected sector jobs, until, finally, as the open market wage approaches the protected sector wage, W^P, the quantity of search unemployment approaches zero.

When additional protected jobs are 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.[15] The EOCL will be the sum of the supply price times the proportions 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 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 (12.16):

$$W^S = P_1 (0) + P_2 (W^P) \tag{12.16}$$

where P_1 denotes the probability of getting zero income, and P_2 denotes the probability of getting a protected sector job. W^S will necessarily be higher than W^o because the open market wage is available with certainty, but these individuals refuse to work at this wage in preference to search for a protected sector job that pays W^P.

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[15] To simplify the analysis we are going to ignore the reaction of the open market wage to the decrease in the workers now available to the open market. This analysis is shown in Figure 12.5B

The quasi-voluntary unemployed are unwilling under any circumstances to work at the wage W^o, requiring a higher wage in order to reenter the workforce. Workers sourced from quasi-voluntary unemployment for jobs at the protected sector wage (W^P) will (with linear supply curves) have a supply price averaging (($W^o + W^P)/2$). Finally, the supply price for workers already employed in the open sector will simply be the open market wage, W^o, 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:

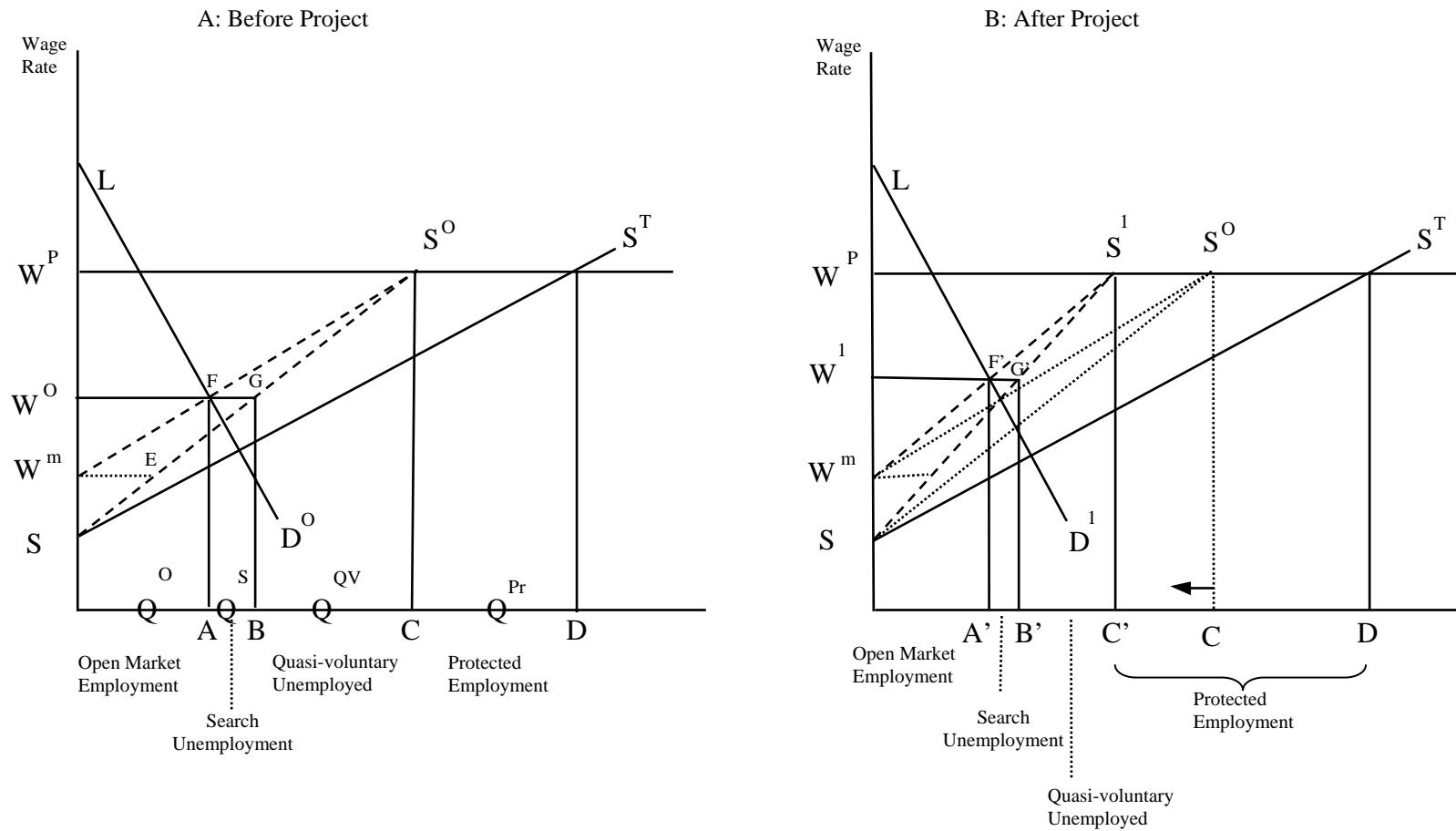$$EOCL^P = W^S H^S + [(W^o + W^P)/2]H^{QV} + W^o H^o \qquad (12.17)$$

where H^S, H^{QV}, and H^O stand for the proportion of labor sourced from each of search unemployed, quasi-voluntary unemployed and currently employed in the open market sector.

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

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

Comparing this value with the EOCL when there is only quasi-voluntary unemployment, the addition of the economic cost of search unemployment ($W^S H^S$) 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.

**Figure 12.5: Estimating the Economic Opportunity Cost of Labor
with Quasi-Voluntary and Search Unemployment**

A: Before Project

Wage
Rate

L

S^O

S^T

W^P

F   G

W^O

E

W^m

D^O

S

Q^O Q^S Q^{QV} Q^{Pr}

A B   C   D

Open Market   Quasi-voluntary   Protected
Employment   Unemployed   Employment

Search
Unemployment

B: After Project

Wage
Rate

L

S^1 S^O S^T

W^P

W^1 F' G'

W^m

D^1

S

A' B'   C'   C   D

Open Market   Protected
Employment   Employment

Search
Unemployment

Quasi-voluntary
Unemployed

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(iv)   EOCL if there is no Open Sector and Labor Market Supplied by Migrants

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 town, or where the only sources of employment available are protected sector jobs). In this case, we want to assume that it is the migration of labor from other regions that is the source of additional workers. 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^P), and also a probability $(1\text{-}P^P)$ of being unemployed. Hence, from the perspective of a potential migrant, if the protected sector wage is W^P, the expected wage from migrating $E(W)$ is equal to the product of the protected sector wage (W^P) and the probability of being employed in the protected sector (P^P), i.e., $E(W) = P^P W^P$.

When there is no open sector, it is the unemployment rate, $(1\text{-}P^P)$ 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^P, 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 protected sector job falls to the point where:

$$P^P = (W^m / W^P) \text{ and } W^m = E(W) \tag{12.18}$$

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 protected 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 $(1-P^P)$, then for every new protected sector job created there will have to be $1/P^P$ migrants. The economic opportunity cost of each of these migrants is equal to $W^P P^P$ when the labor market is in equilibrium. Hence, the economic opportunity cost of labor to fill a protected sector job is expressed as:

$$EOCL^P = (W^P P^P)(1/P^P) = W^P \tag{12.19}$$

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 $EOCL^P$ 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 $EOCL^P$ will need to be adjusted to reflect the net change in tax revenues. We denote the gross-of-tax wage rates in the protected sector and in alternative employment as W^P and W^a, respectively. Further, if we express the proportion of

migrants from the sending region who would have been employed in that region as H_a, and T is the tax rate, then the $EOCL^P$ can be expressed as:

$$EOCL^P = W^P(1 - T) + H_a W_a T(1/P) \qquad (12.20)$$

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. Further 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.

12.9   Conclusion

In this chapter 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 forgone approach, when the latter can be estimated accurately. The primary reliance of the supply price approach 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. Others such as those dealing with interregional and international migration, as well as imperfections in the labor market, including phenomena like migration-fed, quasi-voluntary unemployment, and employment created in protected sector jobs require a more detailed examination of the labor market. In all these cases the special features in question give rise to the need for further specific adjustments in the calculation of the economic opportunity cost of labor for a specific skill on a particular project.

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