ESTIMATING THE OPPORTUNITY COST OF LABOR IN PROJECT ANALYSIS AND COMPARATIVE ADVANTAGE STUDIES

**

A CRITIQUE AND APPLICATION IN THE CONTEXT OF DISEQUILIBRIUM

by

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It is customary here to acknowledge the contribution of one's typist; having been catapulted into the computer age since my return to the U.S. in 1980, I find that I have only my Apple II+ and those who introduced me to the wonders of microcomputers to thank for the wordprocessing.

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I. INTRODUCTION

This study presents a critical analysis of procedures currently used to estimate the opportunity costs of unskilled labor in developing countries. The issue is particularly germane today. Economic analysis is playing an increasingly important role in development planning and policymaking. Labor continues to be the primary input in most developing country agricultural and industrial production. Many labor markets, however, remain relatively thin and subject to a variety of market distortions which render the job of the economic analyst extremely difficult.

In light of these conditions, this research aims to accomplish the following three objectives:

1) To critically evaluate methods currently used for estimating opportunity costs of labor and the adherence of these methods to the underlying dictates of economic theory;

2) To present an empirical case study which examines the problems of opportunity cost estimation and the sensitivity of the estimates to selected assumptions and estimation techniques;

3) To discuss the methodological problems which highly sensitive labor estimates pose for interpretation of

economic analyses, and to suggest means of responding to these problems:

Chapter II briefly reviews the evidence for the underlying premise of this paper -- i.e., that economic analysts have had only mild success in marrying theoretical principles to real world conditions when estimating the opportunity cost of labor. The problems identified in the review provide a justification for research objectives outlined above. The chapter closes with a description of the research methods proposed for meeting these objectives.

Chapter III offers a discussion of both the theory and practice of shadow wage rate estimation in the two types of economic analysis which are most commonly employed in developing countries -- project analysis and policy oriented comparative advantage studies. This section begins with an overview of the theoretical foundations of neoclassical economics upon which economists construct their shadow prices of labor. The review points out the similarities and differences between comparative advantage and project analyses, highlighting those components of neoclassical wage theory which pose problems for both. The major contribution of Chapter III, however, is a critical review of the literature on empirical estimates of shadow prices for labor. The discussion assesses the extent to which practice has been able to conform to theory, noting those factors apparently forcing a wedge between the two.

Chapter IV is a case study of economic profitability ("comparative advantage") of rice production in the "Office du

Niger" zone of Mali. The sensitivity of rice profitability to a variety of shadow wage estimates is examined and some of the more troublesome problems of empirical estimation are illustrated. Particular attention is paid to the sensitivity of these estimates to various assumptions about average market wages, aggregation techniques, and the existence of various types of market and non-market disequilibria. It is argued that analysts are confronted with two serious problems: (1) the dilemma of estimating a single marginal value product under disequilibrium conditions when different economic actors face different marginal value products and (2) the problem of obtaining statistically meaningful estimates. The question that follows from the discussion in Chapter IV is what can be done with economic analysis based on fragile shadow wage estimates to make it more useful to development planners and policymakers.

Chapter V pursues this question with a discussion of the methodological problems posed by the lack of consensus on whose perspective should determine the choice of marginal value product and the implications of using statistically problematic data sets. Because the rules for estimating marginal value products from labor market data are fuzzy, the analyst has a great deal of discretion. When different choices made along the way have different equity and distributional impacts, the analyst risks unwittingly becoming involved in the political process. Suggestions are offered on means analysts might employ to keep the distinction between

political and technical decisions as clear as possible, thereby providing economic analysis which reflects the goals and objectives of client groups and can be used effectively by them.

II. PROBLEM IDENTIFICATION AND STATEMENT OF RESEARCH PLAN

During the past 20 years, significant strides have been made in developing both the theory and the analytical tools required to do economic analysis. Dasgupta, Sen and Marglin; Little and Mirrlees; and Squire and van der Tak are among the pioneers in use of economic analysis to guide project investments. The Stanford Food Research Institute has been in the forefront of applying economic analysis to comparative advantage issues. Despite these advances, the art of translating theory into practice seems to have lagged behind. This chapter begins with a summary of observations by those economists who have been most active in efforts to estimate parameters for economic analysis of various types. The review attempts to show how practitioners rate their success in estimating opportunity costs of labor vis a vis other parameters, what they consider to be the major weaknesses in their labor estimates, and the implications of these weaknesses for the overall economic analysis. The review identifies those problems which the present research is designed to address and provides a justification for the choice of research objectives set out on page one. The chapter concludes with a description of the research methods proposed to meet these objectives.

A. PROBLEMS OF DATA COLLECTION AND ANALYSIS

In studies describing the practical aspects of carrying out economic analysis, a major problem area invariably mentioned has been that of estimating the opportunity costs of labor. This opportunity cost is most often considered to be the output foregone when labor either moves or fails to move to a new activity. According to economic theory, the cost of moving to a new activity would be the marginal value product of labor in its prior activity; the cost of not moving would be the marginal product of the next best alternative use for the labor in question. Direct empirical estimation of these marginal value products using production function analysis is extremely difficult, particularly at an aggregated regional or national level. Given these problems, economic analysts tend to extrapolate from labor market data on wages and rates of unemployment when developing marginal value product estimates. Even with this more popularly used approach, data problems continue to exist and labor market theory tends to be inadequate to the task faced in most developing economies. Scott, MacArthur and Newbery (1976), for example, preface their chapter on estimating shadow wages in Kenya as follows:

> The estimates given in this chapter can be criticized for being unduly laborious and involving a large element of guesswork. In defense of them, the writer can only reply that the subject-matter is important, and that <u>any</u> estimates are bound to involve guesswork at some stage. (p. 64)

Colin Bruce, in a 1976 World Bank Staff Working Paper on estimating parameters for economic and social cost accounting in Thailand, Malaysia, and the Philippines, observes that the

analysts did attempt to make some estimate of the opportunity cost of labor, but concludes that:

> ...it would probably be true to say that greater attention needs to be paid to analysis of the labor market. (p. 141)

Barnum and Squire address the problem of labor valuation at a much more theoretical and mathematically complex level than do the previous authors cited. The empirical production function analysis presented in support of their arguments draws attention to a potentially serious oversight on the part of other analysts. Drawing on work by Berndt and Christensen, they hypothesize that:

> ...estimates of production functions based on an undifferentiated labor variable may lead to errors in the measurement of labor's marginal product if different types of labor (for example, male-female, busy season-slack season, hired-family) have been aggregated incorrectly or have been aggregated when in fact no consistent aggregate index exists. (1977, p. 1)

They test this hypothesis with respect to male and female labor in Malaysian rice production, finding that:

> ...because the elasticity of output with respect to female labor is not statistically different from zero, estimates of the marginal product of labor treated as a homogeneous input can be considerably greater or smaller than the true value depending on the proportions of male and female labor actually withdrawn from production. (1977, p. 10)

In another study of family versus hired labor in Malaysian rice production the authors found that the marginal product of family labor was about three-fourths that of hired labor. (1978, p. 12)

Somewhat in contrast to the Barnum and Squire observations suggesting that more attention be paid to the heterogeneity in labor markets, McDiarmid (1977) recommends using macro data "suitably refined for local conditions" rather than studying labor and capital markets specifically oriented toward a particular project. (p. 130) His feeling is that:

> ...the relation of economic and financial values of a fairly homogeneous resource, such as unskilled agricultural labor, should be a valuable guide and at least a starting point for ratios to be employed for individual projects.
>
> ....the national ratio will be much more stable than the local ratio over any extended time and... adjustments of the national ratio for local conditions should be done sparingly if at all in small-to-medium-sized economies. (p. 10)

After reviewing four case studies where an attempt was made to estimate a national economic price of labor, McDiarmid concludes:

> The question may well be asked whether, in view of the complex formulas needed to derive an approximation of the economic price of labor, the task is worth the candle. The margin of error is bound to be substantial... (p. 130)

Two major sources of estimation error are recognized by McDiarmid: (1) the need to use data based on averages to develop estimates of what is a marginal concept and (2) the instability of prices over time. McDiarmid does recognize that heterogeneous labor markets can also cause estimation errors, but he appears less concerned about this source of error than Barnum and Squire. In the face of such obstacles, McDiarmid concludes that the analyst must judge the need for detailed labor market analysis by the importance of labor

costs in the overall analysis and the mobility of the labor market.

In summary, there appears to be an ample body of literature recognizing the difficulties of estimating shadow wage rates in applied economic analysis. Not all authors agree on the appropriate method for valuing labor; however, they are unanimous about the difficulties inherent in the task. Although there are a variety of ways one can consolidate the numerous observations presented above, one perceives four major issues surfacing:

1) Inadequate knowledge of labor markets leads to "guesstimates" in lieu of estimates and, therefore, large margins of error.

2) The high costs of obtaining better knowledge leading to better estimates must be weighed against the consequences of using poor estimates.

3) Heterogeneity of labor markets is a potential problem with important implications for choices between micro and macro approaches to parameter estimation.

4) Problems related to the use of averaged data for estimating marginal concepts must be addressed.

B. USE OF SHADOW WAGE ESTIMATES IN POLICY AND PLANNING

The above discussion has stressed problems of data collection and analysis required for estimating opportunity costs of labor. Another major topic of interest to the economist must be the use to which shadow wage estimates are put.

The literature on estimating developing country opportunity costs generally ignores the possibility that economic analyses built on weak estimates of important parameters may mislead policymakers and planners. Given the dangers inherent in the unintentional misuse of economic analysis by those making policy prescriptions, the topic should be receiving greater attention. Two particularly problematic issues seem to be glossed over in the development literature. The first is whether the techniques being used to estimate opportunity costs of labor are in harmony with the intended policy uses of the economic analysis. The second is whether analysts provide sufficient information on the underlying assumptions and perceived weaknesses of a particular analysis to permit judicious interpretation of the results for policy and planning purposes.

The issue of techniques being in harmony with policy uses has several components. One is related to the Barnum and Squire/McDiarmid discussion of labor market heterogeneity and the use of micro vs. macro level data. Surely there are cases where one type of data is more appropriate than another for particular policy issues, yet little work has been done on clarifying this distinction. Even if one is certain that the marginal value product being estimated applies to a relatively homogeneous labor group, the existence of any type of market disequilibrium poses complex problems. Given disequilibrium, various economic actors face different marginal value products for a homogeneous unit of labor, yet the analyst tends to

estimate a single value. Such decisions can have equity implications which may or may not be consonant with formally stated government policies. A final problem in marrying estimation techniques with policy applications concerns the use of marginal analysis for situations involving non-marginal changes.

The second problem area identified -- that of incomplete reporting -- is felt to be important because economic analyses currently found in the literature often fail to include a full discussion of the sensitivity of the analysis to labor valuation assumptions and estimation techniques. Incomplete reporting increases the danger of governments making policy decisions which have unintended consequences. It also covers over the equity and distributional implications of some decisions which tend to be presented as "technical" rather than "political" issues.

C. IMPLICATIONS FOR RESEARCH

The preceding review of the literature on economic analysis in developing countries establishes the fact that valuation of labor remains an intractable problem for those engaged in empirical work. The nature of the problem is two-pronged. On one hand, knowledge of labor markets is limited, available data is inadequate, costs of obtaining better data are high, and numerous debates remain on the best way to estimate labor parameters under such constraints. On the other hand, estimates are nonetheless being made while inadequate attention is being paid to developing guidelines for the prudent use of

economic analysis based on fragile labor parameters. In light of these findings, pursuit of the three objectives set forth at the beginning of this paper appears justified.

D. METHOD OF STUDY

Two methods are employed to accomplish these objectives. First, current estimation methods are evaluated based on a brief summary of the theoretical basis for shadow pricing labor and a critical review of empirical studies. The section dealing with the theoretical underpinnings of shadow wage estimation discusses the problems of using a price-auction equilibrium labor market model as the foundation for analysis of the disequilibrium markets most frequently encountered by analysts. The review of empirical studies illustrates the manner in which analysts have grappled with the dilemmas posed by inadequate disequilibrium theory. The number of published studies which actually report the details of methods used to estimate shadow prices is not large. Many of these reports are World Bank Staff Working Papers, but a number of other sources, both published and unpublished, have also been identified. No attempt was made to consult all published accounts of shadow wage estimation procedures, but that literature reviewed is thought to provide a representative sample of empirical work which has been done. The objective of this review is to assess the extent to which constraints of the real world force analysts to use data and/or estimation techniques which do not comply with the rules of shadow pricing set out by the theoreticians.

Second, a case study is presented to meet the next objective of empirically estimating the opportunity cost of labor and demonstrating the sensitivity of such estimates. The case study concerns valuation of family and hired labor used in rice activities in the "Office du Niger" production zone of Mali. The case study area was selected for the following reasons:

1) Published results of two recent financial and economic analyses of rice production in the "Office du Niger" are available (McIntire in Pearson, et. al. and Kamuanga).

2) The author of one of these studies has been kind enough to make all of his data available for this study.

3) The author of this paper has lived in Mali for a number of years. This experience provides a sensitivity to the socio-cultural, economic and political environment in which Malian farmers must make labor allocation decisions and provides invaluable guidance in sorting through various methods of valuing farm labor.

In general, the case study approach was selected as the best means of tracing the various steps involved in the shadow wage estimation process. As one moves through the case study it is possible to observe how various assumptions and decisions along the way play a critical role in determining the nature of the final outcome and its impact on various economic actors.

The results of both the case study and the review of current literature on empirical shadow price estimates are

drawn together in Chapter V to meet the third objective of examining methodological problems posed by fragile opportunity cost estimates and suggesting methods for improving labor valuation practices.

III. THEORY AND PRACTICE IN ESTIMATING OPPORTUNITY COSTS OF LABOR

A. THEORETICAL UNDERPINNINGS OF SHADOW WAGE RATES

The emphasis of this paper is on two different but related types of economic analysis which commonly grapple with problems of labor valuation: project analysis and policy oriented comparative advantage studies. Some readers may find the attempt to make a distinction between the two a bit tenuous, as the underlying economic principles appear to be identical. The point of view taken in this paper, however, is that subtle differences do exist, particularly with respect to the manner in which one identifies the opportunity foregone under conditions of disequilibrium. The following paragraphs provide a brief review of the economic theory common to shadow pricing labor inputs in both types of analysis. A fuller discussion of the distinction between the two types of analysis is presented on pages 42-43 and 150-152.

When the analyst wants to determine the economic cost of labor employed in a project or used to produce a commodity for which the comparative advantage is under study, s/he is interested in determining the value of production being sacrificed elsewhere in the economy as one unit of labor is transferred to the proposed activities. In essence, s/he must calculate the MVP of labor in the pre-project or next best alternative

activity which, in most developing countries, is considered to be some type of agricultural production.

In economic analysis which attempts to account for social costs and benefits such as increases in consumption and income distribution, the marginal value product of labor serves as a base for the shadow wage rate which is further modified and expressed in terms of accounting prices. (See Little & Mirrlees or Squire & van der Tak for a complete discussion of this.) The major concern of this paper is the estimation and use of the marginal value product of labor as a shadow wage rate. Unless otherwise noted, the terms shadow wage rate or shadow price of labor refer to estimates of the marginal value product of labor which are not explicitly adjusted to reflect social costs and benefits or economic distortions not directly influencing the labor market.

1. PRODUCTION FUNCTION AND LINEAR PROGRAMMING APPROACHES

Both production function and linear programming analysis provide straightforward, although highly data intensive, methods for estimating the marginal value product of labor. A number of studies have used these techniques in developing countries.

In one of the earliest studies by Mellor and Stevens (1956), the average and marginal products of farm labor in Thailand were estimated using a very simple regression model with output as the dependent variable and labor as the independent variable. The marginal physical product was found

to be not significantly different from zero at the 5% level. Studies in Nigeria by Norman (1973) and Matlon (1977) suggest that the marginal value product of labor is slightly above the wage rate. A linear programming analysis done by Norman and Pryor found the marginal value product of labor in peak months to be three to four times greater than the wage rate. The studies by Barnum and Squire (1977 and 1978) which were mentioned in Chapter II are examples of production function analysis which was used to examine the variability of marginal products for different categories of labor.

The data requirements for all of these estimates were quite substantial -- most authors having collected data for a large number of households over an entire cropping cycle. Nevertheless, the authors tend to be cautious about their results. High variability in the data and small sample sizes are the problems most frequently mentioned. It is likely due to the problems of collecting adequate data and the necessity of adjusting for a lack of homogeneity in non-labor inputs that have kept project analysts from undertaking production function and linear programming analysis to estimate shadow wage rates. Whatever the reason, a review of the literature makes it clear that those doing project and comparative advantage analysis prefer to tackle labor valuation problems by analyzing labor markets rather than by engaging in production function or linear programming exercises.

2. THE LINK BETWEEN OPPORTUNITY COST ESTIMATES AND LABOR MARKET THEORY

(A) AN EQUILIBRIUM PERSPECTIVE

Unless one is inclined to undertake costly and time consuming production function analysis to estimate the opportunity costs of various types of labor, it is necessary to have some theory about the relationship among such variables as the observed wage rate, quantities of labor supplied and demanded, and the marginal value product of labor. The neoclassical price-auction labor market model is the one upon which economic analysts tend to rely. In a strictly neoclassical world where employers and employees have perfect knowledge of all opportunities, and wages are perfectly flexible in response to changes in labor demand and supply, all labor markets are in equilibrium. This equilibrium implies that (1) demand is equal to supply and (2) producers allocate labor efficiently so that the marginal value products of homogeneous units of labor are equal across all productive activities and equal to the marginal cost (i.e., the wage rate). The markets are able to achieve and maintain this equilibrium because buyers and sellers of labor are unconstrained by poor information, social and/or political forces which might impede the economic actors in their respective quests to maximize profits and utility. Flexible wags are the key to this model for they act as the equilibrating force, assuring that equilibrium is re-established each time demand or supply changes.

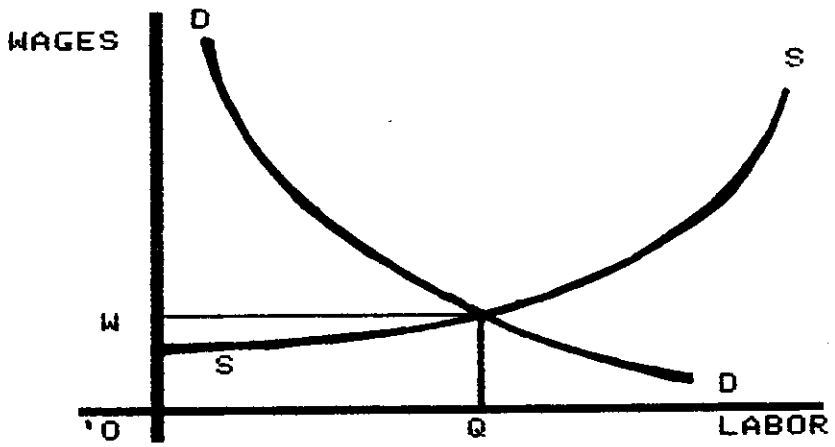
Under these conditions, the economic analyst's job is simplified; involuntary unemployment does not exist and the opportunity cost of withdrawing a unit of labor from one activity for use in another is simply the observed wage rate. Figure I is a graphical illustration of such a labor market in equilibrium. Figure II illustrates how the demand and supply curves in Figure I are derived from the employer's production function and the employee's incomeleisure preference curve, respectively. In general, the demand for labor depends on the marginal physical productivity of factors (which depends on technology, availability and prices of substitutes and complements, etc.) and the value of the goods being produced (which depends on consumer tastes, incomes, etc.). The shape of the supply curve depends on the utility of wages and the disutility of effort. The trade-off is represented by individual utility curves.

Although this equilibrium model has long been the foundation for micro-economic analysis of labor markets, its usefulness for understanding real-world labor markets as well as the macro economy has recently come under attack from a number of quarters. (See, for example, Thurow (1983), Dean (1981), and Appelbaum (1979)) Those questioning the neoclassical theory to date are doing so from the perspective of developed economies. Many of their criticisms, however, could be relevant for developing economies as well. A major problem with the model is that in both developing and developed economies wages are not infinitely flexible and unemployment has

FIGURE I

EQUILIBRIUM PRICE-AUCTION

LABOR MARKET



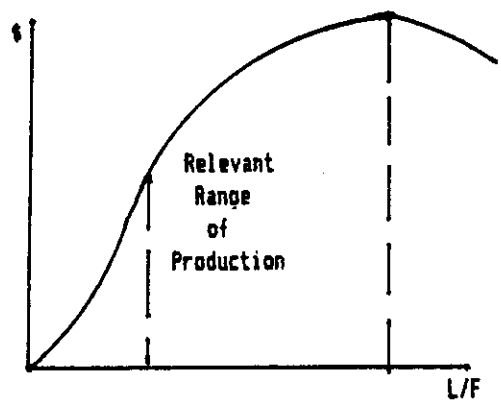
At equilibrium, demand (D) equals supply (S). (Q) units of labor are demanded at wage rate (W), which is equal to the marginal value product of labor.

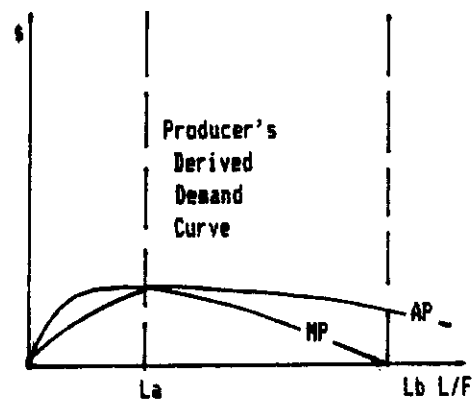
FIGURE II

DERIVATION OF LABOR DEMAND & SUPPLY CURVES

D E M A N D

Producer's
Total Value Product
Curve

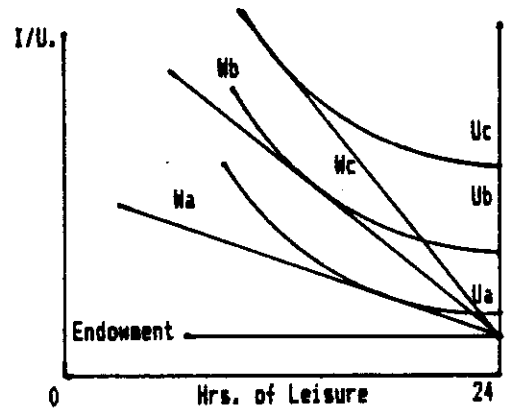


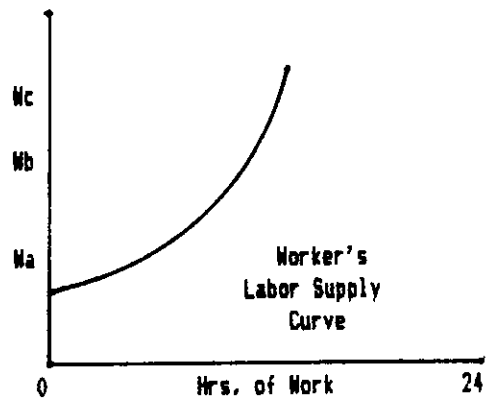


Key:
- L = Units of Labor
- F = Fixed Inputs
- AP = Average Product
- MP = Marginal Product
- = Derived Demand Between La and Lb

S U P P L Y

Worker's
Income/Leisure
Preferences





Key:
- Ua-Uc = Utility Curves
- Wa-Wc = Wage levels: c>b>a
- I/U = Income/Utility Axis

become a permanent fact of life. Real-world labor markets appear to be in constant disequilibrium characterized by the presence of involuntary unemployment. Wages are not playing the equilibrating role prescribed by neoclassical theory.

(B) A DISEQUILIBRIUM PERSPECTIVE

In developing countries, both the efficient allocation of labor across activities and the matching of demand with supply are often precluded due to some combination of the following situations:

1) An environment characterized by technological change often prevents farmers from allocating labor resources efficiently. For example, the introduction of a new high yielding variety might make it profitable for a farmer to pay higher wages, use more labor, or both. Due to inadequate knowledge of the production possibilities with the new variety, the farmer continues to follow labor allocation activities based on the previous production function. Marginal value product of labor might really be greater than observed wages but it takes time for farmers to adapt labor practices to the new technology.

2) Minimum wage laws can motivate employers to hire less labor than they would if wages were allowed to be downwardly flexible. In such circumstances, each producer hires labor until the wage is equal to the marginal value product of labor, but excess supplies of labor exist at this wage. Use of the observed wage in economic analysis as a proxy for opportunity cost of labor ignores the fact that some labor

might be drawn from the pool of unemployed who might have a marginal value product lower than the wage. Figure III illustrates this type of disequilibrium where the marginal value product of those who are employed is considerably higher than it would be were wages allowed to drop. Other political constraints which would elicit similar disequilibria are various type of taxes and subsidies which cause prices of non-labor inputs or revenues from output to be artificially low.

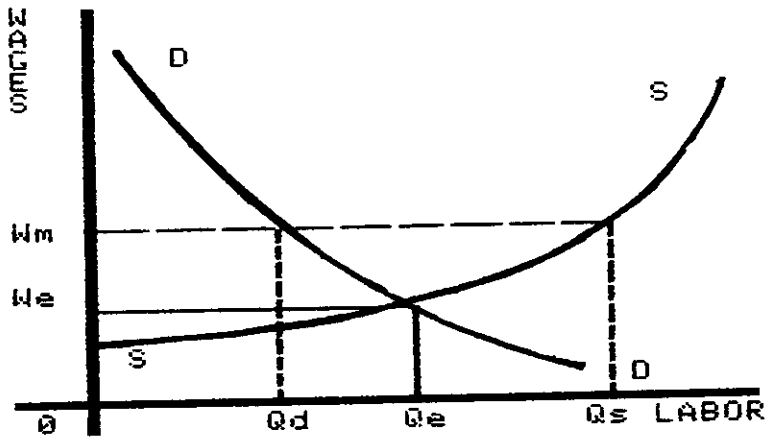
3) Social constraints can prevent producers from maximizing profit by forcing them to employ labor beyond the point where marginal value product is equal to the cost of the marginal unit of labor. Under such conditions, all labor could be employed suggesting that a labor market equilibrium existed, yet the observed wage would be greater than marginal value product because the producer is forced by social circumstances to distribute the average product among workers by some criteria other than marginal productivity. Figure IV presents a way of illustrating this type of disequilibrium in a graphical format. Social constraints which result in wage discrimination based on personal characteristics such as sex or ethnic group might result in the opposite type of market disequilibrium where wages would be less than marginal product.

4) A fourth situation would be where both cases two and three were combined. Unemployment would exist and traditional producers would pay wages greater than marginal product. This latter case is probably the one most commonly

FIGURE III

LABOR MARKET DISEQUILIBRIUM

DUE TO MINIMUM WAGE LAW



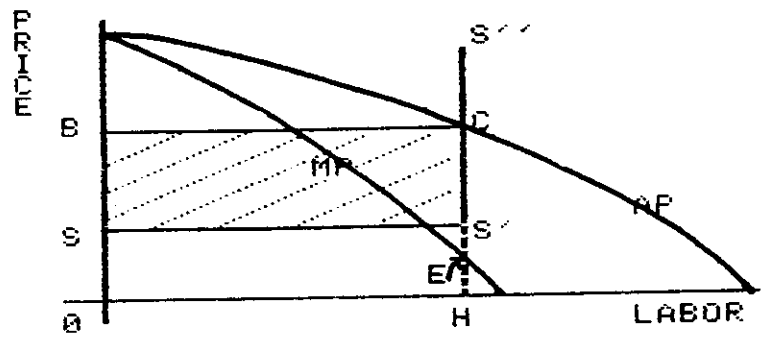
Imposition of a minimum wage at "Wm" results in a movement away from the equilibrium wage "We" and quantity "Qe". The actual quantity supplied, "Qs", is greater than quantity demanded, "Qd".

The marginal value product of labor for those hiring the input according to neoclassical principles of profit maximizing is equal to the minimum wage, "Wm".

FIGURE IV

A TRADITIONAL LABOR MARKET IN

SOCIALLY OPTIMAL EQUILIBRIUM



KEY:

SS'S''	Labor supply curve
OS	Biologically determined subsistence wage
SS'	Labor availability set by socially determined labor participation rates and population
OH	Quantity of labor actually hired which -- in this case -- is equal to quantity of labor supplied. OH is determined by a farmer's sense of social responsibility toward those seeking work.
HS'	Minimum subsistence wage received by worker
BCS'S	Surplus produced once all workers have received subsistence wage. Sharing in this surplus on the part of workers depends on each worker's social relationship to the employer.
HC	Average product of labor
HE	Marginal product of labor, given a farmer's choice of OH as the socially optimum amount of labor to hire. HE, according to Bruce, is the cost of removing one unit of labor from the traditional sector.

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Source: Adapted from Bruce, 1976, pg. 17.

encountered in developing countries where peasant and commercial agriculture exist side by side. Commercial agriculture would hire those workers not hired in the traditional sector up to the point where marginal value product equaled subsistence wage; not all unemployed would be hired. Figure V illustrates one way of graphically conceptualizing this type of disequilibrium in traditional agriculture and the corresponding labor allocation in the commercial sector.

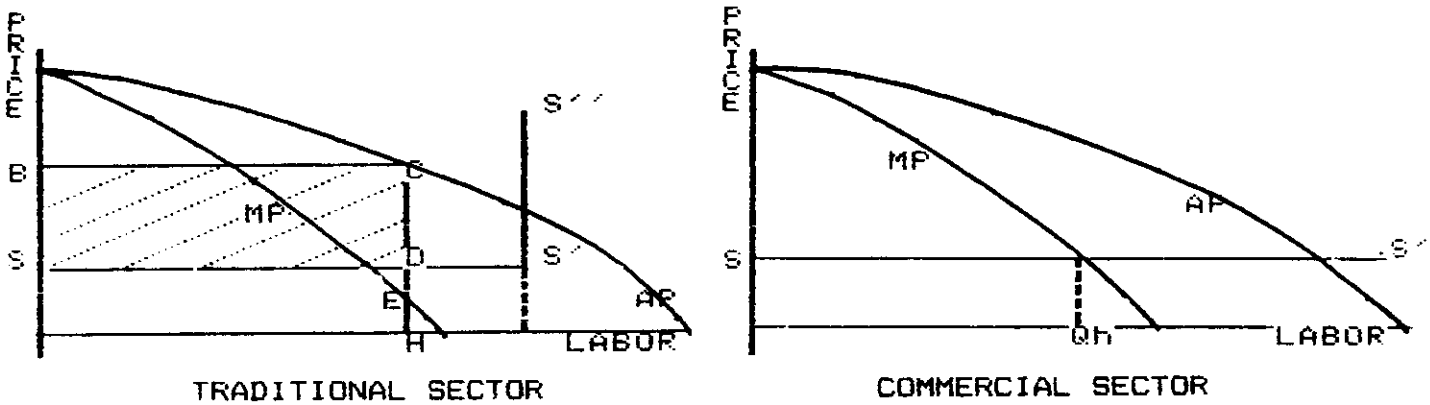
5) A fifth possibility is that no labor market exists or a significant portion of productive activity is performed by farm-household units which neither buy nor sell labor in a market. Under such circumstances, labor allocation decisions are simultaneously influenced by production and consumption considerations making it impossible to obtain the independent demand and supply curves necessary to estimate an equilibrium marginal value product.

Given the persistence of disequilibrium in labor markets, the task of the economic analyst becomes complex. Not only does s/he have to identify that sector from which labor will be withdrawn, but s/he must also decide whose point of view will prevail when a particular marginal value product is selected. Under conditions imposed by minimum wage laws, the marginal value product of labor for a producer currently hiring workers remains the observed wage rate. A project analyst, however, would probably try to estimate some lower equilibrium marginal value product for use in economic analysis. Unemployed workers would favor such a choice because

FIGURE V

TWO SECTOR RURAL LABOR MARKET

WITH UNEMPLOYMENT



KEY:

I. Traditional sector model is the same as Figure IV with the following exceptions:

SS', labor availability, is greater than OH, the socially optimal amount of labor hired.

BCDS is surplus produced over minimum subsistence.

DS' is unemployment in the traditional sector.

II. The commercial sector is supplied by labor unemployed in the traditional sector. Employers equate marginal product with the minimum subsistence wage they must pay and hire Qh units of labor.

III. This dual sector model implies that the marginal value product of labor in the commercial sector is greater than that in the traditional sector.

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Source: Bruce, 1976, pp. 17-19.

demand for their services would increase and. due to minimum wage laws, income received would exceed the low marginal value product used in the analysis. Workers currently employed in the formal sector where minimum wages are guaranteed might object because the growing number of urban workers will increase demand for urban consumption goods causing prices to rise. The producer unable to circumvent minimum wage laws, might be unenthusiastic about the analyst's choice of a reduced marginal value product because a project related growth in the number of urban workers could lead to pressure on food and housing prices which might ultimately lead to worker pressure on government to raise minimum wages. On the other hand, employers in the informal sector who are paying less than minimum wages are likely to be faced with increased labor costs much sooner than their formal sector counterparts if implementation of projects reduces supplies of surplus labor.

(C) IMPLICATIONS OF LABOR MARKET EQUILIBRIUM AND DISEQUILIBRIUM FOR ECONOMIC ANALYSIS

In brief, the analyst costing labor for economic analysis must first identify the appropriate labor activity then determine the extent to which that particular labor market is in equilibrium. If labor supply and demand are fairly well balanced and producers seem to be allocating labor efficiently across activities, the observed wage provides a reasonable estimate of labor's marginal value product. If either of these conditions are not met due to the presence of

technological change, social and/or political constraints, disequilibrium prevails. Given the existence of a disequilibrium situation the analyst must recognize that different economic actors may have different views concerning the marginal value product of a particular unit of labor. Although it is not often recognized as such, the decision as to whose perspective guides the choice of marginal value product is essentially a political -- not a technical -- decision. Once a determination has been made concerning which marginal value product(s) to estimate, the analyst must next face the myriad of problems associated with estimating some type of aggregate marginal value product under conditions characterized by poor data and the absence of a sound disequilibrium theory of labor markets. Each of these steps in estimating shadow wage rates will be examined in depth in the following pages.

Given the complexity of developing country labor allocation activities and the persistence of labor market disequilibrium, a number of alternative labor markets have been conceptualized. Some of these models have been used to posit the overall development process; others are more modest, only attempting to describe market distortions which might cause marginal value products to deviate from observed wages. Those models which appear to have the greatest relevance for understanding the empirical shadow wage estimates described in this paper are discussed below.

3. CONCEPTUALIZING LABOR MARKETS AND THE LINK TO MARGINAL VALUE PRODUCT

(A) THE LEWIS MODEL

The Lewis model (Lewis, 1954) is probably the best known labor market model in development economics and could well be held responsible for stimulating much of the attention given to estimating the shadow wage rate for rural labor. The model was proposed to shed light on the entire development process. It depends on a number of initial assumptions, some of which have been hotly debated in the literature. In a nutshell, Lewis' model assumes that:

1) Surplus labor exists in both the rural and urban informal sectors (e.g., subsistence agriculture, domestic service, self-employment, petty trading, etc.)

2) Supply of labor from the rural and urban informal sectors to the capitalist* sector is infinitely elastic within the relevant range of demand

3) The marginal product of labor in the rural and urban informal sectors is less than that in the capitalist sector

4) If a person is employed in the capitalist sector, his/her productivity -- at the margin -- will determine the wage.

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*Lewis defines the capitalist sector as one in which labor is hired to produce goods and services which are later resold for profit. He points out that such functions can be performed by both public or private institutions and can involve both agricultural and industrial production.

5) Wages remain constant in the capitalist sector over a given range of productivity increase due to the excess supply of labor.

Lewis suggests that labor can be moved from the non-capitalist to the capitalist sector without reducing productivity in the former and thereby providing the fuel for capitalist development sparked by that sector's higher than average propensity to save from profit income. Lewis' faith in unfaltering productivity in non-capitalist sectors as labor is removed is not dependent on a belief that the marginal product of agricultural labor prior to transfer is zero as many have erroneously maintained. He offers two possible behavioral explanations:

1) Social customs of a community tend to set the minimum number of expected work hours per day; the daily supply curve of labor per individual will be perfectly elastic until the acceptable number of hours is reached. If a family of five working a two acre plot of land puts in less than the social minimum, those remaining behind after one worker migrates will automatically increase labor effort to compensate for the loss.

2) A household sets goals according to community standards and will do what it must in terms of labor allocation to achieve these goals whether it has five resident members or four. (Lewis, 1972, pg. 80)

This aspect of the Lewis model dealing with the effects of labor transfer on the non-capitalist sector reflects what

has become a critical and unresolved issue in the estimation of shadow wages. Unlike the neoclassical labor market model, Lewis' model does not incorporate a mechanism for determining the equilibrium wage and therefore a marginal value product of labor. As Thurow (1983) points out, this is also a characteristic of both Keynesian and monetarist macro-economic models. The Lewis model takes the prevailing wage as given and suggests that, due to excess labor supply, productivity can be increased without wages rising. The model sparked a lively debate on what the marginal value product of labor really was in the non-capitalist sector.

Sen (1975), for example, pointed out that the marginal value product of unemployed or underemployed labor has a lower bound determined by marginal disutility of work and the need to earn at least a subsistence wage. In other words, an equilibrium marginal value product -- if that is what the analyst desires -- could never go to zero because the intercept of the labor supply curve must be at least equal to subsistence wages. Those analysts who estimate marginal value products lower than subsistence needs are not, therefore, estimating the value which would prevail at labor market equilibrium. This argument is perhaps a valid description of the reservation wage for heads of households or single individuals who must assure subsistence needs. Its relevance is less clear for individuals whose subsistence is assured and who are seeking income for discretionary purchases such as radios or an extra pair of shoes. The debate continues to

this day, in part because confusion persists as to which marginal value product is being discussed by analysts and which, if any, is most relevant for shadow pricing labor in economic analysis.

(B) THE HARRIS/TODARO MODEL

Harris and Todaro (1970) found the Lewis model lacking in both its underlying assumptions and its predictions of how labor migration would affect national development. The model specified by Harris and Todaro has the following characteristics:

1) The existence of a politically determined minimum urban wage which is substantially higher than agricultural earnings.

2) No surplus of agricultural labor exists, i.e., marginal product is greater than zero and inversely related to the size of the agricultural labor force.

3) Rural-urban migration proceeds in response to differences in expected earnings between the two sectors.

4) Urban unemployment acts as the equilibrating force on migration. Markets are in equilibrium not when agricultural wages equal urban wages but when they are equal to expected urban wages. Expected earnings depend on wages and the level of unemployment which influences the probability of finding work.

The authors used this model to demonstrate that high urban unemployment rates could be explained in terms of rationally behaving migrants seeking to maximize expected income. The

authors suggest that more than one agricultural worker will be likely to migrate for each new job created in the urban sector. If this is true, the opportunity cost of the new job is greater than the marginal product of one agricultural worker. This result is quite different from that suggested by the Lewis model, as will be illustrated below in the discussion of shadow wage estimates for Turkey.

One of the major problems in evaluating both the Lewis and Harris/Todaro models is that little reliable empirical work has been done in measuring changes in rural productivity upon withdrawal of a rural laborer. The work of Barnum and Squire (1979) discussed below is an attempt to remedy this problem. A number of geographers, political economists, and sociologists have also done work in this area, but economists tend to question the relevance of such work for economic analysis. (See, for example, deJonge (1978) for a multidisciplinary approach, Amin (1974) for a political economy analysis, and Goddard and Masser (1973) for a geographer's model.) As recently as 1980, Todaro commented that a persistent knowledge gap remains concerning the consequences of migration on both sending and receiving areas. In particular, he cites a need for better information on changes in household income, productivity, and opportunity costs for different rural subgroups. Without such knowledge, project analysts estimating shadow wage rates are walking on very thin ice. Both the Lewis and Harris/Todaro models remain largely speculative,

providing analysts with food for thought but little substantive guidance on estimating shadow wage rates.

(C) THE BRUCE/TEMPLE MODEL

Bruce (1976) presents a labor market model of the traditional agricultural sector based on empirical studies by G. P. Temple. The model assumes that farm level employment is determined by a landowner's social responsibility toward a particular group of landless laborers; hired labor, in a sense, becomes a fixed input. Wages are constrained on the lower end by the social obligation to provide a worker with minimum subsistence for his family. The upper limit is determined by the excess of average product over subsistence needs. Distribution of any excess product above subsistence depends on the discretion of the landowner and the relative weights of felt social obligations toward different laborers. In the model, wages are not based on productivity but proximity of relationship between landowner and laborer. The model does allow for unemployment -- the joint social responsibility of all landowners does not assure work for all those seeking it. This model aptly describes the fourth case of disequilibrium presented on page 26 above, where producers do not equate marginal value product with wage rates and unemployment also exists. Although this model was developed to describe labor allocation behavior given large numbers of landless laborers, it also has relevance for traditional systems where few individuals are landless. In Africa, for example, more wealthy farmers, political and/or religious leaders may be obliged to

hire less well off farmers for seasonal work at wage rates greater than the marginal value product.

Bruce goes on to point out that most rural labor markets contain two types of decision makers on the labor hiring side: the traditional farmer and the commercial farmer. The supply of labor to the commercial farmer tends to come from those workers for whom no landowner feels a social responsibility. While the traditional farmer is constrained by social responsibility to hire more than the neoclassicist's economically optimal amount of labor and pay wages greater than marginal product, the commercial farmer has no constraint on the amount of labor to hire. Faced by an infinitely elastic labor supply curve at a wage rate set by workers' needs for subsistence wages, the commercial farmer hires additional units of labor until marginal value product equals the wage rate. While this model combining two types of decision makers is one of the most appealing due to its realism, it rules out a clear mathematical formulation of marginal value product based on observed wages in the traditional sector.

(D) HOUSEHOLD CONSUMPTION/PRODUCTION MODELS

A number of economists (Barnum and Squire (1979), Jorgenson and Lau (1969), Nakajima (1969), Singh and Squire (1978 and 1981)) have been developing econometric models of production and consumption decisions in farm households. The models do not deal directly with modeling labor markets; however, labor demand and supply estimates are usually found within the system of equations. Furthermore, the usefulness

of the models is dependent on specific assumptions about the relationship between the labor market and the household.

Barnum and Squire point out that such models are of particular benefit in answering questions about the cost of moving labor from agriculture to other productive activities as they permit one to assess the impact of labor migration on remaining family members and, therefore, to obtain essential information for estimating shadow wage rates. Past efforts to examine these effects have looked only at production, neglecting the reorganization of household consumption patterns (especially with respect to leisure and the impact of the labor market on agricultural wages). Using an empirical study, Barnum and Squire show that taking household reorganization and market interactions into account, the cost of rural/urban migration can be 50% less than that obtained using a strict production approach. (Barnum and Squire, 1979, pp. 5 and 14) This work, although in a rather embryonic stage of development, seems to be getting at what Todaro (1980) said was lacking -- i.e., empirical analysis of changes in productivity due to migration.

Labor demand and supply decision making in an agricultural household situation is not entirely analogous to the neoclassical model of the labor market described previously. In that model, supply and demand decisions were made independently: the former by households supplying labor and the latter by farms demanding labor; the market wage served as the equilibrating mechanism. In the agricultural household case,

the same entity makes both supply and demand decisions. Under such circumstances, consumption and production decisions are not made independently, and, therefore, cannot be estimated econometrically. This problem exists because decisions about consumption of leisure determine the quantity of family labor supply left for production and, therefore, the level of output (assuming that labor is a constraining input and the household does not have access to hired labor).

The authors point out that the dual role of the farm household does not seriously complicate project analysis if most households participate in the existing labor market either as buyers or sellers of labor. This observation is supported by the work of Jorgenson and Lau (1969) which showed that, under certain assumed conditions, production and consumption could be modeled econometrically in a recursive system of equations. Specifically,

1) if households maximize utility which is a function of leisure and other consumption commodities, subject to a resource constraint;

2) if family labor and hired labor are perfect substitutes; and

3) if all households participate in the labor market,

then:

> the optimal production decisions of the household may be taken independently of the consumption decisions. In particular, this implies that at any given market wage rate the quantity of labor utilized on the household farm is independent of the quantity of labor the household is willing to supply. (Yotopoulos and Nugent, 1976, pg. 271)

Work with farm household models such as those discussed above is still highly theoretical with few empirical estimates having been made. Furthermore, the assumptions of perfect substitutability between hired and family labor, and full market participation certainly restricts the model's usefulness for many areas of the world.

Although the assumption of labor market participation by all households is of particular importance in the types of household econometric models discussed above, one is led to ask if the level of labor market participation shouldn't be given more attention by analysts who are simply using market wage rates as proxies for marginal value products of family labor. This is done more in comparative advantage studies than project analysis which lends itself to implicit valuation of family labor; nevertheless, examples of this line of thought are found in both types of analysis. When agricultural households do not participate in labor markets as either buyers or sellers of labor, it requires a huge leap of faith to assume that the marginal value product of family labor is equal to a nearby market wage.

(E) LESSONS DRAWN FROM LABOR MARKET MODELS

Many other labor market models have been conceptualized by economists, anthropologists, sociologists and others in an attempt to compensate for the inadequacies in the neoclassical economic model. The major lesson to be learned from the partial review above is that the choice of technique for estimating a marginal value product of labor implies some

underlying concept of labor market relationships and requires that the analyst consider the correspondence between the implied market model and actual labor conditions in the milieu of interest. A Harris-Todaro model certainly suggests different foregone marginal value products than a Lewis model. It is also important to recognize that little empirical work has been done to test the hypothesized relationships suggested in various labor market models and little work has been done on developing non-market models of labor allocation required for estimating marginal value products of labor for families which never engage in labor market transactions.

Given the economic theory and principles of opportunity cost pricing upon which economic analysis is built, the persistence of disequilibrium and the absence of empirically tested labor market models tend to weaken the very foundations upon which shadow wages are built. A review of empirical shadow wage estimates made in comparative advantage and project analyses is presented in the next several pages. The review makes it clear that analysts frequently assume the presence of a particular model or a particular type of disequilibrium with little attempt to justify that assumption, to clarify which marginal value product is being estimated, or to make the consequences of their choices explicit.

B. COMPARATIVE ADVANTAGE STUDIES FOR POLICY ANALYSIS

Largely in response to the series of droughts which have plagued Sahelian countries during the past ten to fifteen years, West African governments have established goals to

assure self-sufficiency in production of their major grain crops--rice, millet, and sorghum. Food self-sufficiency, it is believed, will protect nations from the devastating drain on their limited resources of foreign exchange which occurs when grain must be imported. The question of whether or not self-sufficiency in food production is really an economically sound goal has been raised from a number of quarters. Studies of national comparative advantages in producing particular food crops are an attempt to answer this question.

1. THEORY OF COMPARATIVE ADVANTAGE

The theoretical underpinnings of a comparative advantage analysis are found in general equilibrium theory as applied to international trade transactions. The details of the theory can be found in any standard economics text and will not be repeated here. In general, the theory maintains that nations which face different cost structures for the production of various goods can benefit from trade. Both the intensity of a nation's demand for particular goods and exchange rates determine the exact pattern of trade which is established. In general, however, each country specializes in those products which it produces most profitably and imports at least some of those products which it produces less efficiently. The implication drawn from this theory by those doing comparative advantage analysis is that a nation should not produce a product which it can import at a lower cost. The purely economic textbook model does abstract from political considerations such as the self-sufficiency and food security goals of

Sahelian countries. Furthermore, institutional constraints throughout the world do not often permit the rapid adjustment of exchange rates required to prevent recurrent balance of trade deficits. One of the major reasons for the model's failure to describe the real world is the existence of uncertainty. The theory assumes that each country knows with certainty the full range of production and trade possibilities and is able to respond instantaneously to any change in these variables. Although attempts have been made to develop trade models which incorporate uncertainty, Jabara (1979) for example, those doing comparative advantage analysis tend to rely on the more static neoclassical version of the theory. Such an approach is open to questioning due to the fact that disequilibrium rather than equilibrium tends to prevail. Nevertheless, economic analysis is performed in this manner and it is worthwhile examining exactly how this is done.

One of the tasks faced by the analyst who wishes to estimate the domestic cost of production is to select the appropriate opportunity cost. This becomes more difficult in comparative advantage analysis than in project analysis due to the fact that one is asking whether a country should increase or decrease production of a commodity. It is possible that the activity foregone by increasing production would not be the same as the next best alternative opportunity if production were cut back. For example, if rice production were economically and financially profitable, farmers might be encouraged to reduce leisure or time spent on off-farm

activities such as petty trading and handicrafts in order to increase rice production and cash incomes. On the other hand, if it were cheaper for the nation to import than to produce rice, government policy might try to discourage rice production. A farmer might respond by increasing production of millet and other food crops to assure subsistence. In the former case, the marginal value product of off-farm activities would be the appropriate opportunity cost; in the latter case it would be the marginal value product of millet production. Under conditions which might prevent families from allocating labor across all activities so that the marginal unit of labor in each activity has the same value, the opportunity cost of off-farm and millet activities could well be quite different. This is a fact of disequilibrium comparative advantage analysis which is frequently overlooked or glossed over by assuming a relatively active, competitive labor market.

2. COMPARATIVE ADVANTAGE ANALYSIS OF WEST AFRICAN RICE PRODUCTION

Despite the difficulties of comparative advantage analysis summarized above, numerous studies conducted during the last decade have tried to assess the economic viability of self-sufficiency objectives in West African rice production. The general approach used has been to isolate the rice production sector from the rest of the economy and compare domestic costs of rice production to the alternative of importing a comparable quality rice at world market prices.

A methodology developed by the Stanford Food Research Institute (see Pearson, et. al. 1981) was used on 1975-76 data in five West African countries to estimate comparative advantages in rice production. The methodology distinguishes between "private" and "social" profitability. The terminology differs somewhat from that used by Squire, Van der Tak and others in project analysis. The FRI "private" profitability is actually "financial" profitability in project analysis language and "social" profitability is the FRI terminology for efficiency or economic profitability. The FRI methodology does not make adjustments for the contribution of policies to non-economic objectives such as income distribution and therefore the term "social" profitability should not be confused with the Squire/Van der Tak type of analysis using "social" prices which incorporate weights for policy objectives other than increases in national income.

The FRI methodology relies on second best optimizing in its analysis which assumes that existing government policies causing non-optimal market distortions will remain in effect during the entire period for which the analysis is to be relevant. The authors suggest that "this is equivalent to deriving the first-order conditions for welfare maximization with market distortions acting as constraints." (Pearson, et. al., pg. 456) It has been mathematically demonstrated by Lipsey and Lancaster (1956) that meeting first order conditions in such second best situations does not guarantee achievement of a Pareto optimum. In other words, if it is

impossible to equate the marginal rate of substitution and the marginal rate of transformation for some pair of goods, it is better to deviate from these Pareto optimal equilibrium conditions for all pairs of goods except under certain very unusual and restrictive conditions. (Ng, 1980, pg. 220)

The FRI study does not explicitly address this problem of second best analysis and the relevance of the results for guiding the policy process. Ng (Chapter 9, 1980) offers an interesting and detailed discussion of second best optimization. He brings the concept of information costs into the maximization process and develops a set of third best rules which suggests that under conditions of informational poverty or informational scarcity, optimizing with second best constraints could well be considered a first best solution. There is no indication in the FRI work, however, that they are relying on Ng's third best assumptions.

According to the FRI method:

> ...positive social profitability implies an international comparative advantage because the country can produce rice efficiently both for its own use and for export. (page 9)

The FRI concept of "efficient" production is characterized by a situation where the social value of output is equal to or greater than the social opportunity cost of the commodities and factors of production employed. Humphries (in Pearson, et. al.) describes the procedure and rationale as follows:

> Production expenses are divided into categories--the taxes and subsidies stemming from government policies, and the real resource costs--which allow results to be calculated in both social and private

> prices. This measure of social efficiency, labeled net social profitability (NSP), equals the difference between the import value of a kg of rice and the cost of producing it domestically. Resource costs are divided into imported inputs valued at c.i.f. prices and primary factors--labor, capital, and land--valued at social opportunity costs. Because the NSP equals the difference between value added in world prices and opportunity costs to the economy of obtaining this value added, a negative NSP implies a lack of comparative advantage, or a loss of economic efficiency. (pp. 78-9)

While this method of analysis does identify those products which are profitable to produce, it does not offer any direct guidance on how much of the product to produce for domestic consumption and/or trade. Further analysis would be required to determine the relative profitability of rice with respect to other crops produced for export. In a closing chapter of the FRI study, a table using resource cost ratios to suggest the relative profitability of rice compared to other commodities such as coffee, cocoa, and palm oil is presented. The table is compiled from a number of sources and it is not clear that all estimates are based on the same underlying assumptions -- particularly with respect to costing of labor inputs.

(A) GENERAL METHODOLOGY FOR TREATING LABOR IN FRI ANALYSIS

It is helpful to keep in mind the general objectives of the comparative advantage analyses carried out by FRI, when turning to the following detailed examination of the methodology employed for estimating economic and social costs of rice labor -- the most costly factor of production in each of the five country analyses performed. With respect to labor

costs, the FRI overview of methodology is limited to a short statement of assumptions used consistently from one country to the next. The assumption which most influences the shadow price of labor in rice production is stated as follows:

> Although most work is performed by the family, all farm labor is valued at the wage rate paid to casual, unskilled workers available from the local labor market. (pg. 446)

The FRI decision to equate the cost of family labor with that of hired unskilled labor in both economic and financial analysis differs from procedures commonly used by project analysts who frequently value family labor implicitly as part of a residual net benefit covering returns to family labor, management, and equity. This residual method is discussed in more detail on page 60 where project analysis techniques are described. It is mentioned here because of its absence from the comparative advantage literature. An analysis which explicitly values all family labor at the wage rate can make a production process appear either more or less expensive than an analysis which relies on an implicit valuation based on residual returns. Winch (1976), for example, found returns to family labor in northern Ghana to be much greater than prevailing wages while Kamuanga (1982) found them to be a great deal less than wages in Mali. One is inclined to ask why those doing comparative advantage analysis do not try to formulate the problem in more of a project analysis framework. This would call for comparing the profitability of rice production to the profitability of those activities which would be

eliminated were rice production increased or expanded if rice production were decreased.

Barnum and Squire (1977 and 1978) suggest that some justification for treating family and hired labor as a homogeneous input should be presented: this is not done in the Stanford study. Using the same concept of valuation for determining the marginal value product of both hired and family labor implies either (1) that family labor would hire itself out as unskilled labor if not currently engaged in rice production or (2) that subsistence production of staple foods would be the alternative employment of family labor and that the wage rate for unskilled labor approximates the returns to family labor in subsistence agriculture. If the situation described in the second alternative were true, the wage rate would reflect the marginal value product of both hired and family labor in the next best alternative activity to rice production. The fact that FRI did an analysis demonstrating that the wage rate in the savannah zone of the Ivory Coast did approximate the returns to subsistence labor implies that the assumption is based on the latter case. Unfortunately, similar data were unavailable for other countries and the existence of these conditions cannot be generalized across national borders.

Although the FRI study assumes that the marginal value product of family and hired labor are equal, a discussion is presented suggesting that under certain circumstances the marginal value product of family labor could be greater than

observed wages. For example, they consider the possibility that farmers might possess technical and management skills of a sufficiently high level to justify an imputed wage greater than that prevailing for unskilled labor. These comments seem inappropriate in this context given that the objective of the analysis should be to cost labor at its next best alternative employment. Were a farmer not farming on his own, it is unlikely in West Africa that he would be hiring himself out as a farm manager. Work by Hoffman and Gustafson which will be discussed in Chapter V criticizes this type of opportunity costing in the U.S., where the possibility of finding work as a hired manager is certainly much greater than in Africa.

Appendix B (pages 464-467) of the FRI report offers an additional explanation of the logic behind equating the opportunity cost of all rice labor with the unskilled wage rate. Among the arguments presented are:

1) Official minimum wage laws do not appear to inflate wages actually paid by farmers;

2) Tax and subsidy distortions usually require no shadow wage adjustment because:

a) Both hired and family labor for rice are withdrawn from production of subsistence crops which tend to be exempt from taxes and subsidies;

b) Income and price effects of a possible decline in subsistence crop consumption (assumed untaxed) and an increase in rice consumption (assumed taxed) are thought to cancel each other out as the products involved are substitutes;

c) Tradeoffs in production and consumption patterns involving subsistence crops and rice will not have an important effect on consumption of other goods and services, hence, there is no need to make shadow price adjustments for distortions in other consumer markets.

Possible exceptions to this rule of thumb were mentioned; one dealing with family labor is of particular relevance. Although the suggested methodology consistently values family and hired labor at a shadow wage based on observed market wages, FRI suggests that the market wage could be an over-estimation of the true opportunity costs of moving a unit of family labor between staple crop production and rice production. The market wage presumably covers costs incurred by hired labor which are not incurred by family labor; i.e., costs of transport, job hunting, living away from home (for temporary labor), purchasing food at market prices, etc. In discussing the effects of this over-estimation, FRI states:

> The problem may not be very great if agriculture is highly commercialized and the rural labor market well developed. It is more severe in traditional, smallholder agriculture which is incompletely linked to the cash economy. (p. 468)

The authors seem to be implying that if agriculture is commercialized, little family labor is used and/or family members can easily move from on-farm to off-farm employment. The existence of commercial agriculture, however, still does not negate the fact that the market wage rate includes payment of costs for participation in the labor market and should not be used as a marginal value product for family labor. When

family labor is employed on the family farm, costs of working away from home are not incurred and should not be allowed to inflate the costs of rice production.

(B) CASE STUDIES OF SHADOW PRICING IN COMPARATIVE ADVANTAGE ANALYSIS

Reports of specific country analyses using the FRI methodology do attempt to justify their choice of the prevailing unskilled wage rate as the opportunity cost of hired labor. Little discussion is offered, however, concerning the appropriateness of valuing family labor at the same rate. A brief summary of assumptions made about the five labor markets considered and adjustments to observed wages deemed necessary, helps to focus attention on a number of unanswered questions.

Ivory Coast

The reasons given for using the annual average observed wage rate as an approximation of the marginal value product for hired labor were that:

1) factor markets functioned well
2) distortions caused by the government were minor
3) seasonality factors did not change the wage rate

Evidence was presented to demonstrate that wages varied by sex and ecological zone; only one isolated case of seasonal variation in wages was found. Shadow wages used took into account variations due to sex and region as well as adjustments for costs of meals, job search and supervision. As mentioned previously, the Ivory Coast is the one country where data were available in one region to confirm that the wage rate -- adjusted for costs of transportation, meals,

supervision, etc. -- did indeed approximate returns to traditional food crop production for farm consumption. This provides evidence -- for the region under consideration -- that the marginal value product of hired and family labor are approximately equal. It is not clear, however, whether the returns to traditional food crop production were returns to only labor or included returns to management and capital investments.

Use of the wage rate or returns to subsistence production as the opportunity cost of rice production implies that, were rice farmers to discontinue rice production, they would engage in subsistence crop production or hire themselves out as unskilled labor. While this is not clearly stated in the analysis, it is implied.

Sierra Leone

> Shadow wage rates for unskilled labor are taken to be the same as market wages. There is ample evidence of the existence of an active rural labor market with minimum distortion of wages. (p. 214)

This is the only statement in the FRI analysis concerning shadow prices of labor in Sierra Leone. No discussion of the relationship between the wage rate and the marginal value product of family labor is presented. Spencer does refer us to an earlier publication (Spencer, 1979) in which the Sierra Leone labor market was studied and observed wages were shown not to be influenced unduly by existing minimum wage legislation, implying that wages were, therefore, adequate estimators of the marginal value product of rice labor. Unlike studies in a number of other countries, Spencer found

strong evidence of seasonality in wages, as well as regional, sex and age related wage differentials.

Senegal

Senegal is another case presented which fails to give strong evidence that the wage rate for unskilled labor provides a true measure of the opportunity cost of both family and hired rice labor. Without presenting their corroborating evidence, the authors state that the factor markets function well, causing prices to reflect scarcity values, and that minimum wage legislation has little impact on market wages. No mention is made of seasonal variation in wages. Some evidence of regional variation is accounted for by relocation costs.

One interesting adjustment, however, is made in the case of female labor engaged in the traditional method of rice production used in the Lower Casamance. The authors felt that female labor would be more appropriately valued at 5/6ths the male rate. The authors state that:

> Ties between the traditional and commercial sectors in this area of underdeveloped infrastructure are weak, and the supply of family labor to the market could be quite inelastic. Hence, valuation of predominantly female traditional on-farm labor at the market wage rate of the commercial agricultural sector overstates the reservation price of family labor in traditional techniques. (p. 280)

The implication seems to be that, given restrictions on their participation in labor markets, women are willing to work in family rice production activities even though returns per unit of labor are less than the market wage. This assumption

brings to the surface two problems of particular interest in the present study: (1) The problem of aggregating across non-homogeneous labor groups and (2) the problem of estimating a marginal value product for the labor of families which do not participate in the labor market.

The problem of non-homogeneous labor comes to the surface when one realizes that the Lower Casamance is settled by families of very different religious and cultural perspectives. Consequently, attitudes toward female participation in the labor market vary sharply from village to village. For example, Balante women of Birkama are not permitted to seek employment outside the village while the percent of Djola women of Oussouye, Diatock and Baraka who migrate in search of employment is often greater than that of village males. (See deJonge, et. al, 1978, pp. 84-85.) The FRI research does not mention such differences, and it is not at all clear that the more predominant tendency in the region is the one reflected in the FRI analysis.

The second question raised by FRI's five-sixths valuation rule for Casamance females concerns the choice of a marginal value product for family labor in any household which does not hire labor in or out: i.e., is the full market wage rate ever a good proxy for such labor? This issue is discussed in more detail in Chapter IV in conjunction with the case study.

Liberia

The typical Liberian farmer engages in both cash and staple (subsistence) crop production. Although rice is

produced as a subsistence and a cash crop, the FRI analysis looks only at the opportunity cost of cash crop rice production. The authors describe a farmer's optimal allocation of labor between subsistence and cash crops as the production point at which returns in subsistence agriculture plus the value of decreased risk derived from food security is equal to the wage and/or returns in cash crop production. Consideration of the risk factor appears important and is surprisingly absent from other FRI analyses. It was observed that families engaged in both staple crop and cash crop production would deal with labor shortages by transferring labor from staple to cash production, hiring unskilled labor to perform staple crop tasks. No mention was made of observed seasonality in wages; differentiation by region and sex was accounted for in the analysis.

The hypothesis is that the next best alternative to cash crop rice production would be to transfer labor to coffee or cocoa production, maintaining approximately the same level of staple crop production. Because there is an active market for labor on coffee and cocoa plantations, the wage rate for this unskilled labor was selected as the marginal value product of alternative cash crop employment and therefore the opportunity cost of rice production. The impact on wages of government policies maintaining low coffee and cocoa prices and high rice prices was considered. No adjustment was made as it was found that the price effects balanced out in the market for unskilled labor which was relatively unsegmented across crops.

Based on these observations of labor utilization, it was determined that the market wage offered a good approximation of the marginal value product for both hired and family labor.

Mali

The Malian analysis does not address the issue of whether the wage of unskilled labor provides an accurate estimate for the marginal value product of family labor in rice production; both types of labor are assumed to have equal value.

Consideration was given, however, to adjustments to compensate for the existence of government price intervention in cotton and peanut production. It was determined that most rice labor was drawn from millet regions where taxes do not exist rather than from peanut and cotton sectors. Given this pattern, adjustments to the observed wage were not found necessary. Further consideration is given to the appropriateness of these assumptions in Chapter IV.

Summary of Case Studies

The following summary observations can be made about the FRI approach to shadow pricing of rural labor.

1) Little data or descriptive material is provided to support the general assumption that the marginal value product of family labor is equal to that of hired labor. There seems to be an implicit assumption that farm families are indeed allocating labor among alternative activities so that the marginal value product for all categories of labor is equal across activities and fairly well reflected by market wage rates.

2) Consideration of non-competitive behavior in the labor market seldom goes beyond the effects of minimum wage legislation and the impact of government imposed product price distortions.

3) The role of sex, location, and seasonality in causing wage variation was considered in most cases and necessary adjustments made to the marginal value product; these variables did not have a consistent role in wage determination from country to country, suggesting that they are parameters for which generalizable rules and/or assumptions should not be postulated.

4) Little time was devoted to presenting a model of the relevant labor markets to explain why the opportunity cost of rice production was based on the marginal value product of a particular alternative activity such as paid employment. The Liberian study came closest to presenting such an analysis. The implicit assumption that a market functions competitively unless constraining government institutions are present seems tenuous in a developing country context where socio-cultural constraints may be more important than those imposed by government. The potential role of socio-cultural constraints has been acknowledged in theory (e.g., the work of Temple discussed by Bruce), but few practitioners have been able to incorporate such factors in their empirical work. The Senegalese case where the marginal value product of female labor was adjusted is an exception.

5) In three of five countries, rice production was found not to have a comparative advantage. The implication of this finding is that farmers in these countries should switch to production of some other crop. Were substantial numbers of farmers to do so, policy makers would no longer be considering a situation of marginal change and the tools of marginal analysis used by FRI would have questionable relevance.

This review of comparative advantage studies has provided several concrete examples of opportunity cost estimates which do not entirely measure up to the dictates of economic theory. In many cases, it is the problem of applying static equilibrium theory to a dynamic disequilibrium situation which is responsible for the inadequate estimates. In other cases, lack of data appears to be the culprit. In the latter case it may have been decided that the cost of better data and estimates outweighed the benefits. One is prompted to ask, however, the extent to which less than ideal estimates should temper the uses made of the full economic analysis and the role which sensitivity analysis might play in rendering these estimates more useful to policymakers. These questions will be dealt with in more detail in Chapter V.

C. SHADOW PRICES OF LABOR IN PROJECT ANALYSIS

1. THEORY AND PRACTICE

International donor agencies financing large scale development projects require detailed ex-ante analysis of project proposals to estimate both financial and economic profitability. Given a situation where markets function freely without

the imposition of government taxes or subsidies, and observed prices reflect the true relative scarcity of resources, financial and economic profitability would be identical. The real concern in project analysis is the situation where various constraints prevent observed prices from reflecting the true cost to society of a particular activity. Squire and Van der Tak provide a helpful illustration of the concept:

> ...a money payment made by the project-operating entity for, say, wages is by definition a financial cost. But it will be an economic cost only to the extent that the use of labor in this project implies some sacrifice elsewhere in the economy with respect to output and other objectives of the country. (pg 16)

In other words, if labor used in a project would have been unemployed without the project, the economic cost to society in terms of foregone output might be zero. The key to the estimation of the economic cost of labor is to determine the marginal value product of labor in its without-project occupation.

When dealing with both the economic and financial costs of family labor in agriculture, a variety of estimation techniques are commonly used. When possible, analysts implicitly value family labor using the method mentioned on page 47. With this method, residual net benefits without a project are compared to residual net benefits with a project. The incremental net benefit due to the project is obtained by subtracting the former from the latter, providing a measure of returns to project investment which is used to decide whether the project meets the minimum returns to capital desired. A

decision can be made to accept or reject an agricultural project using family labor without making any reference to market wages; although any project labor demanded in excess of that used without the project can be explicitly valued at some estimated opportunity cost derived from observed wages. A variation of this method is to calculate the without project net benefit of the farm family to obtain an estimate of returns to family labor, management, and equity. If the analyst assumes that returns to equity capital and management are inconsequential, returns per person day of family labor can be obtained by dividing days of labor input into net benefit. Adjustments can be made to the net benefit for wages or income earned in off-farm activities. The resulting return per family workday in without project activities can then be contrasted to the anticipated return per workday with the proposed project. This approach is more commonly encountered in financial analysis than economic analysis as it provides an indication of incentives for farmers to participate in project activities. In both cases, however, the analyses provide results which may be quite different from a case where all family labor is valued at the wage rate. (See Gittinger, Scott, et. al, or Brown for more details on this residual method.)

When it is not possible to compare the with and without project benefits from farm family labor because the family engaged in farming with the project was not previously so engaged, the opportunity cost of project labor is based on any

income from pre-project employment which is foregone due to project activities. The criterion is actual income foregone, and its calculation requires some knowledge of the pre-project days actually worked by the laborer(s) in question.

Unlike family labor, the cost of hired labor tends to be based on the prevailing wage for unskilled labor adjusted for market distortions. There is an implicit assumption in these procedures that the marginal value product of family labor does not equal that of hired labor, and that farmers do not allocate labor inputs in accordance with neoclassical theory. Numerous techniques for identifying market distortions and quantifying them so as to translate observed wage rates to shadow rates have been developed. Many project analysts begin this process by developing a model of a particular labor market in an attempt to identify the factors which might cause distortions. Once the nature of the distortions is recognized, specific techniques for calculating adjustments can be applied.

2. CORRECTING FOR DISTORTED WAGE RATES

Synthesizing suggestions from a variety of sources, Colin Bruce (1976) sets out five methods for calculating a reasonable estimate of the marginal value product of unskilled labor when it is suspected of deviating from the market wage rate. As Bruce discusses these various methods, the reader is not sure if the marginal value product being estimated is correcting for a disequilibrium created only by supply being greater than demand, or by producers not being able to equate

wages paid with marginal value products, or by some combination of the two. The implication is that there is some exact marginal value product of labor which exists when all the conditions of the equilibrium price auction model are met. The formulas presented are thought to bring the analyst closer to that marginal value product. One observes that the suggested adjustments tend to move estimates in the anticipated direction vis a vis wages. It is unclear, however, exactly what theoretical grounds exist for assuming that the marginal value product is a linear function of wages and unemployment rates. This linear relationship is implied in a number of the estimation methods. The five methods discussed by Bruce are presented in summary form in the following paragraphs.

1) A sample survey which directly asks by what amount output would change if one person's labor were added or taken away from the present productive process. This would be an expensive and time consuming process.

2) Calculation of an average wage which has been weighted by seasonal variation in the ratio of labor utilization to labor availability. Such an average could be expressed as follows:

$$M = \sum_{j=1}^{12} (D_j/S_j)W_j$$

M = Marginal value product of labor
D_j = Labor utilization per month
S_j = Labor availability per month
W_j = Average monthly market wage

This formula assumes that an analyst is able to calculate an average wage for each month of the year, as well as monthly labor utilization and availability for the relevant market. Given classical wage theory, one then hypothesizes that this observed wage would be equal to the marginal value product if and only if labor actually utilized was equal to labor actually available. Bruce's formula for estimating marginal value product would give the monthly observed wage a weight of unity in such a case. If, on the other hand, supply is greater than demand, the observed wage would receive a weight of less than one. Bruce notes that difficulties inherent in measuring labor availability render this method impracticable for implementation, but more feasible than a survey such as that suggested above. Furthermore, the method seems to ignore Bruce's own observation that wages paid in traditional agriculture may be greater than marginal value product due to social constraints. The adjustment only accounts for that part of labor market disequilibrium resulting from excess supply.

Another shortcoming of the method is its failure to weight the marginal value product of different months to reflect seasonal variability in rural labor use. For example, the slack season marginal value product receives equal weight with the peak season marginal value product in the annual aggregation even though it might represent a very small fraction of total labor hours utilized during a given year. An attempt is made in Chapter IV to use this formula in estimating the marginal value product of "Office du Niger" labor.

Additional problems of using the technique will be addressed in conjunction with the case study.

3) In the absence of detailed labor availability and utilization data, one can approximate method two by assuming wages equal marginal value product during the peak season and estimating underutilization during slack periods. These estimates of labor availability can then be plugged into the equation shown above. In other words, the Dj/Sj ratio for the peak period would be unity. A "guesstimate" of the Dj/Sj ratio for slack periods would be made. These ratios would be used in the Bruce formula in conjunction with actual data collected for Wj's.

4) Estimate the average product of labor (in terms of economic prices) by dividing the value of total agricultural production -- preferably for a region, and preferably deducting the value of inputs, such as fertilizers -- by the size of the agricultural labor force. If nothing is known about the difference between the average and marginal products of labor, one could take half the value of the average product as being the very approximate value of the marginal product.

5) To obtain an estimate of marginal value product per worker year, Little and Mirrlees suggest the following:

a) Assume M=Wj in peak periods

b) Obtain an average of peak and non-peak marginal value products for the year

c) Multiply average marginal value product by the estimated number of days labor in the project area is fully

employed to obtain an estimate of marginal value product per man year. This method resembles method three above, but is converted to an annual basis by adjusting for average number of days a worker might expect to be unemployed.

Brown (1979) also suggests a number of ways to estimate the economic cost of both family and hired agricultural labor. His recommendation for basing the value of family labor on net returns to the farm family has already been discussed. For hired labor which appears to be underemployed without the project, he recommends using the peak season wage rate multiplied by the number of days when labor is scarce as an estimate of the annual cost of removing one laborer from the agricultural sector.

By way of summary, Bruce suggests that four specific questions must be answered for proper opportunity costing of labor:

1) What is the marginal value product of project labor before it is moved to the project?

2) What is the marginal value product of family labor in on-farm activities carried out before the project?

3) What are the seasonal fluctuations between the demand and supply of project labor likely to be?

4) What seasonal variations in market wages exist before the project and are likely to exist during it?

Due to the problems inherent in collecting this type of labor utilization and supply data, project analysts tend to resort to one of the suggested short cuts or a variation

thereof rather than conducting a survey or attempting the second method proposed by Bruce. In the past few years a number of empirical estimates of shadow wages have been attempted by field economists actually doing project analysis and by theoreticians trying to test the validity of their theories. Some of this work is reviewed below.

3. SHADOW PRICING OF LABOR IN PRACTICE

(A) Thailand

In his guide to project appraisal Bruce includes an example of country parameter estimations for Thailand. The marginal value product of labor in various labor markets is one of the parameters estimated. When considering the financial, economic, and social prices of labor, the consultants made a distinction between hired and family labor valuation only in the financial analysis.

> ...(financial cost of labor is) costed at Baht 12 for hired labor and Baht 9 for family labor, which is the imputed cost at estimated "reservation wage" (illustrative). (p. 115)

For the economic analysis, all labor was valued at the single rate of Baht 6 derived as follows:

> The CR (consultant's report) estimates that on average throughout the year the labor force is employed only 25 percent of the time--55 percent during peak periods of sowing, weeding and harvesting. The CR further estimates that with the project the labor force will be employed an average of only 50 percent, 75 percent during peak periods.
>
> The CR gives no seasonal variation in wage rates: the rate given of Baht 10/day rising to Baht 12/day is assumed to be an average. Taking into account the underemployment it was roughly estimated that the marginal product of labor is half the market wage, i.e., Baht 6/day. (p. 93)

Although not specified, this decision appears to assume that labor used by the project will most likely be drawn from the pool of wage laborers rather than those currently self-employed on family farms.

(B) Turkey

Mashajekhi (1980) divides the Turkish labor market into three sectors to estimate the shadow wage rate. He assumes that the sectors are linked in a Harris/Todaro type market where migration is a function of urban employment probability and rural-urban wage differentials. The rural market is characterized by surplus labor as well as open unemployment, but marginal value product is assumed to be greater than zero. Mashajekhi points out that his particular variation of the Harris/Todaro model assumes a constant rate of urban unemployment implying that the migration in response to a newly created urban job will be equal to the ratio of the urban labor force to the level of total urban employment. Given these assumptions, the opportunity cost of creating new urban employment which withdraws labor from rural sectors is found by multiplying the marginal value product of rural labor by the migration rate.

In his treatment of the rural labor market no mention of family labor is made; estimates are derived solely with respect to the market for hired labor. In estimating the marginal value product of rural labor, the author relies on World Bank shadow wage estimates for a 1977 forestry project. The method estimated a weighted average wage from observed peak

and slack season payments, assuming M=Wj during the peak season: labor utilization for slack seasons was estimated. This description suggests the third method described by Bruce.

The marginal value product of rural labor also plays an important role in the Mashajekhi analysis of the informal urban sector as the author assumes that the marginal value product of rural labor approximates that in the urban informal labor market. The assumption is based on the observation that rural labor migrating to urban areas tends to be absorbed by the informal sector before moving on to the formal one where wages are higher due to unions and government minimum wage laws. It is not clear how transfer costs and possible differences in rural/urban cost of living would affect this assumption. Given the high probability that urban costs of living exceed those in rural areas, and that migrants will incur transfer costs, one would anticipate that urban marginal value product as well as urban wages would have to be greater than rural marginal value products to sustain rural/urban migration over time.

Table I summarizes some of Mashajekhi's results and permits one to note how shadow wages differ when the migration effect implied by the Harris/Todaro model is considered. This table illustrates the importance of having a clear and accurate conceptualization of the labor market before attempting to estimate shadow wages. In addition to calculations of shadow wages, Mashajekhi presents accounting ratios (Table II), i.e., the ratio of the shadow wage rate to the observed market wage.

TABLE I

SHADOW WAGE RATES IN TURKEY
TURKISH LIRAS

	TEP	EEP	SP1	SP2
LABOR SECTORS				
RURAL	35	59	50	55
URBAN INFORMAL				
NO MIGRATION EFFECT	35	75	60	68
MIGRATION EFFECT	44	84	69	76
URBAN FORMAL				
NO MIGRATION EFFECT	118	173	153	163
MIGRATION EFFECT	148	203	183	192

NOTE: TEP = TRADITIONAL EFFICIENCY PRICE
EEP = EXTENDED EFFICIENCY PRICE (ADJUSTED FOR CONSUMPTION EFFECT.
SP1 AND SP2 INCLUDE ADJUSTMENTS FOR SOCIAL ACCOUNTING.

SOURCE: MASHAYEKHI, PAGE 56.

TABLE II

ACCOUNTING RATIOS FOR TURKISH LABOR

	TEP	EEP	SP1	SP2
RURAL SECTOR	.39	.65	.56	.60
URBAN INFORMAL SECTOR	.32	.66	.55	.61
URBAN FORMAL SECTOR	.43	.64	.57	.60

SOURCE: MASHAYEKHI, PAGE 56.

It is interesting to note that while the absolute levels of shadow wages vary substantially, the accounting ratios are much more uniform.

(C) Morocco

Cleaver (1980) presents an exercise in country parameter estimation for the Morocco Fourth Agricultural Credit Project. The project proposed to make credit available to farmers who were willing to adopt new production techniques. Five model farms were conceptualized, each representing a change in agricultural technology and/or enterprise combinations for farmers. The 1979 Morocco rural labor force was thought to be 3.1 million man years of which only 60% was fully employed. Project related increases in rural employment were estimated to be 78,000 man years of family labor and 37,400 man years of hired labor.

Cleaver describes his rationale for labor valuation as follows:

> The opportunity cost of labor is estimated at about 50% of the average wage rate, which is close to the value of subsistence consumption. An alternative calculation, based on the percentage of labor employed per month and on the average daily wage, yields an average opportunity cost of unskilled labor equal to 30% of the daily wage. The higher opportunity cost was used in the economic analysis. (p. 11)

No distinction is made between family and hired labor. It is interesting to note that were the Moroccan labor market to resemble the Bruce/Temple model presented above, use of an opportunity cost of labor approximating the subsistence wage would be an over statement of the marginal value product of

labor. The fact that Cleaver's alternative calculations, which approximate Bruce's second method, resulted in an opportunity cost lower than subsistence further suggests that the Temple model may be relevant. One assumes, however, that the higher rate was selected to assure a conservative estimate of economic profitability for project activities.

(D) Iran

Irvin (1975) has estimated the marginal value product of unskilled labor for various regions in Iran. These estimates were made in conjunction with an International Labor Organization study to develop a method for selecting road construction technologies which would optimize use of labor from a national social accounts perspective rather than from a private profit maximizing point of view.

The model used a range for estimating net product foregone in agriculture rather than a specific value. The lower limit of the range was zero. This value assumed conditions of open unemployment and labor allocation practices which allowed for a migrant's pre-project work to be performed by a previously unemployed person (i.e., the extreme case of the Lewis model). As pointed out by Sen and noted above, a marginal value product of zero could not possibly be an equilibrium wage, hence, Irvin is suggesting an estimate which cannot be justified by the price-auction model underlying neoclassical labor theory. The upper limit for the marginal value product under conditions of seasonal unemployment or poor labor mobility due to discrimination, inadequate information flows, etc.

was considered to be the casual agricultural wage. The author points out that the model cannot be used if the usual marginal conditions do not prevail -- i.e., if a large change in employment and/or wages is anticipated. This is a clarification which is often neglected in other marginal value product estimates.

Irvin's full shadow wage rate estimate is quite complex as the upper and lower limits of the foregone product are adjusted by a number of subjectively determined parameters such as premiums on investment, foreign exchange, and rural consumption. A discussion of these adjustments is beyond the scope of this paper. One adjustment, however, which warrants further attention here is the cost of transferring a worker to new employment. Irvin considers an estimate of the foregone product of transferred labor to be incomplete if the worker incurs greater costs of food, housing and transportation and/or the employer must undertake greater costs of supervision or administration for each new worker hired. In such cases, the total economic cost is the foregone product plus the sum of these other costs which divert funds from investment to consumption. These adjustments seem appropriate given the fact that the foregone product is indeed being estimated by the agricultural wage (8.75 Rls./hr), the wage paid prior to a laborer's transfer to road construction. This agricultural wage is quite different from the unskilled road labor wage (16 Rls./hr). The wage differential is usually thought to include the necessary compensation required by an

agricultural worker if he is to incur the costs of migrating to road employment.

This discussion of transportation costs leads one to question the tendency of other analysts to ignore such costs when working backwards from market wages to marginal value products of family labor. If Irvin considers their inclusion essential for his analysis, should not those estimating the marginal value product of family labor from observed market wages be doing the reverse, i.e., subtracting out the costs of migration rather than equating the marginal value product of hired and family labor? Other empirical studies reviewed in this paper do not consistently take this into consideration, even though one would expect it to be of great interest in comparative advantage analysis where most labor is provided by the family.

(E) Taiwan and Philippines

Reference was made in Chapter II to McDiarmid's belief that shadow wage rates should be estimated using adjustment parameters derived from macro level data. He attempts to develop a number of these parameters for four countries -- Taiwan, Korea, Indonesia, and the Philippines. Due to data limitations, he was unable to estimate the marginal value products for Korea and Indonesia. McDiarmid followed the UNIDO method (see Dasgupta, et. al., 1972) of estimating the ratio of marginal productivity of agricultural labor to the wage of non-agricultural labor (M/W). He points out that his analysis relies on many of the assumptions associated with the

Lewis labor market model described previously. Of particular relevance are the assumptions of homogeneity in the non-agricultural labor force and the presence of a chronic surplus of labor.

McDiarmid refers to Taiwanese data series on indices of money and real wages for agriculture, mining, and manufacturing, as well as to series on labor productivity growth in the various sectors. Using this data he develops the following set of labor productivity/real wage ratios.

TABLE III
RATIO OF LABOR PRODUCTIVITY TO REAL WAGES, TAIWAN

YEAR	AGRICULTURE	MANUFACTURING
1960	1.87	1.21
1965	2.02	1.31
1969	1.55	1.57

Source: McDiarmid, pg. 99

Drawing on employment statistics which indicated that "1960 was near the start of a large shift of labor from agriculture to industry and services after a considerable period of stability," the author assumes that in 1960 a reasonable equivalence existed between productivity and real wages in agriculture and an equilibrium also existed between the agricultural and manufacturing sectors. Due to low levels of unemployment in Taiwan* and other institutional factors, he further assumes that -- consistent with the Lewis model -- workers in non-agricultural sectors are earning their marginal value products. Given these two assumptions, McDiarmid uses the data in Table III to calculate a 64% decline in parity of

agricultural labor productivity with respect to manufacturing labor between 1960 and 1969. McDiarmid takes this to be a "rough indication of the relationship of marginal productivity of agricultural labor to real wages and, therefore, a rough measure of overpayment of labor in agriculture." (McDiarmid, pg. 98)

Growth in productivity data series were not available for the Philippines forcing McDiarmid to base his M/W ratio on an estimate of average labor productivity in agriculture. A 1970 OECD study estimated that productivity of agricultural labor was approximately 36% that in other sectors and that it had grown 47% from 1949-65. Making a number of observations about the possible relationship between average productivity and marginal productivity during the 1949-65 period, due to non-proportional increases in use of agricultural factors, McDiarmid concludes that marginal product equaled average product in the early 1950's. This inference permits him to estimate a .53 M/W ratio.

If the above summaries of McDiarmid's estimation procedures appear vague, it is because his discussion of the inferences drawn and the mathematical manipulations made is very cursory. The reader is not provided with clear explanations that enable him/her to follow the theoretical and mathematical logic behind the estimates. The highly

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*It should be noted that government employment statistics ignore un/underemployment in Taiwanese agriculture.

aggregated nature of the estimates and the inadequacies in the Philippine data make it extremely difficult to imagine how an analyst would use and/or modify these national estimates for evaluation of projects in regions where productivity and wages might not be well represented by national averages. Although his use of Philippine agricultural productivity data (based on net value of output per household per workday) circumvents the problems associated with trying to understand the relationship between family and hired labor, it presents the new problem of trying to determine the relationship between average and marginal productivity. Use of aggregate productivity measures also assumes that there is equal income and work sharing throughout the agricultural sector and that remaining family members do not increase their output after migration. (See Irvin, 1978, pg. 122 for a discussion of this.) If this latter assumption is implicit in the use of aggregated productivity measures, then it is unlikely that the labor market model underlying McDiarmid's analysis is really a Lewis model as he implies.

(F) Summary

Numerous other attempts have been made to estimate shadow wage rates for project analysis. Appendix A provides a list of other empirical work consulted for the purposes of this study. Brief notes about techniques used to estimate shadow wage rates are included. A review of these studies offers little additional insight into superior techniques for estimating the elusive marginal value product of hired and/or

family labor. As a rule, one finds analysts forced to make sweeping generalizations and tenuous assumptions as described in the few cases presented above. The estimated shadow wage rates are then integrated into the project analysis. The sensitivity of the analysis to marginal value product estimates is often discussed but the sensitivity of marginal value product estimates themselves to various assumptions about labor markets, quality of data used, and methods of data analysis are not always made explicit. In the absence of a price-auction labor market in equilibrium, the analyst is forced to make choices about what data to use and which marginal value product to estimate. The necessity of making such choices frequently puts the analyst in a position where s/he could unwittingly be making political decisions with important equity implications.

D. POLITICAL IMPLICATIONS OF TECHNICAL CHOICES

The public finance literature discusses at great length the political ramifications of choosing a discount rate, pricing foreign exchange, or opting for social versus efficiency pricing procedures. The fact that this paper is devoted to a discussion of shadow pricing labor and virtually ignores the issues of shadow pricing capital or foreign exchange is not meant to imply that correct pricing of non-labor inputs is any less important. It is felt, however, that inadequate attention has been given to valuing labor in economic analysis of activities which have very large labor components.

Having recognized that the route to shadow wage estimates taken by most analysts is often full of detours, one feels obliged to ask some pointed questions about the political implications of choices made at various crossroads along the way. One finds a surprising lack of such discussion in the project analysis literature concerning shadow wage rates. The heated debates tend to be about whether marginal value products of rural labor are equal to, greater than, or less than zero rather than about the macro economic growth and equity implications of using different estimates.

The following discussion presents a brief overview of the distribution and growth implications of various magnitudes of shadow wage estimates. The reader may feel that the examples presented exaggerate the potential impact of any single project or comparative advantage analysis. While this cannot be denied, one must also admit that the only major investments being made in many developing economies are being channeled through the World Bank and other donors who do use principles of economic analysis for allocating funds. Senegal, for example, relies on foreign aid and grants for 85-90% of its new development projects. (Gellar, 1980) The purpose of this discussion is to stimulate thought on the possible cumulative effects of economic analysis, rather than to present evidence that economic analysis is already responsible for some of the macro economic problems discussed below.

(A) INFLATION*

When economic analysis is performed using a shadow wage rate which is less than the actual financial cost of employing labor in project activities, the choice of shadow price could have macro economic policy implications. In the absence of capital rationing, costing labor at less than market rates will result in a greater number of government financed projects passing muster (i.e., net present value > 0). In the more likely situation where capital rationing exists, projects which are selected will very likely be those with sizeable labor inputs. The larger the gap between shadow wages and market wages, the larger the labor component one might anticipate in acceptable projects. As government sets out to implement these projects and pays the going rate, overall demand for labor at this wage will increase, putting upward pressure on wages paid by the informal sector which escape administration of the minimum wage. In other words, if a government wishes to pursue a deflationary economic policy, project analysis which keeps shadow wages below observed wages will not be in tune with the prevailing policy.

In addition to canceling out any deflationary pressure on wages due to excess supply, the implementation of projects with large labor components could well trigger unanticipated

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*The discussion of inflation, monetary and fiscal policy, and growth in the next several pages is drawn from a similar discussion in Schmid, 1983. An effort has been made to recast his discussion to better reflect the developing country context addressed in this paper.

inflationary pressure in labor markets. The size of resulting changes in market wages would most likely depend on the nature of market distortions originally causing wages to be greater than marginal value products (e.g., social, cultural, informational, etc.) and whether or not the projects implemented made any attempt to remove the distortions. Research attempting to ascertain the extent to which the cumulative effects of economic analysis using different shadow pricing assumptions might raise wage levels and, therefore, accelerate inflation in developing countries would seem appropriate.

Neoclassical and Keynesian theory both suggest that in an economy with high levels of unemployment, more laborers can be put to work without causing wages and prices to rise. Recent experience in both industrialized and non-industrialized countries suggests that reality diverges from theory on this issue. While economic analysis in developing countries continues to build on the foundations of neoclassical theory, economists in developing countries are increasingly challenging the price-auction labor model. There has long been a tendency for economists working in developing countries to rely on neoclassical equilibrium theory and simply explain the ever present real-world disequilibrium in terms of market distortions or failures due to different socio-cultural behavior patterns and specific types of government interventions. Perhaps what is needed is a new theory that is founded on disequilibrium rather than a patchwork quilt sewn together with unrealistic assumptions and second best adjustments. The

inflation/unemployment relationship is a complex phenomenon and certainly not simply a function of shadow pricing, but some study of the interactions between choices made in project analysis and the performance of macro economic variables such as inflation seems worthy of more attention than it has received in the past.

(B) MONETARY AND FISCAL POLICY

The impact of shadow wage choices made by project analysts cannot be anticipated without a full understanding of government monetary and fiscal policies which will prevail during project implementation. These policies can reenforce or negate the carefully reasoned development and distributional impacts predicted by project analysis. The manner in which projects are financed, for example, will influence the distribution and developmental impact of the project. Schmid (1983), for example, suggests that economies experiencing slack (i.e., unemployed resources) need not finance projects designed to put the unemployed to work by taxing or borrowing from those already employed. If resources are unemployed, consumption need not be reduced or transferred to increase output. He suggests instead "credit creation" (i.e., printing of new money by the government). Whether one accepts Schmid's perspective on credit creation or not, it is clear that the manner in which a project is financed can either reenforce or negate the expected impact of a particular shadow wage estimate.

In developed economies, the financing options are more readily analyzed than in most developing ones. In the former,

money supply can be expanded by printing or borrowing money, and government resources can be increased through taxation. In developing countries opportunities for outright grants exist as well as for concessionary loans which approach grant status. Developing economies can borrow at market interest rates, with the borrowed funds often coming from saving in developed countries, rather than at the expense of current home consumption. The money supply option is complex -- many developing countries have their currencies tied to major world currencies such as the French Franc or the British Pound, thereby assuring convertibility in world markets. This situation seems to render unilateral expansion of the domestic money supply during slack periods an impossibility. Other countries, having maintained the right to expand their own money supplies and having actually taken advantage of that right, have frequently courted economic disaster due to inability to actually increase output, thereby leading to rampant inflation and non-convertibility of their currency, despite very high levels of economic slack. The limited ability of many developing country governments to administer various types of tax programs renders taxes a less likely means of financing government projects than one would find in developed countries. The most popular tax appears to be on exports of agricultural products, frequently taxing the very individuals that are the intended recipients of low shadow wage rates.

(C) GROWTH

The growth implications of particular shadow wage estimates must also be considered. A low shadow wage causes projects with large labor components to be selected. When this labor is employed on projects at prevailing market wages, the difference between the value of the market wage in the new occupation and the value of the foregone product is transferred from investment to consumption. If government believes that private consumption adds less to national objectives than government investment -- which is often the case -- then the lower the shadow wage, given a fixed level of market wages, the greater the flow of resources from investment to consumption and the slower the rate of economic growth. On the other hand there are those who argue that economic growth can be spurred by increasing consumption if that consumption is directed toward locally produced goods and services. (See, for example, King 1977) Such growth depends on an appropriate mix of government policies encouraging expansion of output in those sectors likely to experience increasing demand. Agricultural price policies would be a critical variable for an analyst to examine if s/he believed that increasing demand could stimulate growth without causing inflation. In addition to asking analysts to carefully document the underlying labor market assumptions used in developing shadow price estimates, one appears justified in asking them to trace through the macro economic implications of their choice with respect to national development goals and objectives.

Having raised a number of questions about the manner in which various assumptions made by an analyst estimating shadow wage rates could have growth and equity implications, it is time to look more closely at the exact nature of choices which are encountered in the course of an economic analysis. The case study presented in the next chapter is an attempt to examine the extent to which estimation techniques chosen by analysts can influence the value of shadow wage rates used and the outcome of the economic analysis.

IV. CASE STUDY OF THE "OFFICE DU NIGER"

A. INTRODUCTION

Having reviewed the theory and practice of shadow pricing labor, it is now time to turn to a case study of labor valuation in the "Office du Niger" rice production zone of Mali. The reasons for selecting the "Office du Niger" have already been summarized in Chapter II. Unless otherwise noted, the data used in the following discussion and analysis were collected by Mulumba Kamuanga during a 1979-80 cost-route survey of 89 farm households in the Niono, Sahel, and Kolongo sectors of the "Office". Details of his sampling and survey methods can be found in Chapter 3 of his dissertation (Kamuanga, 1982) and will not be repeated here.

This case study begins with a fairly lengthy description of the "Office du Niger". Special attention is given to the historical development of rice production in the area and the role of "Office" production in the national economy. An attempt is also made to identify the wide range of economic, socio-cultural, and political factors influencing the demand and supply of labor in the region. Familiarity with this background material is an essential prelude to fully understanding the intricacies of labor allocation in the zone and the importance of proper accounting for labor's marginal value product in economic analysis.

Following this descriptive section, the results of past research by McIntire and Kamuanga are summarized and discussed. Special attention is given to the sensitivity of their conclusions to changes in the cost of labor inputs. The next part of the chapter describes an attempt to estimate the marginal value product of labor in the "Office du Niger". The second method described by Bruce (i.e., weighting observed wages by the ratio of utilization to supply) is employed. Problems encountered using this technique are discussed. An argument against equating the marginal value product of "Office du Niger" family labor with that of hired labor follows.

B. DESCRIPTION OF THE "OFFICE DU NIGER"

1. HISTORY

The "Office du Niger" was created by the French as a public enterprise in 1932, and charged with the responsibility of developing irrigated agriculture in the Middle Niger Basin of Mali. In 1961, the Malian government took ownership of the "Office" and it became a state enterprise. Originally the "Office" was to produce rice and cotton -- the former as a subsistence crop and the latter for cash. Over time, crop emphasis has changed; current production consists of rice produced by settlers for both consumption and cash as well as sugar cane produced primarily by hired labor on "Office" run plantations.

Since its creation, the "Office du Niger" has been sparsely populated. In 1979-80, 54,110 inhabitants formed the

4,985 families settled in the Office's 138 villages which had access to 53,260 hectares of developed land. By way of comparison, it is interesting to note that the nearby "Operation Riz" in Segou supports 115,000 to 125,000 people on only 35,000 hectares. (Pearson, et. al. pg. 335) Approximately 67% of the settler population was considered economically active by the government (i.e., between the ages of 8 and 55), and 23% were active males between 15 and 55 years of age. (Kamuanga, pg. 93 and personal notes) Many observers consider labor to be the overriding constraint on both "Office du Niger" rice and sugar cane production (Kamuanga, pg. 90-1, "Office du Niger" annual report, 1978-79, deWilde pg. 290).

During the colonial period, farmers were brought to the "Office du Niger" from other areas of Mali and neighboring colonies, especially Upper Volta. Early settlement was often by force and caused serious disruption of traditional socio-cultural patterns. (See Zahan, 1963, for a discussion of this point.) Supply and demand of labor throughout the "Office" shows considerable variation in composition (i.e., use of male vs. female vs. hired vs. communal labor). Much of this variation can be explained by the unusual mix of ethnic backgrounds, compounded by the effects of dislocation associated with settlement.

To date, the "Office du Niger" is the largest West African rice production system designed for full water control. In 1977-78, approximately 39,500 hectares of the "Office" were planted in rice and 2,700 in sugar cane. Rice

contributes only 2.2% to Malian gross national product (5% of the total value of agricultural production). (Kamuanga, pg 9) Despite the relatively low contribution of rice production to gross national product, government development plans call for significant increases in production as consumer demand shifts from traditional food staples of millet and sorghum to rice, requiring large imports of rice and therefore outflows of valuable foreign exchange. Due to the vagaries of rainfall throughout Mali, the water control system of the "Office" appears to offer the most promise for increasing rice output. The "Office du Niger" dominates the Malian rice sector, providing approximately 40% of total rice output during years of normal rainfall and as much as 90% during years of drought. Official, government sanctioned market transactions in paddy come almost exclusively from the "Office" during poor years and are 65-70% composed of "Office du Niger" product during good years. (Kamuanga, pg. 15-16)

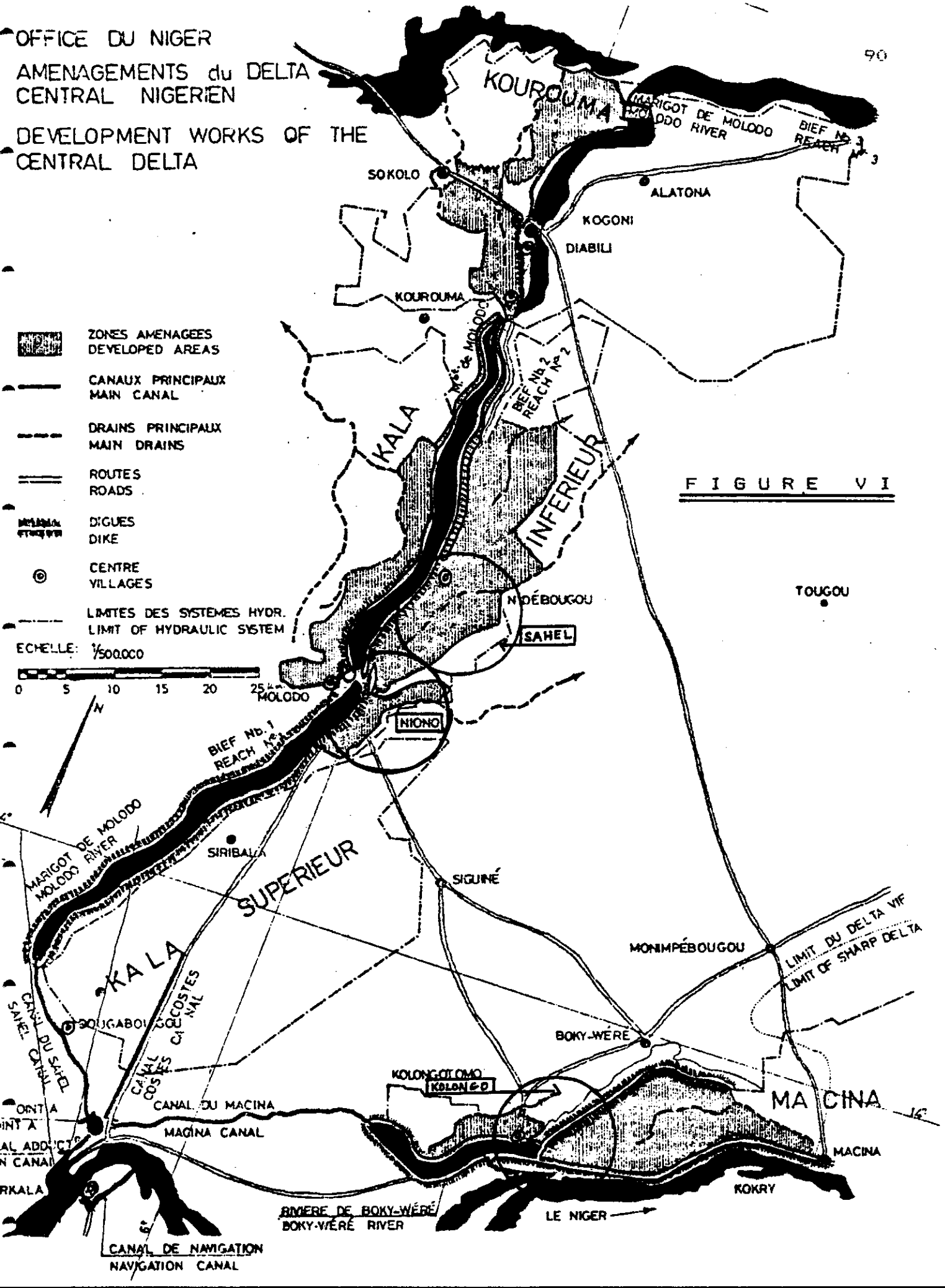
Mali's rice exports to other West African nations have been weak and sporadic. (See Association pour le Developpement...., 1977.) Furthermore they are poorly documented due to the existence of both official and clandestine exports. Clandestine marketing of rice for sale in neighboring countries is encouraged by the price differentials existing between the official Malian producer price of 60 MF, the black market Malian price of 90-95 MF, the Senegalese price of 128 MF and the Niger price of 108 MF (per kilogram prices for 1979-80 as reported by Kamuanga, pg. 308-9). Despite the past

history of low rice exports, current development goals to establish foodgrain self-sufficiency and surplus for export rely heavily on increasing "Office du Niger" production which is considered by many to have a comparative advantage in West Africa.

In summary, although current rice production does not account for a large share of Malian gross national product, government development plans envision significantly increased rice production for both domestic consumption and export. Rice production in the "Office" currently accounts for 40-90% of output in any given year. Due to the potential for water control in the zone, plans for expanding the Malian rice sector rely most heavily on intensification of "Office" production capabilities. All types of economic analysis concerning rice production in the "Office" are, therefore, of critical importance to government planners.

2. DESCRIPTION OF THE SURVEY AREAS

The farmers in Kamuanga's sample were drawn from three of eight rice producing sectors in the "Office du Niger" -- Niono, Sahel, and Kolongo; these sectors are identified on the map in Figure VI. Sahel and Niono are located on the Sahel Canal; farmers in these sectors benefit from soil and irrigation infrastructure which is considered superior to that available to Kolongo farmers located on the Macina Canal. It is also noteworthy that Sahel and Niono are located near the sugar cane plantations and factories of Siribala and N'Debougou and near one of the largest urban centers in the


OFFICE DU NIGER
AMENAGEMENTS du DELTA CENTRAL NIGERIEN
DEVELOPMENT WORKS OF THE CENTRAL DELTA
ZONES AMENAGEES
DEVELOPED AREAS
CANAUX PRINCIPAUX
MAIN CANAL
DRAINS PRINCIPAUX
MAIN DRAINS
ROUTES
ROADS
DIGUES
DIKE
CENTRE
VILLAGES
LIMITES DES SYSTEMES HYDR.
LIMIT OF HYDRAULIC SYSTEM
ECHELLE: 1/500.000
0 5 10 15 20 25 km
N
KOUROUMA
MARIGOT DE MOLODO
MOLODO RIVER
BIEF No 3
REACH No 3
SOKOLO
ALATONA
KOGONI
DIABILI
KOUROUMA
KALA
INFERIEUR
BIEF No 2
REACH No 2
FIGURE VI
TOUGOU
NDÉBOUGOU
SAHEL
MOLODO
NIONO
BIEF No 1
REACH No 1
MARIGOT DE MOLODO
MOLODO RIVER
SIRIBALA
SUPERIEUR
SIGUINÉ
KALA
MONIMPÉBOUGOU
LIMIT DU DELTA VIF
LIMIT OF SHARP DELTA
CANAL DU SAHEL
SAHEL CANAL
BOUGABOU
CANAL COSTES
BOKY-WÉRÉ
KOLONGOTOMO
KOLONGO
CANAL DU MACINA
MACINA CANAL
MACINA
MACINA
KOKRY
RIVIERE DE BOKY-WÉRÉ
BOKY-WÉRÉ RIVER
LE NIGER
CANAL DE NAVIGATION
NAVIGATION CANAL

Office, the town of Niono. Conversely, Kolongo farmers are relatively isolated from urban centers and other "Office" activities.

(A) ETHNIC DIVERSITY

Table IV presents a picture of how farmers in the sample are distributed among the various ethnic groups living in the Office. It is not clear that the sample distribution by sectors mirrors the actual ethnic breakdown existing in the "Office".

It is worth noting that labor utilization patterns tend to vary by ethnic group and, therefore, what appear to be sectoral differences may be due to the predominance of a particular ethnic group in the area. For example, Mossi women regularly participate in all rice production activities whereas Bambara and Minianka women tend to help with the harvest only; and Bozo, Samogo and Maure women play no active role in rice production. Social structures also differ with respect to sources of labor from the extended family. Mossi farmers depend heavily on help from the family of intended sons-in-law while this is not true for other groups. Bambara farmers, being less distant from their villages of origin than other settlers, often call upon relatives at home for help. Out migration during the slack season in search of paid employment is more characteristic of Bambara and Minianka than Mossi. The Bambara and Minianka men have to amass large sums of money for a dowry while the Mossi men tend to earn credit toward the "dowry" in the form of labor assistance given to potential

TABLE IV

ETHNIC DIVERSITY IN THE OFFICE DU NIGER

SECTOR	DISTRIBUTION OF RESPONDENTS BY ETHNIC GROUP
Sahel	10 Bambara
	3 Minianka
	3 Peul
	2 Mossi
	2 Other
Niono	21 Minianka
	7 Bambara
	4 Peul
	1 Other
Kolongo	13 Other
	9 Mossi
	8 Samogo
	4 Bambara
	2 Peul
	1 Minianka

Source: Compiled by the author from Kamuanga's data.

inlaws. These observations are all generalizations rather than universally true patterns of behavior, yet it will be helpful to keep them in mind when looking at specific sectors which tend to be dominated by one ethnic group or another.

(B) CROP CALENDAR

The most important factor affecting the demand for rice labor is the calendar of cropping activities which is dictated by climatic factors. Table V shows the approximate periods during which various production activities are performed throughout the entire zone. In general the most labor intensive tasks occur in the June/July and November/January periods although there is some variation from sector to sector. Throughout the "Office", the labor complement of most farms comes from family labor supplemented by help from extended family and village mutual aid associations during peak periods. Some farmers do use hired labor, especially during the harvest season when millet farmers from the Dogon plateau and Seno Plain migrate to the "Office" in search of slack season employment. In recent years there has been a growing number of absentee settlers (civil servants, in particular) who farm large tracts of land using more hired than family labor; this type of farming, however, still accounts for only a small portion of output and is not considered in the following discussion.

(C) AGGREGATION PROBLEMS

The brief sketch of the survey areas presented above makes it clear that to describe and value a homogeneous unit

TABLE V

"OFFICE DU NIGER"

CROP CALENDAR FOR RICE

FIELD ACTIVITIES	EARLIEST DATE	LATEST DATE
First shallow pre-irrigation	April 1	May 15
First plowing	April 30	June 5
Second pre-irrigation	May 1	June 15
Second plowing	May 15	June 30
First harrowing, sowing, and second harrowing	May 20	June 30
Shallow field inundation	May 21	June 30
Second inundation	May 31	July 15
Hoe weeding	June 15	July 31
Hand weeding	June 15	October 31
Fertilizer application (mineral)	June 20	October 31
Deep and final inundation	July 10-15	August 31
Draining of fields	October 25	December 15
Harvesting (cutting and binding)	November 5	January 5
Stacking	December 10	March 10
Mechanical threshing	December 20	March 31
Paddy collection and transport	December 20	June 30

Source: Office du Niger, Service Agricole, presented in Kamuanga, p. 47.

of labor for the entire "Office du Niger" is not an easy task. The Kolongo, Sahel and Niono sectors of the "Office" are different in terms of labor as well as non-labor resources. Of particular importance in the non-labor category is the inferior quality of soil and irrigation infrastructure in Kolongo which reports consistently lower rice yields than Niono and Sahel. These differences, plus the physical distances separating Niono and Sahel from Kolongo, suggest that Kolongo could be treated as a separate labor market. In addition, Niono and Sahel sectors also exhibit substantial dissimilarities with respect to opportunities for non-farm employment and hired labor supply, suggesting further disaggregation of the data into three distinct markets.

Performing economic analysis at such a disaggregated level is generally not feasible. Many writers (Little-Mirrlees, McDiarmid) recommend developing national shadow wage rates which can be adjusted when absolutely necessary to accommodate unusual conditions in specific regions. The approach in this case study will not be to work backward from a national shadow wage rate but to examine the problems and feasibility of developing a single regional shadow wage rate for the "Office du Niger". Due to a concern for problems of aggregation in shadow price estimation, however, the disaggregated data for each of the three sectors will be presented and the implications of the aggregation discussed.

C. A REVIEW OF THE MCINTIRE AND KAMUANGA STUDIES

1. INTRODUCTION

The conclusions reached by McIntire and Kamuanga concerning financial and economic profitability of "Office du Niger" rice production are really quite different. Both authors found that most "Office du Niger" farmers were not operating financially profitable enterprises due to low producer prices offered by government purchasing agents. Both authors also found that, on average, rice production was economically profitable to the nation. The difference in the magnitude of the economic profit estimates, however, is rather astonishing. Kamuanga found the margin of profit to be a weak 2000 MF per metric ton while McIntire estimated 57,355 MF. (100 Malian Francs equal one French Franc.) In comparing the two analyses, the source of the discrepancy is not immediately apparent. Valuation of labor on a per unit basis is not a likely candidate for both authors costed it in a similar manner. Amount of labor used per hectare of rice, however, did differ. McIntire estimated an "Office du Niger" average of 90 workdays while Kamuanga's average reported per sector and farm ranged from 81 to 147, yielding a weighted average of 104 for the entire sample area. McIntire also seems to have based estimates on an average yield per hectare of 2.25 metric tons while Kamuanga's observed yields ranged from 1.28 to 2.34.

Kamuanga's yields do represent lower than average production due to unfavorable rainfall during the 1979-80 season.

The fluctuations in year to year yields due to unpredictable weather conditions brings to the forefront the issue of appropriate data sources and collection methods to meet the needs of financial and economic analysis. A tendency to rely on intermittent but intensive survey data collection in many developing countries rather than on less intensive but more consistently collected time series reporting tends to weaken the overall policy value of the data. One might ask if any economic analysis meaningful for long range planning and policymaking can be extracted from cost-route survey data collected during a single year characterized by poor rains.

Other probable sources of the different profit margins are use of different opportunity costs for land and/or dissimilar methods of accounting for recurrent "Office du Niger" overhead. Given the fact that this rather large difference in profits is not associated with labor valuation techniques per se, it is appropriate to ask what, if any, difference would be observed in estimates of profitability if different assumptions had been made with respect to labor costs. This question is pursued in the next few pages.

2. SENSITIVITY OF KAMUANGA'S PROFITABILITY ANALYSIS TO LABOR COSTS

Kamuanga found significant variation in financial and economic profitability associated with geographic differences as well as farm size by hectare. The financial analysis of rice production disaggregated by zone and farm size revealed returns to family labor and management ranging from -10,905 MF

for large farms (10-15 hectares) in Kolongo to 41,138 for medium size farms (5-10 hectares.) in Sahel. When taking into consideration the opportunity cost of farm labor valued at prevailing wage rates, Kamuanga observes that:

> Management income estimates were found to be negative in each size group, per casier and for the entire O.N. survey area. In economic terms this means that O.N. settlers in the survey area did not generate a return above the financial and opportunity costs of all resources, i.e., they were not in a position to reinvest or increase their current level of consumption out of their earnings from the production of rice alone in 1979-80. (pg. 161)

In the economic analysis, Kamuanga made the following adjustments to financial costs:

a) Allowance was made for government subsidies on fertilizer, fungicides, and seeds.

b) A shadow price of land was imputed from the residual return to land in sugar cane production (in financial analysis, land had a zero opportunity cost as farmers are not allowed to produce anything but rice.

c) A shadow price of 15% for capital was incorporated.

d) Labor was valued at the prevailing average wage rate for each region (the same value as that imputed in the financial analysis to obtain net returns to management).

e) A complete adjustment for recurrent maintenance costs of the "Office du Niger" irrigation system was not possible as available data did not distinguish between irrigation of rice and sugar cane. An adjustment was, however, made for administrative overhead (supervision) and extension to rice farmers.

For the survey area in general, Kamuanga found that, rice could be produced for 2,000 MF per metric ton less than the cost of imported Thai brokens to the Segou region. The average, however, hides the fact that the net economic returns in both Sahel and Kolongo were negative, leaving Niono in the position of earning sufficient returns to compensate for its neighbors' poor performance.

Kamuanga points out that his analysis is potentially sensitive to two factors: One is the very low opportunity cost of "Office du Niger" land (8% of residual return per sugar cane hectare) and the other is the uncovered portion of "Office du Niger" recurrent costs. No mention is made of the analysis' sensitivity to labor valuation, probably because Kamuanga was comfortable with a 700 MF per adult workday opportunity cost which had previously been used by McIntire. In other words, the magnitude of potential errors in his estimate of overhead and land seemed greater than the magnitude of labor cost errors.

Table VI is adapted from Kamuanga's dissertation. It shows the breakdown of economic costs by zone and size of farm for the survey area. A comparison of the total value of labor (line 1) with total economic cost per hectare (line 9) reveals that labor, when valued at the prevailing wage rate for each zone, is approximately 50% of total costs per hectare. Given the very slim margin of profitability (2,000 MF net economic returns using Kamuanga's import substitution price of 90,326 MF), an estimate of labor costs 4.4% higher could move rice

TABLE VI

ECONOMIC COST OF RICE PRODUCTION PER METRIC TON
(MALIAN FRANCS)

	NIONO			SAHEL			KOLONGO			SURVEY AREA		
FARM SIZE (HA)	< 5	5-10	10-15	< 5	5-10	10-15	< 5	5-10	10-15	< 5	5-10	10-15
1. TOTAL VALUE OF LABOR	82800	70488	73440	118170	106470	119340	65400	39420	41580	80325	65806	80775
2. SEEDS	8584	11092	12346	15197	13221	19363	6318	8502	9594	8557	10490	13997
3. FERTILIZER	7301	11913	8141	11558	9960	14393	5913	6231	4326	7315	8981	4474
4. INTEREST AND DEPRECIATION ON FARM EQUIPMENT	7201	9432	8273	5867	9052	7025	5857	5840	8153	6243	7798	7821
5. REPAIRS AND MAINTENANCE	3606	5821	2650	6660	2630	2714	4706	1996	2178	4991	3482	2514
6. MACHINE THRESHING	11820	11929	10014	10657	11785	13325	5109	4877	3529	8688	8845	9496
7. LAND FEE AND O.N. OVERHEAD	33521	33521	33521	33521	33521	33521	33521	33521	33521	33521	33521	33521
8. OPPORTUNITY OF O.N. LAND	10400	10400	10400	10400	10400	10400	10400	10400	10400	10400	10400	10400
9. TOTAL ECONOMIC COST PER HA	165233	164596	158785	212030	197039	220081	137224	110787	113281	160040	149333	162998
10. ECONOMIC COST PER METRIC TON	80210	76914	89709	118453	98029	94052	107206	83930	84538	93591	82046	89559
AVERAGE BY ZONE		82278			103512			91891			88398	

SOURCE: KAMUANGA, PAGE 185.

production from the profitable to the unprofitable category. This 4.4% average sensitivity rate masks the extreme variation by farm size and zone revealed in Table VII, which presents the percentage change in labor costs necessary to alter the profitability of rice production for each farm size/zone combination presented in Table VI. Only 10-15 hectare farms in Niono are very sensitive to labor valuation where a 1.49% change in labor costs would make production unprofitable. None of the other eight sector/farm size groups exhibit a high degree of sensitivity. On the other hand, the high variation of costs/metric ton, both above and below the import substitution price of rice, cause the average cost of production for the entire sample (88,398 MF) to be quite sensitive to changes in the average labor costs. Another way of viewing the sensitivity of profits to labor costs is to calculate an elasticity of profit with respect to imputed labor costs. These elasticities show the percent change in profit give a 1% change in labor costs. Table VIII presents these elasticity factors for each sector/farm size category as well as for the farm sizes aggregated across regions. This table confirms the fact that aggregated elasticities tend to be greater than disaggregated ones.

3. SENSITIVITY OF MCINTIRE'S PROFITABILITY ANALYSIS TO LABOR COSTS

Unlike Kamuanga, McIntire did discuss the sensitivity of his economic analysis to labor costs. He calculated the elasticity of net social profitability with respect to the

TABLE VII

PERCENTAGE CHANGE IN TOTAL LABOR COSTS
REQUIRED TO CHANGE THE SIGN OF
PROFITABILITY IN KAMUANGA'S
ANALYSIS OF "OFFICE DU NIGER"
RICE PRODUCTION

FARM SIZE	NIONO	SAHEL	KOLONGO
< 5 HECTARES	+25%	-57%	-33%
5-10 HECTARES	+41%	-85%	+21%
10-15 HECTARES	+ 1%	-93%	+19%

SOURCE: Calculated by the author from Kamuanga's data.

TABLE VIII

ELASTICITIES OF ECONOMIC PROFITABILITY WITH RESPECT TO UNSKILLED LABOR COSTS

**

PER CENT CHANGE IN PROFITABILITY GIVEN A 1% INCREASE IN COSTS OF UNSKILLED LABOR REPORTED BY KAMUANGA

FARM SIZE	NIONO	SAHEL	KOLONGO	ALL SECTORS
< 5 HECTARES	- 3.974	-2.34	-3.027	-14.389
5-10 HECTARES	- 2.456	-6.877	-4.669	- 4.367
10-15 HECTARES	-67.247	-13.688	-5.36	-57.86

Source: Calculated by the author from Kamuanga's data.

cost of unskilled labor inputs for "Office du Niger" rice delivered to five different locations. The results are presented in Table IX. In the best case situation, Bamako, a 1% increase in labor costs causes a .6% decrease in net social profitability. In the worse case, Dakar, a 1% increase results in a 4.571% decrease in net social profitability. Of all primary inputs considered (unskilled labor, skilled labor, and capital) unskilled labor is found to be the most sensitive.

> Among the factor prices, only changes in the costs of unskilled labor are likely to make much difference in total social costs and net benefits of rice production. This implies that errors in measurement in field labor times would have important consequences for estimations of net social profitability, as would errors in estimation of the shadow price of unskilled labor. (pg. 355)

By comparing Tables VIII and IX one observes that the overall conclusions of the McIntire analysis are less sensitive to changes in labor valuation than those of Kamuanga. This is related to the high level of net social profitability estimated by McIntire (67,355 MF/metric ton or 65,000 MF greater than Kamuanga's average economic profit). In those cases where Kamuanga found the absolute value of the profit estimate close to zero, the elasticity of profit with respect to labor costs are quite high; where the absolute value of profit is large, elasticities are much smaller.

Although McIntire concludes that net social profitability should be considered sensitive to labor costs, he suggests that the errors in estimating the shadow price of labor would

TABLE IX

ELASTICITIES OF NET SOCIAL PROFITABILITY

WITH RESPECT TO COSTS OF

UNSKILLED LABOR

**

REPORTED BY MCINTIRE

DESTINATION OF RICE	ELASTICITY
BAMAKO	-0.623
KAYES	-1.118
ABIDJAN	-3.484
DAKAR	-4.571
BOUAKE	-1.385

SOURCE: Pearson, et. al., pg. 353.

not be likely to alter the comparative advantage of one crop versus another if the same error was consistently made across crops. This point is well taken. However, the Stanford research, as already noted, is more an analysis of absolute advantage than comparative advantage. Profitability of rice production is not in general being compared with that of other crops. In the few instances where an attempt is made to compare commodities using input cost ratios, it is not clear that the analyses for other commodities followed the FRI rules for valuing inputs. (Pearson, et. al., p. 420) It is, therefore, difficult to draw any conclusions about comparative profitability.

In summary, data collected for both of these studies suggest that the economic profitability of rice production is sensitive to the value placed on labor, although Kamuanga's data demonstrate consistently greater sensitivity than those of McIntire. Given this sensitivity, it is helpful to turn to a discussion of how the authors derived the opportunity costs of labor and consideration of alternative methods.

D. ESTIMATING THE OPPORTUNITY COST OF "OFFICE DU NIGER" LABOR

1. INTRODUCTION

For both Kamuanga and McIntire, estimating the economic cost of labor involved two distinct steps:

1) Estimation of an average wage paid to hired labor.

2) Consideration of adjustments to this average wage necessitated by factors causing wages to be greater than actual marginal value product.

In Chapter III of this paper, a number of shadow wage rate estimation techniques were described. The objective here is to apply the second of those techniques described by Bruce to the "Office du Niger" situation using Kamuanga's data. The following pages describe the steps which were taken to estimate average wages and transform them into marginal value products using Bruce's formula. At each stage of the analysis an attempt is made to clarify the assumptions underlying the analysis and the probable impact of these assumptions on the final profitability estimates. Observations are also offered on the equity implications of various choices made along the way.

(A) THE AVERAGE WAGE

In brief, the task of estimating a simple average wage -- uncorrected for market distortions -- is not so simple as one might think. Both McIntire and Kamuanga calculated average wage rates per workday of labor activity from survey data. McIntire's surveys were conducted in small urban centers near rice production regions. Kamuanga's data came from farm interviews; his wages are based on what "Office du Niger" farmers reported paying for the hired labor used in both farm and off-farm activities. In the absence of perfect knowledge on the part of laborers and producers it is unlikely that these two different survey approaches would result in the same

average wage: particularly if unskilled labor in McIntire's more urban markets is not really the same input as unskilled labor in the rural areas surveyed by Kamuanga.

Having access to Kamuanga's data on wage rates provides a number of important insights which are masked by presentation of aggregated averages. The data also permit one to illustrate how methods of aggregation and weighting wage data can significantly alter conclusions about average wages.

(B) WHAT DATA AND WHICH WAGE?

Kamuanga collected data from each farm on hours worked by hired labor and wages paid in both cash and kind. All categories of labor were included in his estimate of average wages: male, female, elderly, children. Well over 90% of all observations for hired labor were for males 15-60 years of age. A review of the few cases of labor in other categories revealed that the variation in wages reported tended to be extreme -- e.g., a child tending animals received anywhere from 88 to 3000 MF per hour. The range for adult women and the elderly was also very broad: 7 to 1510 and 10 to 3000 MF, respectively. There seems to be some social or cultural factor strongly influencing wages for hired labor outside of the adult male category. For the purposes of this paper, the decision was made to estimate only the average wage for adult males. This appears justified given the fact that they do provide 93% of hired labor recorded in the survey and their wages appear to be less subject to unexplained variation than those of other age/sex categories.

This decision does not have equal impact on the sample size of all survey areas. Niono, having the greatest labor market activity, lost only 14 of 212 observations. Sahel lost 8 of 74 and Kolongo lost 17 of 46 observations. Not having a reliable estimate of wage rates for women and children makes it extremely difficult to estimate the marginal value product of such labor which accounts for as much as 25% of rice labor on many "Office du Niger" farms. With respect to female labor the dilemma is in some ways similar to that faced by FRI analysts in the Casamance. Female labor in the "Office" is not a homogeneous input across ethnic groups. The problem is further complicated by the fact that little such labor is offered in the market; that which is seems to receive wages which strongly contest the existence of a price-auction style market. Furthermore, wage data which do exist defy meaningful aggregation to an average wage. A decision to equate the marginal value product of female labor with that suggested by adult male wages cannot be justified on the basis of the data. On the other hand, a decision to impute some lower marginal value product to female labor implies that the activities which occupy women's time, and most likely prevent them from participating in the labor market (e.g., childcare, housekeeping), are of less value to the family than work performed by men -- an interpretation which is open to dispute.

In addition to omitting observations on wage rates for women and children, one other category of data used by Kamuanga has not been used in this study. This is because

there was strong evidence that enumerators in the Niono sector recorded an exact 700 MF/workday wage in all cases where farmers reported hiring labor but could not provide precise wage information. A decision was made to omit these suspect observations from the present analysis, although Kamuanga did elect to keep them.

(C) AGGREGATION

Table X is reproduced from Kamuanga's dissertation. The author calculated an average wage for each farm size/zone combination resulting in nine different wage rates. One of the problems in estimating an average market wage rate is immediately revealed by the Table, which lists standard deviations that are as large or larger than the average rate. A good part of this variation could be due to the fact that Kamuanga included the non-adult male observations which exhibited unusually high variability.

Having obtained disaggregated wage rates, Kamuanga combined them to provide unweighted averages per zone. For the multiple purposes of his analysis, it was of interest to obtain wage rates at various levels of aggregation. The choice of which level of aggregation to use in the final economic analysis, however, seems to have posed some problems.

Table VI presented above summarized Kamuanga's economic analysis of rice profitability; a few quick calculations reveal that line one -- Total Value of Labor -- is obtained by multiplying the sector wage rate times the average number of workdays/hectare for each farm size category. It is not clear

TABLE X

PROPORTION OF HIRED LABOR AND AVERAGE WAGE

PAID ON "OFFICE DU NIGER "RICE FARMS

**

REPORTED BY SURVEY AREAS

ITEM	NIONO	SAHEL	KOLONGO	ENTIRE AREA
SIZE GROUP: < 5 HECTARES				
1. HIRED LABOR (% OF TOTAL)	9	1	1	3.7
2. AVERAGE WAGE PAID (MF/WD)	1,020	615	845	
3. STANDARD DEVIATION	(422)	(215)	(706)	
SIZE GROUP: 5-10 HECTARES				
1. HIRED LABOR (% OF TOTAL)	14	1	1.5	5.5
2. AVERAGE WAGE PAID (MF/WD)	471	818	734	
3. STANDARD DEVIATION	(671)	(919)	(408)	
SIZE GROUP: 10-15 HECTARES				
1. HIRED LABOR (% OF TOTAL)	7	6	1	4.7
2. AVERAGE WAGE PAID (MF/WD)	662	910	215	
3. STANDARD DEVIATION	(504)	(904)	(418)	
AVERAGES				
1. HIRED LABOR (% OF TOTAL)	10	3	1.5	4.6
2. AVERAGE WAGE PAID (MF/WD)	718	781	598	699

Note: Average wages are in Malian Francs per 8 hour workday.

SOURCE: Adapted from Kamuanga, 1981, pg. 138.

why he elected to use the aggregated zone rate here rather than the relevant rates for each farm size. A possible explanation is that his aggregated rates were a closer approximation of the 700 MF rate used by McIntire and others. His decision to use this unweighted zone average in his economic analysis provides a wage rate which is quite different, however, from that which would have been obtained by other methods of aggregation.

Another problem with the data presented in the calculations of economic profitability is that the reader loses track of the high variance and large standard deviations associated with the calculation of the average wage and the average labor input per hectare. Kamuanga does not report a standard deviation for his average workdays per hectare. If one were to draw inferences from similar cost-route surveys which did provide the standard deviations, one might expect that those for the "Office du Niger" would be as large or larger than the means. (See, for example, Lappia, 1979.) It is somewhat disconcerting to imagine what such large standard deviations would do to a confidence interval for average labor costs per hectare. Taking 5-10 hectare farms in Niono sector and assuming a standard deviation on labor inputs of 100, one would obtain the following rough estimate of a 95% confidence interval on labor costs per hectare:

Average Cost/Ha. = Average Wage * Average Workdays/Ha.

AC/Ha. = 471 * 115 = 54,165 MF

A standard deviation for this product of 54,165 MF was calculated using a method described by Robison (Forthcoming):

SD = 112,584 MF

The 95% confidence interval would be approximately 54,165 MF plus or minus 2 * 112,584 MF. In other words, profit could be a negative 171,003 MF or as high as a positive 279,333 MF. Clearly, no statistically sound conclusions can be drawn from economic analysis based on data with such high variability.

Table XI compares the labor costs presented in Table VI with those obtained using two different methods of aggregation. Line one of the Table presents Kamuanga's labor cost estimates. Line two shows the costs he would have obtained using the disaggregated wages from Table X. Line three reports the costs obtained by considering only adult males and calculating a weighted average of all observed wage rates. The differences obtained are frequently very large and, in a number of cases, could easily change the net profitability of rice production for a given zone. Table XII illustrates various estimates of net profitability. The magnitude of profits is quite sensitive using both method two and three. Only method two, however, actually changes the sign of profits in three of the categories.

Kamuanga did calculate an average wage rate of 700 MF/workday for his entire sample. This was obtained using a simple unweighted averaging of the sectoral averages, i.e.,

TABLE XI

COMPARISON OF "OFFICE DU NIGER" LABOR COSTS

OBTAINED USING THREE DIFFERENT AGGREGATIONS

METHOD	SECTOR	NIONO			SAHEL			KOLONGO		
	FARM SIZE (HA)	< 5	5-10	10-15	< 5	5-10	10-15	< 5	5-10	10-15
	MANDAYS/HA	115	98	102	151	136	153	109	66	70
	KAMUANGA									
	LABOR COST	82800	70488	73440	118170	106470	119340	65400	39420	41580
	DAILY WAGE	718	718	718	781	781	781	598	598	598
	METHOD II									
	LABOR COST	117300	46158	67524	92865	111248	139230	92105	48444	15050
	DAILY WAGE	1020	471	662	615	818	910	845	734	215
	METHOD III									
	LABOR COST	68195	58114	60486	128652	115872	129504	64092	38808	41160
	DAILY WAGE	593	593	593	852	852	852	588	588	588

NOTES: KAMUANGA'S METHOD IS DESCRIBED IN THE TEXT, PP. 99 & 101.
METHOD II USES KAMUANGA'S DISAGGREGATED WAGES FOR EACH FARM SIZE/SECTOR COMBINATION.
METHOD III USES A WEIGHTED AVERAGE OF ALL WAGES PER SECTOR AND INCLUDES THE ADJUSTMENTS TO KAMUANGA'S DATA MENTTIONED ON PAGES 97-99.

Source: Compiled by the author from Kamaunga's data.

TABLE XII

COMPARISON OF THE ECONOMIC PROFITABILITY OF "OFFICE DU NIGER" RICE PRODUCTION USING THREE DIFFERENT METHODS TO ESTIMATE AVERAGE WAGES

SECTOR	NIONO			SAHEL			KOLONGO		
FARM SIZE (HA)	< 5	5-10	10-15	< 5	5-10	10-15	< 5	5-10	10-15
KAMUANGA'S METHOD									
DAILY WAGE	718	718	718	781	781	781	598	598	598
LABOR COST/HA	82800	70488	73440	118170	106470	119340	65400	39420	41580
ECONOMIC COST/HA	165233	164596	158785	212030	197039	220081	137224	110787	113281
ECONOMIC COST/MT	80210	76914	89709	118453	98029	94052	107206	83930	84538
IMPORT SUB PRICE	90326	90326	90326	90326	90326	90326	90326	90326	90326
PROFITABILITY	10116	13412	617	-28127	-7703	-3726	-16880	6396	5788
METHOD II									
DAILY WAGE	1020	471	662	615	818	910	845	734	215
LABOR COST/HA	117300	46158	67524	92865	111248	139230	92105	48444	15050
CHANGE LABOR COST/HA	34500	24330	5916	-25305	4778	19890	26705	9024	-26530
ECONOMIC COST/HA	199733	188926	164701	186725	20817	239971	163929	119811	86751
ECONOMIC COST/MT	96958	88283	93051	104316	100406	102552	128070	90766	65720
PROFITABILITY	-6632	2043	-2725	-13990	-10080	-12226	-37743	-440	24601
METHOD III									
DAILY WAGE	593	593	593	852	852	852	588	588	588
LABOR COST/HA	68195	58114	60486	128652	115872	129504	64092	38808	41160
CHANGE LABOR COST/HA	-14605	-12374	-12954	10482	9402	10164	-1308	-612	-420
ECONOMIC COST/HA	150628	152222	145831	222512	206441	230245	135916	110175	112861
ECONOMIC COST/MT	73120	71132	82390	124308	102707	98395	106184	83466	84225
PROFITABILITY	17205	19194	7936	-33982	-12381	-8069	-15858	6860	6101

NOTE: PROFITABILITY IS THE IMPORT SUBSTITUTION PRICE MINUS ECONOMIC COSTS.
METHODS FOR AGGREGATION ARE THE SAME AS IN TABLE XII.

SOURCE: COMPILED BY THE AUTHOR FROM KAMUANGA'S DATA.

718, 781, and 598 MF. (See Table X.) In analyzing the "Office du Niger" data for the purposes of this paper, an average rate of 631 MF was estimated for adult males. An average wage for the entire sample area was calculated weighting each observed wage by the number of hours actually paid at that wage. No attempt was made to aggregate average wages by family size or sector using a weighting factor such as number of surveyed farms in each category. This estimate is not drastically different from Kamuanga's, but it does represent a 10% reduction in labor costs. It should be remembered that the difference is due to the different methods of aggregation as well as to the omission of observations noted above. Table VIII illustrated the impact on profits of only a 1% change in labor costs, providing some indication of how important a 10% change might be.

In summary, it seems fair to say that analysts need to spend more time thinking through the problems of data collection and aggregation encountered in estimating average wages from survey data. Current methods used result in estimates with little or no statistical significance, yet these estimates are relied upon for policy analysis.

2. FROM WAGES TO MARGINAL VALUE PRODUCT

Assuming that it is possible to resolve the data and aggregation problems in order to obtain a meaningful average wage estimate, it is next necessary to consider the factors which might cause that wage to deviate from the marginal value product of various categories of laborers. In Chapter III, a

brief summary of the economic theory of wage determination was presented. One can generally assume that an observed market wage represents the marginal value product of labor if all the conditions necessary for a price-auction equilibrium model are present. Much of the literature on marginal value product of labor in developing countries suggests that two types of deviations from price-auction equilibrium are present in rural areas of developing countries: (1) unskilled labor in rural areas tends to be in excess supply throughout most of the year and (2) wages paid by traditional farmers are often greater than marginal value products due to social constraints. It has been suggested that when markets deviate from the neo-classical model, the following equation can be used to obtain a more accurate estimate of marginal value product than that provided by observed wages. (Bruce, 1976)

$$M = \sum_{j=1}^{12} (D_j/S_j)W_j$$

where M = marginal value product of labor
D_j = monthly utilization of labor
S_j = monthly availability of labor
W_j = monthly observed wage

The formula exhibits a number of theoretical weaknesses. The lack of a clear conceptual foundation for the assumption of a linear relationship between unemployment, wages, and marginal value products was mentioned in Chapter III. The formula also seems to be adjusting only for disequilibrium characterized by surplus labor and not for that associated with traditional farmers paying wages greater than marginal

value products due to social responsibility. Furthermore, Bruce notes that there exists some lower (but unspecified) limit to the ratio Dj/Sj; for "M" cannot fall to zero and remain consistent with the price-auction equilibrium model. Despite these theoretical problems, the formula, or a variation of it, has been used by numerous analysts; and it is worthwhile to look beyond the conceptual issues into the practical problems of obtaining such marginal value product estimates.

Although the Bruce formula appears straightforward, careful consideration must be given to the manner in which Dj, Sj, and Wj are defined and estimated, as a number of alternative scenarios are possible. In the following pages, two different approaches are examined in depth. One is to estimate an aggregated marginal value product for all farm-household labor; the other is to estimate a marginal value product for non-rice labor only. Use of the former method implies that marginal value products of labor are equal across activities while the latter suggests that they might differ.

(A) AGGREGATED MARGINAL VALUE PRODUCT FOR ALL FARM-HOUSEHOLD LABOR

This discussion is presented in two parts: the first deals with the questions faced by the analyst trying to estimate the demand and supply parameters required by Bruce's formula; the second presents the marginal value products calculated using different conventions for Dj and Sj

estimates. Before turning to part one, a brief description of Kamuanga's labor data is useful.

Kamuanga's data provide a detailed accounting of the wages paid and the hours of family and hired labor utilized in four major categories of activity:

1) Rice production

2) General farm activities not exclusively related to rice production (e.g., building and equipment repair and maintenance, transporting, marketing)

3) Livestock production

4) Off-farm activities (i.e., all activities other than those recorded in 1-3 above; examples would be millet production and vegetable gardening, petty trading, handicraft production, absence from productive activities due to illness or fulfillment of social and religious obligations).

Labor supply data are recorded as stocks of family labor only, with no information about actual availability for various productive activities.

IS DEMAND FOR FEMALE LABOR FULLY ENUMERATED?

Unfortunately, Kamuanga neglected to record one category of productive activity which should have been included in general farm activities, i.e., female labor allocated to cooking, washing, and general housekeeping duties. The fact that allocation of male labor to household activities such as home repair and maintenance was enumerated, but not that allocated to female household activities tends to understate demand for female labor. A failure to correct for this omission would

overstate the level of unemployment implied by Bruce's Dj/Sj ratio and therefore underestimate the aggregate marginal value product.

A number of labor studies in Africa suggest that labor time devoted to these omitted activities tends to be at least two hours per day per married woman. (Pudsey cited in Cleave (1974) and McSweeney cited in Shaner (1982)) Kamuanga's data are adjusted with such an estimate below to obtain a more complete picture of aggregate demands on family labor time.

HOW LONG IS A WORKDAY?

Kamuanga provides data on the stock of family labor by sex and age. The major issue is to determine how many hours per day or month each family member is available for those activities which are itemized on the demand side. In his analysis, Kamuanga estimated labor supply on the basis of eight hours per day and twenty-five days per month per person. This is not an unreasonable rule of thumb. There are approximately twelve hours of daylight year-round in the "Office du Niger". Given the absence of electricity, most activities other than resting and chatting are performed during daylight hours. Time devoted to activities such as eating meals, personal hygiene, prayer, and leisure were not enumerated and could easily occupy the remaining four hours of daylight. Although the eight-hour estimate appears reasonable, a choice of either six or ten hours could easily be justified. Given the apparently arbitrary nature of the choice, an analyst might be well advised to examine the impact on marginal value

product estimates given a range of assumptions about family labor supply. This is done below.

IS LABOR HOMOGENEOUS ACROSS AGE/SEX GROUPS?

In aggregating data for all age/sex categories of family workers, one assumes that such labor units are homogeneous and, therefore, perfect substitutes. For example, Sj for the land clearing and planting season would include both male and female labor even though females do not participated in this activity. The result would be an estimate of a potential marginal value product were constraints concerning labor allocation to change rather than a marginal value product representing present practices. Without disaggregating the data into separate Dj and Sj for each major labor activity -- which would require more detailed supply data than normally available -- the analyst using Bruce's formula cannot adequately separate the actual from the potential marginal value product. Some attempt, however, can be made to correct for suspected over estimates of supply by weighting the availability of and demand for various age/sex categories differently. One example of how this might be done is presented below.

SHOULD SUPPLY BE ADJUSTED FOR MIGRATION?

While family labor is the most important source of "Office du Niger" supply, the analyst must also consider the supply of labor available for hire. Those farmers who do hire labor tap two different labor pools to meet this demand: (1) neighboring farm families and (2) migrants from the millet

regions of the Dogon Plateau and the Seno Plain. In the former case, supply is already accounted for in the Sj when the stock of "Office du Niger" family labor is factored in at a given number of hours per day. The fact that average wages paid during the months of greatest labor demand are not the highest monthly wages paid throughout the year (see Tables XIII and XIV below where the data are presented), suggests that in-migration does influence wages and should be accounted for in the Dj/Sj ratio.

Accounting for changes in Sj due to migration, however, is not so simple. No concrete data seem to be available on the employment rates for these migrants. The conventional wisdom in the "Office du Niger" is that a labor constraint exists during harvest (i.e., Dj > Sj). If this is true, the analyst should adjust the Sj by the number of hours of hired labor actually reported (assumed to be entirely migrants during the peak season) and adjust the Dj by a larger amount based on perceived labor shortage. On the other hand, one also hears of migrants who do not readily find work, and one sees unemployed men congregating at market centers in search of work. If the evidence for unemployment during the peak season appeared stronger than that for undersupply, then Sj should probably be adjusted upward to include changes in supply due to in-migration. An example of his latter adjustment is presented below.

It should be noted that no adjustment is necessary to account for out-migration by "Office du Niger" farmers because any such migration was recorded by Kamuanga as an off-farm demand on family labor time.

ARE MARGINAL VALUE PRODUCTS EQUAL ACROSS ACTIVITIES?

Another problem with a total aggregation of the data is the implicit assumption that a given unit of labor engaged alternatively in each of the enumerated activities is equally valuable at the margin. This would be true if farmers were operating in a strictly neoclassical economic environment. Under such conditions, one assumes that the producer allocates resources among productive activities so that the marginal value products of the input are equal across activities. Bruce notes that even when the wage is greater than the marginal value product due to social constraints, labor within the traditional agricultural sector is not necessarily misallocated. He suggests that traditional farmers could still be allocating labor so that the marginal value products were equal. The fact that agricultural wages are greater than marginal value products, however, would imply a misallocation of resources between agriculture and other sectors. The marginal value product estimates presented in Tables XIII-XVII assume that labor is allocated efficiently across all activities. Additional estimates which examine the possibility of unequal marginal value products are presented in the next section of the paper.

EMPIRICAL ESTIMATES OF AN AGGREGATED MARGINAL VALUE PRODUCT

Table XIII uses Bruce's formula to estimate a separate marginal value product for each zone in Kamuanga's study. Monthly wages shown are the average hourly wage paid to all adult male laborers irrespective of the type of work performed. Demand is the total number of hours worked by family and hired labor in all activities enumerated by Kamuanga (i.e., female household activities are not included). Supply is based on the stock of family labor only, each family member ten years or older being factored at eight hours/day and twenty-five days/month. The data for each zone are presented to illustrate the extreme variability from zone to zone and month to month, as well as the fact that in two of the three zones wage data was not available for all months. The analysis results in three quite different marginal value products: Kolongo is 27.4 MF per hour or 219 MF per eight hour day; Sahel is 56.9 MF (455 MF/day), and Niono is 46.5 MF (372 MF/day). It should be remembered that the soil quality and irrigation infrastructure are quite different from zone to zone, probably accounting for a large part of the differences found in the marginal value product estimates.

One particularly intriguing result of this analysis is that observed wages do not always vary directly with the demand/supply ratio. Table XIII reveals that peak wages are not necessarily paid during months where the ratio approaches unity. This was true for Niono and Kolongo sectors and was

TABLE XIII

SECTORAL ESTIMATES OF THE MARGINAL VALUE PRODUCT OF UNSKILLED LABOR USED BY "OFFICE DU NIGER" FARMERS

SAHEL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER HR.	45.5	MISSING	159.38	119	77.5	74.63	MISSING	MISSING	175	MISSING	100	62.5
DEMAND PER MONTH	3535	3296	3714	1273	2113	2980	3622	3299	2083	2803	3288	2488
SUPPLY PER MONTH	4700	4700	4700	4700	4700	4700	4700	4700	4700	4700	4700	4700
DEMAND/SUPPLY	0.75	0.70	0.79	0.27	0.45	0.63	0.77	0.70	0.44	0.60	0.70	0.53
(DEM/SUP)*(WAGES)	34	MISSING	126	32	35	47	MISSING	MISSING	78	MISSING	70	33
MVP OF LABOR	57 PER HOUR		455 PER 8 HOUR DAY									
NIONO												
WAGE PER HR.	75.63	62.38	77.75	64.88	115.13	85.13	73.25	66.25	85.13	68	64.75	68.88
DEMAND PER MONTH	5767	4323	4574	2964	3667	4618	5137	3648	4892	4229	5872	5024
SUPPLY PER MONTH	7375	7375	7375	7375	7375	7375	7375	7375	7375	7375	7375	7375
DEMAND/SUPPLY	0.78	0.59	0.62	0.40	0.50	0.63	0.70	0.49	0.66	0.57	0.80	0.68
(DEM/SUP)*(WAGES)	59	37	48	26	57	53	51	33	56	39	52	47
MVP OF LABOR	47 PER HOUR		372 PER 8 HOUR DAY									
KOLONGO												
WAGE PER HOUR	75.38	100.5	MISSING	89	82.13	94.75	92	93.75	93.75	87.5	53.75	55.75
DEMAND PER MONTH	2143	1272	1088	1625	2005	2913	2570	2251	2112	1556	1699	2899
SUPPLY PER MONTH	6350	6350	6350	6350	6350	6350	6350	6350	6350	6350	6350	6350
DEMAND/SUPPLY	0.34	0.20	0.17	0.26	0.32	0.46	0.40	0.35	0.33	0.25	0.27	0.46
(DEM/SUP)*(WAGES)	25	20	MISSING	23	26	43	37	33	31	21	14	25
MVP OF LABOR	27 PER HOUR		219 PER 8 HOUR DAY									

Note: Wages in Malian Francs. Supply assumes an 8 hour workday and 25 workdays per month. Calculations are made using Kamuanga's data adjusted as described on pages 97-99 and Bruce's formula described on page 106.

carried over into the aggregated sample estimate. Similarly, months reporting the lowest average wages are not necessarily those months with the greatest excess supply. This was true for all sectors. Factors other than demand and supply appear to be influencing wage levels. Possible explanations might be cash shortages during harvest which depress wages during peak demand, a significantly greater supply of labor during harvest than allowed for in the analysis, or different wage rates being paid for different tasks (e.g., land clearing rewarded at a higher price than harvest activities). Further study of this result appears warranted.

In Table XIV the data for all three zones are aggregated. The monthly wages reported are an average of all observations for the entire survey. The demand is a simple sum of the demands for each zone shown in the previous table. Supply is estimated at three different levels -- six, eight, and ten hours per day per family member ten years of age or older. The percentage change in marginal value product given the two hour per day increments from six to eight hours is 25%; from eight to ten hours it is 20%. The confusing aspect of this analysis is that at the level of hourly wages, marginal value products seem to vary depending on the length of the workday assumed. If, however, the analyst decides to convert hourly rates to daily rates, multiplying each hourly marginal value product by the respective number of hours worked, the differences cancel out leaving a consistent estimate of 332 MF.

TABLE XIV

AGGREGATE ESTIMATES OF THE MARGINAL VALUE PRODUCT OF ALL UNSKILLED LABOR USED BY "OFFICE DU NIGER" FARMERS

SIX HOUR WORKDAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER HR.	75.5	64	133.8	79.3	102.9	84.4	79.3	73.8	88	70.9	62	64.3
DEMAND PER MONTH	11445	8891	9376	5862	7785	10511	11329	9198	9087	8588	10859	10411
SUPPLY PER MONTH	13819	13819	13819	13819	13819	13819	13819	13819	13819	13819	13819	13819
DEMAND/SUPPLY	0.83	0.64	0.68	0.42	0.56	0.76	0.82	0.67	0.66	0.62	0.79	0.75
(DEM/SUP)*(WAGES)	63	41	91	34	58	64	65	49	58	44	49	48

MVP OF LABOR 55.29 PER HOUR 331.76 PER 6 HOUR DAY

EIGHT HOUR WORKDAY

WAGE PER HR.	75.37	64	133.75	79.25	102.87	84.38	79.25	73.75	88	70.88	62	64.25
DEMAND PER MONTH	11445	8891	9376	5862	7785	10511	11329	9198	9087	8588	10859	10411
SUPPLY PER MONTH	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425
DEMAND/SUPPLY	0.62	0.48	0.51	0.32	0.42	0.57	0.61	0.50	0.49	0.47	0.59	0.57
(DEM/SUP)*(WAGES)	47	31	68	25	43	48	49	37	43	33	37	36

MVP OF LABOR 41.45 PER HOUR 331.60 PER 8 HOUR DAY

TEN HOUR WORKDAY

WAGE PER HR.	75.38	64	133.75	79.25	102.88	84.38	79.25	73.75	88	70.88	62	64.25
DEMAND PER MONTH	11445	8891	9376	5862	7785	10511	11329	9198	9087	8588	10859	10411
SUPPLY PER MONTH	23031	23031	23031	23031	23031	23031	23031	23031	23031	23031	23031	23031
DEMAND/SUPPLY	0.50	0.39	0.41	0.25	0.34	0.46	0.49	0.40	0.39	0.37	0.47	0.45
(DEM/SUP)*(WAGES)	37	25	54	20	35	39	39	29	35	26	29	29

MVP OF LABOR 33.16 PER HOUR 331.61 PER 10 HOUR DAY

Due to this ironing out of differences at the level of daily wages, analysts point out that choosing an arbitrary length for the workday will not change the results of the analysis so long as the assumption is used consistently for all calculations. (See, for example, Friedrich, 1977) One of the problems with this rule is that the results remain subject to variation depending on which activities are included in demand. In other words, if the eight hours per day is what is available for all productive activities (both farm and household) the marginal product will have one value; if Bruce's formula is calculated charging only farming activities to the eight hours, a different marginal value product will be obtained. This is illustrated below with adjustments made for demands on female labor.

Before going on to the next table, it is worth noting the differences between the aggregate rate per hour on Table XIV and the separate zone marginal value products of Table XIII. If policy decisions are made about the profitability of rice production using the aggregated marginal value product without looking at marginal value products for each zone, regions with higher marginal value products might be encouraged to increase production even though they do not have the comparative advantage implied by the more aggregated estimate. Similarly, regions which do have a comparative advantage due to lower opportunity costs of labor might be discouraged from producing because the aggregated marginal value product was high enough to render rice production unprofitable.

Table XV shows a more complete estimate of labor demand in general farm activities by incorporating demands for female labor in housekeeping, cooking, and childcare duties. This and the next several tables use the convention of an eight hour day and report daily rather than hourly wages. The results should be compared to the 332 MF daily rate obtained in Table XIV. In Table XV, labor demand is increased by two hours per day for each married woman in the sample. The change in demand results in a 10% increase in the estimate of the marginal value product (i.e., from 332 to 365 MF/day).

Table XVI attempts to incorporate changes in labor supply due to seasonal in-migration. Available data are totally inadequate to properly adjust supply due to this migration. A conservative estimate of a 10% increase in the December, January, and February labor supply due to in-migration is used in Table XVI to illustrate the possible impact on an aggregated marginal value product estimate. Comparing the result to the comparable eight hour/day marginal value product of Table XIV, one finds a 2% change in the estimate.

Table VIII presented coefficients of profit elasticity with respect to changes in labor costs ranging from 2.3 to 57.86 depending on farm size and zone. Given these coefficients, the 2.1% change in labor costs associated with this adjustment for in-migration could elicit a change in profits ranging from 4.8% to 121.5%. The 10% change due to adjustments for female labor demand would entail profitability changes in the range of 23% to 578.6%. The potential for

TABLE XV: ESTIMATES OF MVP OF LABOR FOR THE ENTIRE SAMPLE

DEMAND ADJUSTED FOR GENERAL HOUSKEEPING ACTIVITIES*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER DAY	603	512	1070	634	823	675	634	590	704	567	496	514
DEMAND PER MONTH	12389	9835	10320	6806	8729	11455	12273	10142	10031	9532	11803	11355
SUPPLY PER MONTH	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425	18425
DEMAND/SUPPLY	0.67	0.53	0.56	0.37	0.47	0.62	0.67	0.55	0.54	0.52	0.64	0.62
(DEM/SUP)*(WAGES)	405	273	599	234	390	420	422	325	383	293	318	317
MVP OF LABOR	365											

*INCREASES DEMAND BY TWO HOURS PER DAY PER MARRIED WOMAN.

TABLE XVI: ESTIMATES OF MVP OF LABOR FOR ENTIRE SAMPLE

SUPPLY INCREASED BY SEASONAL MIGRATION*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER DAY	603	512	1070	634	823	675	634	590	704	567	496	514
DEMAND PER MONTH	11445	8891	9376	5862	7785	10511	11329	9198	9087	8588	10859	10411
SUPPLY PER MONTH	20268	20268	18425	18425	18425	18425	18425	18425	18425	18425	18425	20268
DEMAND/SUPPLY	0.56	0.44	0.51	0.32	0.42	0.57	0.61	0.50	0.49	0.47	0.59	0.51
(DEM/SUP)*(WAGES)	341	225	544	202	348	385	390	295	347	264	292	264
MVP OF LABOR	325											

*ASSUMES 10% INCREASE IN DECEMBER, JANUARY, AND FEBRUARY.

inadvertent manipulation of both marginal value product and profit estimates is great in situations where it is not clear exactly what should be factored into the Dj and Sj parameters.

Table XVII illustrates the effects of one additional adjustment which is commonly made by analysts. Both demand and supply reflect a method of weighting labor inputs based on age. This method was used by Kamuanga and is quite commonly encountered in economic analysis. It weights all laborers younger than 15 or older than 60 by a factor of .5. The adjustment implies that the very young and very old need to put in eight hours of work to perform the equivalent of four hours of effort expended by an adult aged 15-60. An eight-hour work day is assumed. In comparing this result with that obtained in Table XIV one finds little change in the estimated marginal value product.

The calculations performed in the last several tables are presented for purposes of illustration only and no attempt has been made to come up with a "best guess" scenario of which Dj, Sj, and Wj value would be most appropriate in the "Office du Niger". Theoretically, an analyst, in consultation with policymakers, could try to estimate a marginal value product by selecting the Dj, Sj, and Wj values which were most consonant with national policy objectives. Such an endeavor would require the analyst to carefully think through the various choices available and to explain to policymakers the growth and equity implications of each choice. This is a particularly difficult task when markets are not in equilibrium and

TABLE XVII: ESTIMATES OF MVP OF LABOR FOR ENTIRE SAMPLE

SUPPLY AND DEMAND ADJUSTED FOR AGE*

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER DAY	603	512	1070	634	823	675	634	590	704	567	496	514
DEMAND PER MONTH	10895	7713	7976	5101	6725	8952	9506	7723	7914	7396	9394	8887
SUPPLY PER MONTH	15975	15975	15975	15975	15975	15975	15975	15975	15975	15975	15975	15975
DEMAND/SUPPLY	0.68	0.48	0.50	0.32	0.42	0.56	0.60	0.48	0.50	0.46	0.59	0.56
(DEM/SUP)*(WAGES)	411	247	534	202	346	378	377	285	349	263	292	286
MVP OF LABOR	331											

* <15 OR >60 YEARS OF AGE WEIGHTED .5; ALL OTHERS WEIGHTED BY UNITY.

there is not a single, obvious marginal value product to estimate.

(B) MARGINAL VALUE PRODUCT OF LABOR USED IN NON-RICE ACTIVITIES

There are numerous factors which might lead one to question whether the marginal value products of all categories of farm labor are equal across every activity. If disequilibrium exists and marginal value products in all activities are not equal, the analyst should really be estimating the marginal value product of some alternative to rice production -- either the opportunity foregone by increasing production or the next best alternative activity if rice production were cut back. This section of the paper looks at the problem of estimating marginal value products in non-rice activities for families which actively participate in labor markets as well as for those which do not.

WHEN FAMILIES ACTIVELY PARTICIPATE IN LABOR MARKETS

A look at average wages for different activities in the "Office du Niger" suggests that wages and marginal value products might not be equal from one activity to another. Average rice labor wages were found to be 85 MF/hour, general farm activities were 83 MF, off-farm 67 MF, and livestock only 53 MF. As a result of these differences, it seems appropriate to estimate a marginal value product of non-rice labor.

Table XVIII presents the data and final estimate for the marginal value product of these activities. The wage per day was obtained by omitting all observations on wages paid for rice labor. Eliminating these observations removed approximately 55% of all wage hours enumerated, sharply reducing the number of remaining observations. The demand estimate is based on the demand reported by Kamuanga for all non-rice activities. Annual demand for these activities is approximately 42% of the total rice and non-rice demand. Supply is factored at eight hours per day minus the number of hours devoted to rice activities. The result is a marginal value product for these activities of only 22 MF/hour or 179 MF per eight hour day. This marginal value product is only 54% of the aggregated marginal value product estimated in Table XIV. This difference suggests that the marginal value product for different activities may not be the same and that extreme caution should be used in trying to estimate the opportunity cost of rice labor from an average market wage for an undifferentiated group of unskilled laborers.

WHEN FAMILIES DO NOT PARTICIPATE IN LABOR MARKETS

The preceding discussion has dwelt on the problems of estimating the opportunity cost of rice production under disequilibrium conditions when farm families do participate to some extent in labor markets. There are a number of new problems associated with placing a value on family labor for farms which do not buy or sell labor. A close look at the degree of labor market participation by "Office du Niger"

TABLE XVIII

ESTIMATES OF THE MARGINAL VALUE PRODUCT OF NON-RICE LABOR USED BY "OFFICE DU NIGER" FARMERS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
WAGE PER HR.	69.3	51.76	81.6	82.66	93.55	70.97	82.1	76.9	79.3	68.75	56	65.11
DEMAND PER MONTH	4685	4965	6163	3136	3411	3781	4475	3337	3502	3451	4007	2800
SUPPLY PER MONTH	11665	14499	15212	15699	14051	11695	11571	12564	12840	13288	11573	10814
DEMAND/SUPPLY	0.40	0.34	0.41	0.20	0.24	0.32	0.39	0.27	0.27	0.26	0.35	0.26
(DEM/SUP)*(WAGES)	28	18	33	17	23	23	32	20	22	18	19	17

MVP OF LABOR 22.39 PER HOUR 179.13 PER 8 HOUR DAY

WAGES IN MALIAN FRANCS; SUPPLY ASSUMES AN 8 HOUR WORK DAY AND 25 DAYS PER MONTH.

farmers suggests that it is quite limited. Kamuanga's data reveals that only 4 of 20 farms in Sahel, 16 of 33 in Niono and 5 of 36 in Kolongo reported having any family members hire out their labor at some time during the survey year. This represents less than 30% of farms in the total sample. For the 70% of farms not selling labor in markets, there is no reason to assume that marginal value products of family labor are equal to wage rates, even when labor is allocated efficiently across all activities. Furthermore, in the case where different marginal value products exist for various tasks, it is highly unlikely that the wage rate offers the best guide to a farmer's opportunity cost in rice production.

One interpretation of using a market wage to value family labor which is not presently active in labor markets is that farmers would be likely to switch to wage labor if they were not engaged in rice production. This appears unlikely given the seasonality of labor demand in the area. Another indication that most farmers do not consider wage employment an

[illegible] ES OF TI [illegible] AN [illegible] 85 65 40 28 39 PER [illegible] SUPPLY [illegible]

mers were asked to identify strategies for reducing their indebtedness to the "Office du Niger". Only 35% of the farmers considered working as a hired laborer a viable solution. (Kamuanga, pg. 287)

Another way of justifying a marginal value product of family labor equal to the wage rate would be if farm families hired labor at these wages -- the implication being that at the margin the family valued its own time in other activities

at the same rate they were willing to pay hired labor. Participation in the hiring side of the labor market, however, is also fairly limited. Of 89 farms in the sample, 35 (39%) hire no labor at all, and twelve of those hiring labor use less than 5 workdays per year. Approximately 52% of sampled farms hire less than 1% of their total on and off-farm labor requirements.

A discussion of the importance of labor market participation rates was presented during the review of farm household production/consumption models. The issues raised in that discussion appear particularly relevant to the "Office du Niger" situation where low rates of participation are in evidence.

Given the seasonality of wages, is it really appropriate to value an entire family's labor at some average annual wage rate if one member of that family works for a few days at a wage which may well be very different from the average estimated? It does not seem appropriate if some alternative activity exists which currently occupies more of the farm family's labor outside of rice production and could, therefore, be considered an alternative to rice production activities.

Kamuanga's data provides an excellent inventory of time spent in activities other than rice production and gross revenues earned in these activities. Table XIX presents a picture of family labor allocated to various activities by month and by sector. Table XX reports gross revenues earned

TABLE XIX

ALLOCATION OF FAMILY LABOR TO OFF-FARM ACTIVITIES

WORKDAYS PER MONTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
KOLONGO													
ILLNESS	2	14		16	5	9	10	2		4	2	1	65
CEREMONIES	1		9	20	3	13	12	113	46	10	43	1	271
TRAVEL				40	6	65	4	28	14	133		3	293
WAGE EMPLOYMET				44				2				1	47
WOOD GATHERING	80	141	75	205	175	136	114	123	108	83	24	26	1290
CRAFTS	57	126	77	43	43	65	54	99	128	65	11	31	799
CARVING	15	25	13	21	14	5	19	16	20	16	7	20	191
FISHING, HUNTING,													0
TRAPPING	14	18	3	28	10	15	22	33	18	12	4	10	187
DRYLAND AGRIC. OR													0
VEG. GARDENING	18	30	30	6	0	54	98	116	104	86	26	18	586
NIONO													
ILLNESS	41	3	14	63	44	26	117	48	45	78	20	8	507
CEREMONIES		30	42	92	41	79	97	86	78	43	24	3	615
TRAVEL	2	1	6	125	143	217	78	17	19	1			609
WAGE EMPLOYMET	59	47	78	11	22	46	74	97	24	12	18	39	527
WOOD GATHERING	9	25	38	38	29	4	16	2	24	16	2	7	210
CRAFTS		8	7	11	1	30	38	8	13		274		390
CARVING				1						24			25
FISHING, HUNTING,													
TRAPPING	65	24	14	4	14	16	12	12	11	18	5	14	209
DRYLAND AGRIC. OR													
VEG. GARDENING	170	188	220	190	96	132	174	204	216	162	180	80	2012
SAHEL													
ILLNESS				28	11	40	48	13	14			1	155
CEREMONIES	3		44	25	2	17	17	114	19		61		302
TRAVEL		7	21	62	9	2	8		7				116
WAGE EMPLOYMET	7			3		15							25
WOOD GATHERING	1	13	42	7	3	1			3		2		72
CRAFTS	23	197	285	6	459	352	367	330	248	164	207	74	2712
CARVING													0
FISHING, HUNTING,													
TRAPPING	3	4	4		2	2	8	1	2				26
DRYLAND AGRIC. OR													0
VEG. GARDENING	36	36	24	6	48	60	90	96	74	62	44	30	606

SOURCE: COMPILED BY THE AUTHOR FROM KAMUANGA'S DATA.

TABLE XX

VALUE OF GROSS REVENUES RECEIVED IN OFF-FARM ACTIVITIES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
NIONO												
DRYLAND FARMING			73800	240275	19375	33200	127425	77500		47400		
VEGETABLE GARDENING	11520	17365	38500	366670	250645	388134	222945	55950	11260	21350	9775	6000
NON-AGRICULTURAL PROD.+	17300	118740	7500	14750	1250	47075	115425	52375	91695	24675	44060	19960
GATHERING		735	900	99455	80695	19540				1500	875	
MISCELLANEOUS						1500	27635			1900	200	
WAGE INCOME	64150	72930	78325	217441	65600	42600	149420	116750	21250	16575	62700	27000
NO. FARMS EARNING WAGES	4	5	6	6	5	4	5	6	3	3	3	1
TOTAL NON-RICE INCOME	92970	209770	199025	938591	417565	532049	642850	302575	124205	113400	117610	52960
SAHEL												
DRYLAND FARMING		72000	24000	5500	4250							
VEGETABLE GARDENING	35624	32880	9700	19450	2190							
NON-AGRICULTURAL PROD.+	13900	10000	32000	3000	8100	8125	82050	34400		43900	7000	18000
GATHERING			25750	17400	40550	28110	17165					
MISCELLANEOUS		24000		39300	2600							
WAGE INCOME	1200		12000	12000				38950		15375	12750	15000
NO. FARMS EARNING WAGES	1		1	2				1		1	1	1
TOTAL NON-RICE INCOME	50724	138880	103450	96650	57690	36235	99215	73350		59275	19750	33000
KOLONGO												
DRYLAND FARMING	102775	20450	7500	8625	3100	17575	4500	12335	17975	41825	105000	101000
VEGETABLE GARDENING	750	11000						200	5360	3025	550	650
NON-AGRICULTURAL PROD.+	29100	61760	16335	6430	94060	81660	111630	64255	74940	59820	9950	16810
GATHERING	2100	550	200	1500	6200			3650	10985	24900	5900	3150
MISCELLANEOUS	600		800		6270	1365	3745	4025	4020	3120		
WAGE INCOME	18500	300		4500	700	35000	8000	8000			3200	35900
NO. FARMS EARNING WAGES	1	2		1	1	3	1	1			4	5
TOTAL NON-RICE INCOME	153825	94060	24835	21055	110330	135600	127875	92465	113280	132690	124600	157510

+ INCLUDES REVENUE FROM TRADING/COMMERCE.

* REPRESENTS TOTAL NUMBER OF FARMS IN EACH SECTOR WITH INCOME FROM PAID EMPLOYMENT DURING THE YEAR.

SOURCE: COMPILED BY THE AUTHOR FROM KAMUANGA'S DATA.

in a number of these activities. Unfortunately, the data were not collected for the purposes of calculating net returns to labor and it is not possible to develop opportunity costs of rice production based on these off-farm occupations. Both the relatively small amount of time which farmers spend in off-farm wage employment and the relatively small portion of off-farm revenue accruing from this activity suggest that analysts should look to activities other than wage employment when trying to identify marginal value products of family rice labor.

These two tables suggest that farm families engage in a large number of alternative off-farm activities. Opportunity costs based on these activities would probably reduce the labor costs of "Office" rice production and thereby improve the profit picture presented by those who rely strictly on wage based marginal value products. This is a particularly important consideration in comparative advantage analysis if marginal value products are not considered equal across activities. What is needed under such circumstances is an opportunity cost based on what the farmer would do were he not producing rice. It is more reasonable to assume that farmers would attempt to expand existing non-rice activities such as millet production then to think they would seek wage employment in an environment with relatively low and strictly seasonal demands for hired labor. The analyst's time might be better spent collecting data on returns to off-farm activities

rather than trying to force market wage rates into an analysis where they do not belong.

(C) General Observations on the Use of the Bruce Formula

It must be stressed that the calculations presented in Tables XIII-XVIII are illustrative and do not pretend to be accurate estimates of "Office du Niger" marginal value products under the conditions described. Given the high variability in the wage data, even when only the less variable adult male wages are used, the calculations have no statistical significance. Nevertheless, the tables do provide some indication of the extent to which different assumptions about Dj, Sj, and Wj can change estimates. Assumptions about the length of the workday and alternative methods for weighting labor inputs by age do not appear to have a direct impact on marginal value product estimates. Assumptions about the length of the workday can have an indirect effect on marginal value product estimates if comparable demand data are not used.

Important changes can be obtained by altering assumptions about supply due to migration and demand for female labor. The most significant differences, however, appear when marginal value products are calculated at disaggregated levels by zone (Table XIII) or by activity (Table XVIII). The variations among zones and the differences between rice and non-rice marginal value products suggest that labor markets are not in equilibrium and that use of aggregated average wage

rates across geographic areas and labor activities could result in misleading economic analysis.

V. LESSONS TO BE LEARNED

A. INTRODUCTION

The review of literature and case study presented above have identified a wide range of factors which call into question both the theoretical appropriateness and practical usefulness of shadow wage rates as they are currently conceived and estimated. Although a multitude of obstacles faces the analyst at every step in the process, there appear to be three underlying sources of the problems identified:

1) Poor adherence to underlying principles of economic theory and/or theory which is inadequate in dynamic situations characterized by disequilibrium;

2) Inadequate adherence to the rules of statistical analysis and inference;

3) A failure to make explicit the policy implications of various "technical" choices, thereby allowing those in positions of political authority to evade the difficult decisions which are rightfully theirs to make.

Each of these problem areas will be discussed in turn.

B. PROBLEMS OF THEORY

The practice of valuing labor for economic analysis at a shadow wage rate assumes the existence of some type of market disequilibrium -- i.e., the neoclassical price-auction theory of labor markets in static equilibrium is inadequate. Under

such circumstances, theoreticians and analysts alike agree that the economic cost of a unit of labor should be less than the prevailing disequilibrium wage rate, even though that wage rate does reflect the true financial cost of using labor. The fuzzy area in both theory and practice concerns the determination of exactly how much lower than the market wage the opportunity cost of labor should be. Theory is not clear on whether analysts should be estimating the marginal value product which would prevail at the unattained equilibrium or some other marginal value product. Analysts do not make it clear exactly what types of disequilibria they are correcting for and which marginal value product they are estimating. Furthermore, analysts frequently fail to specify the exact category of labor activity to be foregone and why a particular marginal value product has been selected to reflect this foregone opportunity. Under conditions of disequilibrium one cannot assume, as is often done, that marginal value products are equal across all categories of unskilled labor.

One other problem which theory does not deal with adequately is the long-run aggregate macro-economic impact of implementing many projects which have been evaluated with shadow wage rates.

C. PROBLEMS OF STATISTICAL INFERENCE

The case study of the "Office du Niger" presented a number of examples illustrating how shadow wage estimates are subject to variation given different methods of data collection, aggregation and analysis. It was pointed out that the

data alone pose serious problems because they are highly variable, yielding large standard deviations which make it impossible to develop statistically significant estimates with the sample size typically used in a cost-route survey such as Kamuanga's. In some cases, the high variability in observed wages might be attributed to erroneous aggregation of non-homogeneous categories of labor. In other cases it may simply be due to the fact that wages are not determined in a price-auction environment but by a variety of socio-cultural factors which vary among employers as well as employees.

The major concern with respect to statistical inference is whether analysts can justify use of their economic analysis for policy and planning purposes. Certainly, profitability estimates with confidence intervals similar to those calculated for illustrative purposes in Chapter IV provide an inadequate basis for policy analysis. Nevertheless, decisions are made using estimates which could well have equally large margins for error because analysts do not pay attention to the statistical properties of their data and analysis.

D. CLARIFYING THE POLITICAL CONTENT OF TECHNICAL CHOICES

1. DISTRIBUTIONAL IMPLICATIONS OF CHOOSING OPPORTUNITY COST INDICATORS

(A) A U. S. EXAMPLE

Poor choice of opportunity cost indicators in economic analysis can wreak unanticipated havoc when that analysis is put to use by policymakers who are unaware of the weaknesses. An interesting example of policy recommendations gone awry due

to incorrect estimation of the opportunity costs for farm inputs is described by Hoffman and Gustafson. This example does not deal with opportunity costs of labor, nor with a developing country situation. It is, however, quite relevant to the present discussion for it deals with the need to impute costs of non-market activities carried out by farm-households. The authors examine the 1973 U.S. Agriculture and Consumer Protection Act which contained a provision for adjusting target and support prices to reflect current costs of production. This required that the costs of inputs not readily determined by market transactions be imputed from appropriate opportunity costs. The act specified that the imputed return to fixed costs equal the existing interest rates charged by the Federal Land Bank and the imputed returns to management be comparable to the normal management fees charged by other similar industries.

When costs of production were computed using these opportunity costs, the U.S. Department of Agriculture found itself trying to explain why farmers were increasing production while the accounts showed them to be continuously losing money -- a situation which suggests irrational behavior of producers, a flaw in economic theory, or inaccurate cost-return estimates. (Hoffman and Gustafson, p. 3) The authors analyze the cost-return estimates and provide a convincing argument against the use of the recommended opportunity costs. It is not necessary to elaborate the serious problems which can reverberate

throughout all sectors of an economy if an agricultural program sets target and support prices on the basis of cost estimates which are highly inflated due to inappropriate use of opportunity costs.

While this example is drawn from U.S. experience, it has much to offer those doing economic analysis in developing countries where the opportunity cost of labor -- the primary input into most production processes -- often has to be imputed or estimated from very poor data. In view of the estimation constraints discussed throughout this paper, analysts can be forced to use proxy data and insufficiently researched assumptions about labor markets. Resulting opportunity cost estimates may not reflect the value of output which will be foregone because the incorrect opportunity has been identified. If a government designs development policies based on such faulty economic analysis, economic development could be severely hampered. One must ask if these dangers could ever outweigh the benefits of economic analysis and whether means are not available for reducing the probability of policy decisions being misdirected.

(B) IN PROJECT ANALYSIS

The discussion in Chapters III-IV identified a number of cases where the analyst had to decide what, if any, productive activity would be foregone if government financed a particular project requiring unskilled labor inputs. Choice of an appropriate opportunity cost requires more than a simple identification of the geographic region and occupation from which

transferred labor will be drawn. Complex social, cultural, and behavioral interactions take place when migration occurs, requiring careful assessment of changes in consumption and production decisions of both migrating and non-migrating family members. This is particularly true when labor is withdrawn from rather closed farm-household firms. The labor market model underlying an analyst's choice of indicator for the product of foregone opportunities can significantly influence the nature of projects undertaken by government and therefore the overall development of a nation.

For example, reliance on a Lewis market model would result in lower shadow wage rates than use of the Harris/Todaro model. Many more projects would have an acceptable net present value, and among those with present values greater than zero, labor inputs for the former model would tend to be greater than those for the latter. In reviewing empirical shadow wage estimates, the assumed labor market models and associated marginal value product adjustments are seldom, if ever, adequately justified by empirical work.

In the absence of sound empirical work defending the use of a particular market model over another, one is inclined to ask for a more comprehensive analysis -- perhaps even a comparison of shadow wage estimates associated with a number of different but equally feasible models and behavioral assumptions. To fully round out the analysis, one might then try to predict the project-macro policy interactions, suggesting

which underlying assumptions would result in project selection consonant with national growth, equity, and inflation policies.

This is not an easy task. For example, an analyst wishing to describe the distributional impact of an analysis might have to examine the relationship between marginal value product and wages in project employment as well as in pre-project employment. Analysts often assume that wages are equal to marginal value product in the urban labor markets which usually determine wages paid to project employees. If this assumption were incorrect, those moving into government financed project employment would be receiving a subsidy equal to the difference between the wage and the marginal value product of their project work. This subsidy has equity implications, particularly for those whose tax money may be financing the project. It could also mean that other inputs into the production process are receiving less than their marginal value products. If a society agrees in general that marginal product is a fair indication of an individual's share of total product, then a project analysis which encourages increased employment of resources receiving more than their marginal product is not consistent with policy objectives.

(C) IN COMPARATIVE ADVANTAGE ANALYSIS

Choice of the appropriate opportunity cost for comparative advantage analysis appears even more complex than that for project analysis. The analyst must identify the product foregone as the production of the commodity under study is

accelerated as well as the most likely alternative activity if production of the commodity were to be curtailed. It is not clear that these would always be the same activity. If an analyst considers only one marginal value product, i.e., either the foregone product or the next best alternative, one is inclined to ask how the choice was made without prior knowledge about the sign of the commodity's net profit.

For example, if rice production in the "Office du Niger" exhibits a comparative advantage and government wants to expand its production the analyst must ascertain the source of any increased labor needs. Two possible scenarios come immediately to mind: (1) current "Office" farmers might spend less time on millet, vegetables, and off-farm activities in order to produce more rice or (2) more settlers could be brought into the "Office", probably from millet, peanut, or cotton areas. A response involving significant amounts of migration could result in a very different foregone product than one which did not. This would be particularly true if migrating families moved from a production system which made extensive use of female labor into an "Office du Niger" system which offered much fewer opportunities for productive use of female labor. If one used the marginal product of a single millet laborer as the opportunity cost, not allowing for losses in productivity due to family migration, rice projects would be evaluated more favorably perhaps than millet projects and distributional effects of project analysis might result in

rice regions unjustly receiving greater government investment than millet regions.

Looking now at the other side of the coin, one must ask what farmers would do if they were encouraged to abandon rice production. Given the critical role that production of a food crop plays in assuring minimum food needs, most "Office" farmers would probably increase their production of millet and/or manioc. At the same time, government authorities might encourage production of sugar cane given the existence of the "Office's" irrigation infrastructure. It is unlikely that "Office du Niger" farmers would turn to wage labor and also unlikely that the prevailing market wage accurately reflects marginal value products in millet, manioc, and/or sugar cane production. Again, one might anticipate some out-migration of farmers which suggests even another possible value for the next best alternative to rice production.

Given circumstances where market wages are suspected of deviating from marginal value products in agricultural production, and wage employment does not appear to be the appropriate "opportunity" base upon which to graft shadow wages, an analyst would be well advised to identify a number of possible labor movement scenarios and estimate shadow wages for those considered most probable. The evidence is seldom conclusive enough to unconditionally identify THE next best opportunity or THE foregone product. Some attempt should be made to identify probable candidates for both categories and then to determine the extent to which these values may differ.

Policymakers should be presented with a number of alternatives, permitting them to make the political choices rather than hiding such choices in the technical analysis.

One final word of caution to the comparative advantage analyst is in order. Developing shadow wage rates for economic analysis is based on an assumption of marginal changes. If the results of a comparative advantage analysis are used to recommend non-marginal changes (i.e., discontinuing production of a crop which is cheaper to import than to produce), a shadow wage using market wages as the marginal value product for the marginal farmer's next best alternative could well provide very misleading analysis. Taking the "Office du Niger" again as an example, the marginal farmer may be able to find wage employment, but if all "Office" farmers were to seek wage employment at the same time it is unlikely that the market would be able to absorb everyone. Strictly speaking, any type of marginal analysis would provide misleading results if non-marginal changes were anticipated. On the other hand, if market wages vary from marginal value products in more realistic alternatives such as millet farming, a shadow wage based on the latter may do less damage than one based on market wages.

2. EQUITY IMPLICATIONS OF MEASURING THE VALUE OF THE FOREGONE PRODUCT

The review of various shadow pricing techniques presented in Chapters III and IV revealed that analysts use a wide variety of data sources and methods of analysis to quantify

the marginal value product of foregone opportunities. Among the data sources were formal cost-route surveys, informal labor market surveys, and national statistical series on aggregate levels of employment as well as productivity parameters for various sectors of the economy. There is a tendency in the profession to make the best use of existing data sources when performing economic analysis rather than to spend scarce resources on formal surveys. Even in the case of the cost-route data collected for the Office du Niger, the survey was not designed specifically to estimate marginal value products of agricultural labor; it had to serve a myriad of purposes and therefore presented a number of problems when put to the task of estimating an average wage.

Even if analysts had the time and money to collect their own data, numerous problems would remain. There is a clear debate in the literature as to the relative merits of macro vs. micro level data and analysis of labor productivity and wages. McDiarmid was the strongest proponent of using macro data and estimating macro parameters. In reviewing his empirical estimates, however, one finds that the analyst using such data must be able to make some very strong assumptions about the past occurrence of market equilibriums and/or the relationship between average and marginal productivity at a given period in time. Furthermore, McDiarmid offers the reader little guidance on how one would go about adjusting these macro parameters for use in a regional application. Without a clear understanding of how the data were collected, the nature

of specific questions posed, definitions used, etc., an analyst would be hard pressed to make any meaningful adjustments to the national parameters.

Use of national data might also pose problems with respect to distributional objectives. Many developing countries are extremely heterogeneous, with some geographic areas and/or socio-cultural groups much better linked to the modern urban sector than others. Unless special efforts have been made to assure that all regions are "fairly" represented in aggregated data, use of national shadow price parameters could have quite unexpected effects on particular regions or interest groups. The problem of "fair" representation is more political than technical. If data are collected by administratively determined regions, how will that data be weighted in the national aggregation? Should the population of the region determine the weight? What about using the number of hectares under cultivation? Or perhaps the percent of the labor force actively participating in the market would be better. These are not easy questions to answer. Different decisions could well produce different profitability estimates and therefore different mixes of government financed projects. The best an analyst can do under such circumstances is to make choices explicit and point out the distribution and growth implications of alternative methods. This is a very difficult task for the analyst using macro level data which tend to be quite opaque by the time they are translated from survey responses or periodic reports to national statistical indexes.

One finds little discussion in the project analysis literature on whose interests are reflected when a particular value is placed on inputs or outputs. If one were to estimate a shadow wage rate from agricultural value added parameters as suggested by Irvin (1978, p. 122), whose point of view should be reflected in the numbers assigned to the value added? Many markets exist for agricultural products and therefore many market prices. Do governments decide to value a product at world market prices? If so, should the import or export price be used? What are the implications of valuing at world prices if very different prices prevail within a country. No matter what choice is made, some groups will be favored at the expense of others.

A single farmer may have several different ways of valuing a given commodity if he produces the same product to meet different goals. A millet farmer, for example, produces a certain amount to meet his subsistence needs, an additional quantity to satisfy required sales to government buying agents, and perhaps some to be sold in a local market. The price he receives from the government agent is not the same as the local price, and his personal valuation of production for subsistence will probably differ from both "market" prices. While it is not being suggested that analysts attempt to incorporate individual farmer's personal valuation of subsistence crops into economic parameters, some reflection on the issue is recommended. The purpose of project analysis is to select government investments which are most likely to bring

about the changes in economic growth and equity called for in national goals and objectives. If international markets are thought to be distorted, or international prices have little meaning in terms of private valuation by producers and consumers within a country, an analyst should make this clear and consider the extent to which a variety of shadow wage estimates representing divergent views should be presented to policy makers.

E. SUMMING UP

Despite the harsh criticisms of economic analysis in general and shadow pricing of labor in particular, the reader should not interpret the critique as a rejection of benefit/cost analysis. The intent of the paper is to identify the most pressing problems and stimulate thought and discussion which might lead to more appropriate economic analysis than is presently being carried out.

Although the discussion has been exclusively concerned with problems encountered in shadow pricing labor, comparable problems are encountered in estimating other shadow prices -- particularly those for foreign exchange and capital. In many cases, labor will be such a small part of an economic analysis that the problems raised in this paper will appear trivial, and an analyst will be well advised to concentrate on other issues. When labor is a major input -- as it is in comparative advantage analysis dealing with agricultural commodities -- the issues raised in this paper should be given serious attention.

The inadequacy of current theory for dealing with dynamic, disequilibrium labor markets should be recognized; and analysts should stop pretending that there is some ideal true marginal value product which they are trying to estimate. The fact that such a marginal value product is non-existent does not render economic analysis useless. In fact, recognition of the ambiguities posed by a static equilibrium theory could result in economic analysis which is of greater use to planners and policymakers than that currently being produced. An analyst who recognizes the fact that different marginal value products exist under disequilibrium conditions can produce an extremely useful document by laying out in an organized fashion a number of alternative estimates and making the political implications and statistical strength of each estimate clear.

Faced with recommendations for more complete reporting of assumptions made by analysts and for multiple estimates indicating the tradeoffs among assumptions, the reader may feel that the costs of such detailed analysis would far outweigh the benefits. There is certainly a danger of this occurring.

Most reports of project analysis do not include the costs of performing the analysis itself. The World Bank, which is the organization most active in developing country cost-benefit analysis, estimates that the costs of the analysis range from 5-10% of total project costs on average. (Gittinger, MSU seminar, 1981) For multi-million dollar projects, this represents a sizeable amount of resources. One is

prompted to ask who are the beneficiaries of this analysis. The World Bank obviously believes that this analysis, as currently performed, helps it to better invest its limited resources and assure loan repayments. I am unaware, however, of any type of comparative analysis indicating that projects with "sub-standard" analysis perform less well than those with more thorough but costly analysis.

Who, besides the organization providing funds, benefits from the analysis? One would assume that the recipient nation would benefit also. Whether or not it does would seem to depend on who does the analysis and how well they are able to develop country parameters which are consonant with national goals and objectives reflected in existing economic, political and social policies. Although country economists are playing an increasingly larger role in project analysis, this has not been true in the past and remains a far off dream for many nations which lack the skilled manpower. Much analysis is performed by expatriates. Their high salaries, travel costs, and living accommodations account for a large part of that 5 to 10% of project costs devoted to analysis -- a distributional aspect of the cost-benefit process which is often overlooked. Given the very different perceptions an expatriate might have of market conditions, migratory behavior, etc., an explicit report of all assumptions made and a careful analysis of the implications thereof for shadow wage estimates, equity, and economic growth would seem to be of great value to the host country. If such information is not supplied, countries

which are offered financing by a variety of organizations. each using different models and assumptions, have no way of comparing one proposal with another.

In the longrun, one would hope that progress could be made toward better theory as well as better data. Both of these improvements could reduce the costs of economic analysis. The data problem is perhaps the most tractable. It requires a major change in attitudes toward data collection and a move away from crash programs based on intensive, but infrequent, surveys conducted by expatriates. Data banks need to be created which keep track of important economic parameters over time. More developing country nationals need to be trained and provided support to develop such data bases. Better analysis at lower costs could probably be obtained in the future if fewer high salaried expatriates were involved and better time series data become available.

Resolution of the theoretical problems will not be easy. Perhaps as more Third World economists are trained in a variety of economic traditions (neoclassical, Marxist, socialist, etc.), they will be able to come up with a synthesis that better models the social, political, and economic conditions of their environment than the neoclassical tradition now used in economic analysis. What is needed is greater recognition of the current problems, a willingness to consider alternative theories, and a lot of serendipity.

APPENDIX A

This appendix presents a supplemental list of empirical studies attempting to estimate the marginal value product of labor in developing countries. Although those publications discussed in depth in the main body of the paper are considered to be representative of all studies reviewed during the course of this research, interested readers may want to refer to some of the following publications which were consulted by the author but not discussed in the paper.

Byerlee, Derek. "Rural Labor Marrkets in West Africa. With Emphasis on the Semi-Arid Tropics," in the Proceedings of the International Workshop on Socio-economic Constraints to Development of Semi-Arid Tropical Agriculture, ICRISAT, Andhra Pradesh, India, 1979.

A good review of the literature on production function analysis of labor in West Africa.

Collier, William L., et. al. "Agricultural Technology and Institutional Change in Java." *Food Research Institute Studies*, Volume 13, pp. 169-194.

Discusses structural and cultural factors which might influence wage rates and, therefore, the level of employment in Indonesia. Considers causes of descrepancies between the marginal value product of labor and wages.

Guisinger, Stephen. *Wages, Capital Rental Values and Relative Factor Prices in Pakistan.* Washington, D.C.: World Bank, 1978

Discusses the relative importance of pricing capital and labor, suggesting that undue attention has

been given to controling the former rather than the latter.

Lappia, Joseph Njagba. *Agricultural Development Projects and Small Farmer Behavior: The Economics of Small Farmer Rice Production and the Distribution of Benefits in the Integrated Agricultural Development Project in Sierra Leone.* Unpublished Ph. D. dissertation at the University of Wisconsin, Madison.. 1979.

The treatment of labor in this study is similar to that of Kamuanga. The study is particularly interesting because of its extensive reporting of standard deviations and discussion of the high variability found in labor inputs from farm to farm.

Linn, Johannes F. *Economic and Social Analysis of Projects: A Case Study of Ivory Coast.* Washington, D.C.: World Bank, 1977.

An Application of the Squire/Tak method to the Ivory Coast. National parameters are estimated and three different projects are assessed using these parameters.

Low, A. R. C. "The Effect of Off-Farm Employment on Farm Income and Production: Taiwan Contrasted with Southern Africa." *Economic Development and Cultural Change*, Volume 29, No. 4, pp. 741+.

Discusses the negative impacts on agricultural productivity due to increases in off-farm employment opportunities in Southern Africa. Similar off-farm opportunities in Taiwan are found to complement agriculture.

Lunning, H. A. *Economic Aspects of Low Labour Income Farming.* Wageningen: Center for Agricultural Publications and Documentation. Agricultural Research Reports 699, 1967.

Uses production function analysis to study marginal product of labor. Lengthy discussion of whether or not productivity does determine wages in countries such as Nigeria and Surinam.

Ryan, James G., R. D. Ghodake, R. Sarin. "Labor Use and Labor Markets in Semi-Arid Tropical Rural Villages of

Peninsular India", in the Proceedings of the International Workshop on Socio-economic Constraints to Development of Semi-Arid Tropical Agriculture. ICRISAT, Andhra Pradesh, India, 1979.

Analyses labor data from six villages. Discusses the importance of segmenting markets by sex. Concerned primarily with wage employment and its relationship to technology.

Sandford, Stephen. "An Economic Evaluation of the Scheme." in *MWEA: An Irrigated Rice Settlement in Kenya*, edited by Robert Chambers and Jon Moris. Munich: Weltforum Verlag, 1973.

The evaluation considers a variety of assumptions about the marginal value product of labor and presents the results in a series of tables. A "best guess" scenario is selected and justifications for the choice presented.

Schol, Wolfgang. *Estimating Shadow Prices for Columbia in an Input-Output Table Framework*. Washington, D.C.: World Bank, 1979.

Presents what he considers to be a more accurate method of estimating national shadow prices for commodities. The method takes into consideration influences on traded commodities coming from the non-traded goods sector.

Scott, M. FG. "Shadow Wages of Surplus Labour in Mauritius," in *Using Shadow Prices* edited by I. M. D. Little and M. FG. Scott. London: Heinemann Educational Books Ltd., 1976.

Case study using the Little/Mirrlees method of shadow price estimation.

Scott, M. FG., J. D. MacArthur, and D. M. G. Newbery. *Project Appraisal in Practice: The Little/Mirrlees Method Applied in Kenya*. London: Heinemann Educational Books, 1976.

Includes extensive discussion of data problems and thought processes which go into estimating shadow wages for hired and family labor. Has excellent summary of factors which might cause marginal value product of hired labor to differ from family labor.

Shields, Nwanganga. *Women in the Urban Labor Markets of Africa: The Case of Tanzania.* Washington, D.C.: World Bank, 1980.

Discusses factors which influence the supply of female labor in urban markets and presents a method for estimating this supply. Does not directly discuss estimating marginal value product, but the discussion of supply is relevant to those concerned with shadow wages.

Sparling, Edward W. "A Survey and Analysis of Ex-Post Cost-Benefit Studies of Sahelian Irrigation Projects." A consulting report, Department of Economics, Colorado State University, May 1981.

Compares the results of two cost-benefit analyses which come to completely different conclusions. Believes the source of the differences is not the fault of the analysts but due to problems of data.

Squire, Lyn, I. M. D. Little and Mete Durdag. *Application of Shadow Pricing to Country Economic Analysis with an Illustration from Pakistan.* Washington, D.C.: World Bank, 1979.

Suggests that shadow prices should be used more extensively than at present. Rather than confining them to project analysis, authors suggest that they should be used in developing wage, immigration, emmigration, food subsidy, and many other policies.

Winch, Fred Everett III. *Costs and Returns of Alternative Rice Production Systems in Northern Ghana: Implications for Output, Employment and Income Distribution.* Michigan State University doctoral dissertation, 1976.

Extensive financial and economic analysis similar to Kamuanga's study. Unlike Kamuanga, however, Winch found market wages to be lower than returns per workday calculated using a residual method of analysis.

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