WORK ALLOCATION BEHAVIOUR IN RURAL PHILIPPINES: A BOUNDED RATIONALITY MODEL

by

PRUDENCIANO ULJER GORDONCILLO

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to the Department of Applied Economics, Faculty of
Business, Victoria University of Technology
P.O. Box 14428 MMC Melbourne
Victoria 3000, Australia

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IN MEMORY OF LUZVIMINDA CORNISTA PhD

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ABSTRACT

In most developing countries like the Philippines the rural sector in general, and agriculture in particular play a significant role in economic development. Hence, relevant information on the rural workers and rural employment opportunities are necessary conditions for the development of appropriate programs and policies.

Economic development models adopted in most third-world economies are anchored on the neoclassical theory that work is a positive function of the wage rate. However, studies particularly in depressed agrarian societies have shown that the work is an inverse function of wage rate. Hence, there is a need to explore alternative analytical framework that can provide a more plausible explanation.

The research has three major goals: to establish the socio-economic profile of the rural workers; estimate a labour supply function; and assess the likelihood of access to gainful rural employment. Measures of central tendencies were used to establish the socio-economic profile of rural workers. The labour supply function was estimated using a system of equations relating work, the level of wage rate, non-work income, and work aversion in a *bounded rationality* framework. Finally, the likelihood of access to gainful employment was estimated using the logistic probability distribution (logit) model. In a descriptive context, the Philippine rural sector is characterised by poverty and inequity. An average family of six is too large for a population wherein 40 percent live below the poverty threshold. The inequity is best expressed in the Gini Coefficient of about 0.46 for both income and landholdings. Further, the agrarian structure is such that roughly half is characterised by an unsecured access to the use of lands.

The estimates of the structural equations have indicated that the wage-work curve is downward-sloping. Further, the wage-work curve is influenced by other socio-economic variables including the dependency ratio, and qualitative attributes pertaining to tenure and cropping pattern. Therefore, the existing economic framework of the development programs carried out in the Philippines needs to be reexamined. The very broad classification rural workers as agricultural workers need to be changed considering the variation in work allocation behaviour across tenure and cropping patterns. Because of farm work aversion, there is the need to make farm less demeaning and burdensome by adopting appropriate technologies and by elimination of policies biased against agriculture.

The logit model is an attempt to determine the effects of some socio-economic attributes to the likelihood of gainful farm employment. The estimated coefficients supported the hypotheses. The likelihood of access to gainful employment is mainly influenced by the ratio of non-work income to the absolute poverty threshold, the dependency ratio, size of landholdings, and by tenurial structure.

DECLARATION OF ORIGINALITY

I, PRUDENCIANO U. GORDONCILLO, hereby declare that the work embodied in this thesis is a result of original research and has not been submitted for a higher degree to any other university or academic institution.

This thesis may be made available for consultation within the Library system of Victoria University of Technology and may be photocopied or lent to libraries from other academic institutions for the purpose of consultation.

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CHAPTER 1

INTRODUCTION

1.1. Background

Most of the controversial and heated public economic policy debates in any economic society involves issues concerning labour economics in general, and work and wages in particular. There are, however, profound differences between the industrialised and developed economies and the underdeveloped and primarily agricultural economies of the third world as far as the level and intensity of the arguments are concerned.

In the highly industrialised and developed economies, controversial labour issues are centred on wages, welfare payments, social security, taxation, work incentives, workplace environment or work safety, and discrimination, among others. Because of the nature of industrial workers and the level of sophistication that the advanced economies have achieved, union power is easily generated and harnessed. Hence, issues relevant to the workers are readily forwarded for discussion in the legislative or policy agenda of government. Otherwise, there is always the "street parliament" or the picket lines where issues are often resolved.

Unfortunately, workers in the agricultural sector of the third world economies are not organised. Consequently, rural workers are often merely referred to as the *clientele* by government planners and policy makers. As such, they are simply receptors of tailored programs and policies. In contrast, the labour related issues on income and access to work opportunities in the third world economies are often embodied in the prescribed conventional economic development paradigm. For instance, the popular wisdom behind the policy prescription for an agricultural based development of third world economies (Adelman, 1986 and Mellor, 1986) hinges on the neoclassical labour supply theory that the supply curve is a direct function of the wage rate. Specifically, Adelman (1986, p. 61) argued that: "*...Labour-intensive growth strategies...can therefore also be wage increasing policies, since an increase in the demand for labour can either raise the quantity of labour or raise wages (or both)...*". Similarly, Mellor (1986, p. 77) stressed that: "*...Developing countries have a large pool of extremely low-productivity if not idle labour...In effect, this provides* *a highly elastic labour supply...".*

Empirical work, however tend to indicate that the quantity of labour supplied is inversely related to the wage rate (Pencavel, 1986). For instance, Pencavel cited Douglas' (1934) estimate of the wage rate coefficient in US labour supply at about -0.1 to -0.2. It seemed that the methodology of the neoclassical economic analysis is inadequate in explaining this phenomenon.

It is in the context of the issues presented above that understanding rural labour issues is very crucial for the development of the Philippine Economy. Therefore, for planners and policy makers whose primary concern is the interest of the rural workers, acquisition of appropriate and accurate information is a necessary condition. At this juncture of its development, the Philippine economy can be characterised as predominantly agricultural. About 60 percent of its estimated 60.7 million people live in the rural areas; the agricultural sector accounts for roughly a quarter of the gross domestic product (GDP); and, nearly 63 percent of its estimated 24 million labour force is based in agriculture and rural industries (National Census and Statistics Office, 1990). Further, it must be noted that about 42 percent of the rural population live below the absolute poverty threshold (Cornista, 1992). Hence, recent development issues and problems either directly or indirectly concern the rural labour. It is in this context that understanding the utilisation of rural labour is of paramount significance to Philippine development.

As of 1990, the Philippine government, through the National Economic and Development Authority (NEDA) has outlined an array of strategies and policies geared towards poverty alleviation and equity ranging from wage policies to the Comprehensive Agrarian Reform Program (CARP). Based on the NEDA Development Report, the legislated minimum wage structure are as follows:

Non-Agriculture	
Metro Manila	114.84 pesos per day
Outside Metro Manila	96.42 pesos per day

Agriculture

Plantation	85.58 pesos per day
Non-Plantation	63.38 pesos per day

To put these figures in perspective, 114 Pesos is roughly equivalent to AUD 7.12 in 1990 exchange rate. Further, the average legislated minimum wage across the board is equivalent to an annual income of about 32,000 Pesos. Based on the GNP per capita (1990 prices) of about 18,240 pesos (NCSO, 1990), it is apparent that the individual is taking home an annual pay which is barely over half the legislated minimum wage.

Aside from the legislated wage floor, various non-wage benefit schemes were promulgated including:

1. tax exemptions;
2. profit sharing;
3. access to housing and livelihood support programs; and
4. additional support to sugar workers.

The development plan also outlines major programs to enhance rural/agricultural income. These programs include: Livelihood Enhancement for Agricultural Development (LEAD); Countryside Agro-Industrial Development (CAIDS); Integrated Area Development (IAD); and the Comprehensive Agrarian Reform Program (CARP).

Among the above policies and strategies, the legislated minimum wage is theoretically the policy that would immediately and directly affect the rural workers. However, it is common knowledge that the actual wages paid to hired rural workers in non-corporate or non-commercial agricultural enterprises are very much lower than the wage floor set by the government.

For the Philippine case, the recognition that there is massive unemployment and underemployment in the rural labour sector has been a common cry in various fora including those within the academics, policy makers, and legislators. However, this has not gone beyond the discussion stage. *Ad hoc* efforts have been done to remedy the symptoms but, most fail to mitigate the underlying problems. The state of massive rural poverty and economic backwardness is indicative of the inefficacy of the past and existing rural development programs. This could be primarily attributed to the inability to consider appropriate information concerning on rural labour conditions during policy formulations. Most legislation and policies formulated to mitigate problems related to rural labour employment are often based on the framework which may not be reflective of the actual socio-economic conditions in the rural areas. This is an undesirable state because logic would dictate that effective policies on rural labour allocation hinges on the knowledge of the factors affecting labour utilisation, particularly in terms of what these factors are and how they affect labour allocation.

In the past, attempts were made to examine rural labour situations in the Philippines. Bautista (1986) examined the structure of rural employment opportunities. This, however, was limited in terms of method and scope. Analytically, the research was descriptive and the scope was limited to only three small villages. Rural manufacturing employment was also studied by Fabella (1987). The model estimated the proportion of rural labour employed by the sector with respect to some attributes including education, access to infrastructure, access to electricity, income, financial institutions, and technology. Evenson (1978) also examined the determinants of time allocation in rural Philippine Household. This empirical work was limited to the province of Laguna which is a constraint in so far as drawing broader policy implications to rural development problems. Further, the analysis was limited to a simple regression analysis based upon Becker's (1965) household production model.

Apart from the limited empirical work just cited, little is known about the rural workers. One of the major constraints on the efficacy of existing policies on rural workers is the failure of the policy makers to have a clear and appropriate knowledge and understanding of the relevant issues and concerns of rural workers. Some of the critical questions that need to be addressed include: How do they allocate the available household human resource?; What are the determinants of the utilisation of household labour?; and Who are the rural workers? Finally , existing policies are based on the very broad classification of agricultural workers. Effective policies should consider the variations of the rural labour structure.

A host of other critical empirical issues and questions are important in the formulation of appropriate policies for rural labour and rural development. These are:

1. What are the determinants of labour utilisation in the rural areas? Is the decision to work primarily determined by the existing level of wages? If so, is work a positive function of wage rates or otherwise?
2. Is it reasonable to assume that income generated in the rural areas come only from wages? If non-work income is considerable, can it be a determinant of work allocation decisions?
3. Will there be differences in the work allocation behaviour among rural workers across the agrarian structure and across the type of agricultural employment?
4. What are the determinants of the level of wage rate?
5. What are the other determinants of labour utilisation?
6. Is there a formal labour market in the rural areas that determines the level of employment and level of wages? And, in employment, what are some of the terms and conditions of work?

To illustrate a specific case that highlights the significance of the aforementioned issues and concerns on rural labour, consider the existing policy of a legislated minimum agricultural wage. It has been the policy of the Philippine government to establish a wage floor for agricultural workers. Based on the methodology of neoclassical economic analysis, the policy will result in unemployment since demand will be less than supply at the minimum wage. Within the same framework, the only way to mitigate unemployment is to induce demand so that the level of unemployment or the surplus labour can be absorbed. This analysis will only hold true if the labour supply is actually upward sloping. However, is wage rate really the primary determinant of work allocation? Or, is the number of hours of work a positive function of wage rate?

Another policy environment which bears a significant effect on rural labour is market deregulation. Upon the ousting of the 20-year dictator President Marcos, the new government has aligned existing policies with the neoclassical argument, that is, a free-market oriented economy. In the past, industries including agricultural inputs and machineries, were heavily protected. Lifting the protection would have tremendous impact on agricultural input prices. If the argument is to be accepted that labour and capital are substitutable, then changing agricultural input prices would have significant effects on the demand and supply of labour. Similarly, the final impact would depend largely on the shape of the supply curve of labour.

The promotion of labour intensive agricultural technologies, cottage industries and the development of infrastructures to increase cropping intensity would likewise have significant effects on labour supply and demand. Similarly, increased cropping intensity creates an upward pressure on labour demand; again, the actual effect would depend on the behaviour of the labour supply.

Finally, a better understanding of the rural workers could help provide appropriate measures to mitigate the problems associated with rural-urban migration. On one hand, rural-urban migration draws the more productive labour, real or potential, out of agriculture. On the other hand, movement of people from the rural areas to the urban areas cause congestion and a host of socio-economic problems associated with urban poverty.

Is this rural-urban migration phenomenon a consequence of the lack of employment opportunities in the rural areas? Or, is it because of the qualitative differences between rural and urban employment opportunities? Or, could it be attributed to a different work allocation behaviour?

The significance of understanding the rural labour situation goes beyond the implications for policy formulations. Relevant and accurate information on rural labour serves as a benchmark for impact assessment of programs and policies geared towards improving income, reducing income inequality and mitigating rural unemployment and ensuring rural development.

1.2. Objectives of the Research

As argued earlier, the main concern facing rural constituents is poverty. Poverty however, is simply a sign. The problem is rooted in the programs and policies adopted by government planners and policy makers. Hence, the problem lies in developing effective policies to mitigate the massive poverty in the rural areas.

Economic research, as an applied academic exercise involves the investigation of quantitative and qualitative events and the establishment of their relationships. Once the events are measured and their relationships established, steps can be developed to control events and influence them towards desirable outcomes. It is along this process that this research is hoped to make some contribution.

In general, the goal of the study is to analyse the state of rural labour in the Philippines and to explore indicative avenues for increasing labour employment opportunities in the rural areas. The general objectives can be broken down to more specific objectives as follows:

1. It is the aim of this research to establish the social and economic profile of rural workers. As mentioned earlier, knowing the socio-economic profile of the rural workers will not only provide policy makers the appropriate information for policy formulation but also serve as the benchmark for any impact evaluation of development programs and policies;
2. One of the specific concerns of this research is to establish the types of rural workers. These categories will be established across the agrarian structure and across cropping patterns. Such classification of rural workers is relevant considering the existing classification. At present, for purposes of policy implementation, rural workers are simply categorised as agricultural workers without due considerations to the differences of workers across the agrarian structure and across cropping patterns;
3. While it has been commonly accepted that there is massive unemployment and underemployment in the rural areas of the Philippines, there has not been a broad assessment of the problem across the country. Thus, it is the specific goal of this research to assess the level of rural labour utilisation in terms of the number of days per month that an individual is able to access gainful employment;

4. The assessment of rural labour utilisation can be made more substantive by estimating the parameters of the factors that influence the level of labour utilisation. Hence, one of the specific objectives of this research is to develop models that can quantify the influence of socio-economic attributes to labour allocation;
5. It is argued in this research that the socio-economic attributes of the individual as well as the community will have an influence on employment opportunities. Therefore, one of the specific aims is to develop a model that can quantify the likelihood of access to gainful employment; and
6. Finally, it is the specific aim of this research to develop a policy framework for increasing employment opportunities in the rural areas of the Philippines. Such a framework will draw much of the needed inputs from the result of the preceding five specific objectives.

1.3. Analytical Framework

Economic development models adopted in most third-world economies are anchored on the neoclassical theory that work is a positive function of the wage rate. However, studies particularly in depressed agrarian societies, have shown that work is an inverse function of wage rate. Hence, there is a need to explore alternative analytical framework that can provide a more plausible explanation.

1.4. Structure of the Dissertation

The first chapter introduces the significance of the agriculture sector to the Philippine economy in general, and the significance of rural labour in rural development efforts of the Philippine government in particular. Also, the inefficacy of existing policies and programs has been stressed . This is due to the inadequacy of appropriate and relevant information on rural labour conditions and an inappropriate theoretical framework of the advocated policies and programs.

The second chapter outlines the literature review that covers past empirical work with emphasis on the conceptual framework. The review presented the literature based on the neoclassical economic framework and those that do not follow the mainstream economic methodology. This is followed by the section that outlines an alternative theoretical framework for the analysis of labour supply. In particular, the third chapter outlines the framework of the *theory of bounded rationality.*

The fourth chapter covers the analytical methods which is further structured to include the following sections: the variables; the hypotheses; the analytical tools; and the models. Specifically, three models were developed in the chapter. One covers the labour supply function, another to test for structural differences in labour supply behaviour across the agrarian structure and across cropping patterns, and another for the logistic probability function.

The fifth chapter provides a description of the data set. It is also in this chapter that the socio-economic profile of rural workers is described and the estimates of the parameters of the models are presented including the inferences with respect to the parameter estimates.

Basically, this research will make use of secondary data available in various institutions in the Philippines involved in rural development. The data set will be subjected to rigorous descriptive and inferential statistical analysis. The descriptive part, which basically involves measures of central tendencies and distribution, will be sufficient to address the objectives involving the establishment of the socio-economic profile of the rural workers and the classification of rural workers.

The inferential component of the analysis will address the objectives of quantifying the effects of socio-economic attributes to the level of work and to assess the likelihood of access to gainful employment given the characteristics of the individual and the community. Specifically, the methods of simultaneous equations will be used to estimate a labour supply model. To assess the likelihood of access to gainful employment, the logistic probability distribution (LOGIT) model will be used.

Finally, chapter six includes the summary of the methodology, summary of the findings, conclusions and the implications, both for policy and further research.

CHAPTER 2

Labour Supply Analysis: A Historical Perspective

2.1. Introduction

Labor economics, in general and labor supply, in particular has been one of the most contested issues in economics. The debates along this specific concern have been brought forth in the history of economic thought both at the theoretical and empirical levels.

Within the bounds of the theoretical debate, arguments are further structured within two levels. The first is within the context of the debate on the methodology of economics as a science. As Blaug (1980) noted, the debate on the methodology of science has been going on for more than one and a half centuries. In a nutshell, the debate on the methodology of science is centered on whether to test the theory is to simply verify it or whether it is appropriate to falsify in order to test its validity. The second level of the theoretical debate pertains to the conceptual framework of labor supply analysis which is anchored on the utility theory of demand for commodities. In essence, the mainstream neoclassical approach to the analysis of labor supply is derived by treating leisure as a normal commodity. Hence, the analysis is a straightforward extension of the utility theory for normal commodities which yields a downward-sloping demand curve for leisure and as a residual an upward-sloping supply of labor.

It is within the various contexts cited above where most of the endless debates stem from. On the one hand, work as a commodity should not be treated as just another commodity that is object for consumption. After the employer agrees to buy the working hours that the employee offers, the former can not isolate the work time from the individual. Instead he has to deal with an individual who has his own perceptions of what is expected of a worker and who has the ability to respond to the working conditions that the employer may establish. As stressed by Coase (1937), there are so much more dimensions to the labor market transactions that a straightforward extension of the demand curve for normal commodities as an analogy for the demand for leisure is inappropriate.

On the other hand, leisure is as complex, if not more, as a commodity as work. For one thing, it has been commonly argued that its price is the work foregone. But the demand for leisure time can not be isolated from the activity for which the leisure time is utilised. Otherwise, the price of leisure being equivalent to the wage rate foregone is simply the value of an idle time and not for leisure. Further, if wage is acceptable as the price of leisure, it can only be valid if the individual is willing to work at all levels of wages along the income-leisure or income-work plane. What would be the wage income foregone if in the first place the individual is not willing to work at all at a given range of wages? A more radical argument is raised by Bentivogli (1992, p.108) on the price of leisure: "*...If leisure is simply considered as non-work, its price is given in terms of foregone earnings from work (that is, the wage rate). A consumer price index would be preferable if leisure were seen as consumption time.....*" Further, it has been generally raised as to whether it is appropriate to simply divide time between work and leisure.

At the empirical level, the arguments vary from the analytical methods to the measurement of the variables. For instance, Deaton and Maulbauer (1980) argued that the budget constraint in the neoclassical labor supply analysis is better treated as non-linear than linear constraint. In a literature survey, Berndt (1991) has pointed out empirical arguments where the amount of work and the level of wages are simultaneously determined. Further, Berndt (p.637) noted that: "*...In reviewing second generation empirical results...we emphasized that the substantial heterogeneity that is observed in the estimates of wage and income elasticities could be due in part to the fact that the various studies differ in terms of estimation method, functional form and data base...*"

2.2. The Neoclassical Approach to Labour Supply Analysis

Despite these problems, a lot of theoretical and empirical work has been done on the subject of labour economics, in general, and labour supply, in particular. Most of the works on labour supply draw their theoretical foundations from the concept of an ordinal utility earlier forwarded by Pareto. He argued that a social system possesses some attributes and properties which bear significant implications to the determination of social equilibrium. One among these properties is "utility" which in one form Pareto related to economic prosperity. Further, he noted that if "utility" is supposed to be used in the determination of the social equilibrium, then it has to be properly defined in a way that corresponds to a measure of quantities. However, it may not be necessary to determine the actual numerical differences in "utility" for it to be useful in the determination of social equilibrium. It is sufficient to represent the differences in "utility" in terms of mere indices as relative measures without having to know the exact measure of the difference. Pareto (1913, pp. 1456-1458) argued:

> *"... If we ask, 'Is Germany today, in the year 1913, more powerful in prestige and military sense than she was in 1860?', everyone will answer yes. But if we go on to ask by how much more powerful she is, no one will be able to answer. And we can go on with other questions of the kind that are susceptible of increase or decrease without our being able to represent them in their various stages by exact figures... Yet anybody can see that prosperity and power of France are greater than Ethiopia... Everyone understands, without any requirement of numerical definiteness that there was a difference... Even differences far less marked are perceptible and roughly invaluable, and for all lack of numerical precision, we still have an impression of the situation that does not go very far from the facts."*

This very concept of utility paved the way for what has been the standard theory in neoclassical economics in general, and labour supply, in particular. But of course the process has been long and not without heated debates. Since then, several formulations have been forwarded on the theory of labour supply. Some argued that the relationship between labour supply and wage rate is positive, others argued otherwise, while some thought of the relationship as a combination of both positive and negative relationships. The neoclassical framework has been, so far, the most dominant basis for empirical works done along the issues of labour supply and time allocation. Within the boundaries of the neoclassical framework, some found evidences of an upward-sloping labour supply, downward-sloping curves, and others have estimated backward-bending labour supply curves.

However, to better understand the theoretical developments of labour supply analysis, it is worthy to journey back into the earlier economic arguments forwarded for the analysis of time allocation and labour supply. In the earlier days of theoretical development, Knight (1921) contended that labour supply is always negatively inclined. He noted that:

> *"...If wages are raised, the marginal utility of income will be reduced. Thus the added disutility of the last unit of labour time will now exceed the added utility of the last unit of money wage. Hence the worker will want to shorten his working day when wages rise."*(pp. 314-315).

It is worthy to note that explicitly, Knight considered the idea of work disutility as the main argument of the work allocation behaviour. However, this has been neglected and avoided in the subsequent theoretical and empirical developments in labour economics.

To date, mainstream economic literatures on labour supply are derived from the neoclassical paradigm which is basically an application of the utility theory of consumer behaviour. King (1990) outlined the basic assumptions of the neoclassical labour supply model:

1. the quality of labour is constant;
2. income is only derived from work or there is no unearned income;
3. the preference function between leisure and work is independent;
4. the individual is free to choose how much labour to supply without restrictions subject only to the limitation of time and wage rate;
5. work and leisure are the only possible uses of time; and
6. work is utility neutral.

Given these assumptions, the problem of time allocation can be readily accommodated by the standard indifference curve analysis. This of course implies the acceptance of the standard axioms of choice in indifference curve analysis which as outlined by Deaton and Maulbuer (1980) includes the following six axioms: reflexibility; completeness; transitivity or consistency; continuity; non-satiation; and convexity. Finally, the individual is assumed to be rational in the sense that the individual faced with budgetary constraints behaves as a utility maximiser. Applying the conventional constrained optimization framework yields the well-known backward-bending labour supply (Annex A).

The dynamics of the income and substitution effects can be presented using the Slutsky equation (Berndt, 1991). Such that,

$$\left(\frac{\partial W}{\partial S}\right)\Big|_{gross} = \left(\frac{\partial W}{\partial S}\right)\Big|_{dU=0} + W\left(\frac{\partial W}{\partial Y}\right).$$

The left hand side of the equation is the gross substitution effect, the first term on the right side is the compensated substitution effect and the last term is the pure income effect. Since according to Naylor and Vernon (1969),

$$\left(\frac{\partial w}{\partial S}\right)\Big|_{dU=0} < 0,$$

then the gross substitution effect depends upon the magnitudes of the compensated substitution effect and the pure income effect. If the compensated substitution effect is dominant, then the supply curve is downward sloping, otherwise, labour supply slopes upward.

Therefore, the actual shape of the labour supply curve, based on the neoclassical economic theory, is an empirical question because it can not be determined *a priori* whether or not work is inversely related to the level of wage rate.

The argument that the supply of labour will depend upon the elasticity of the demand for income became the basis for what has been the standard neoclassical labour supply theory - the backward bending supply of labour. Robbins (1930) provided the conceptual bases for the backward-bending labour supply. He argued that:

> *"...It is generally accepted proposition of theoretical economics that the effects of a change in the terms on which income from work can be obtained depend upon the elasticity of the demand for income in terms of efforts. If the elasticity of demand for income in terms of effort is greater than unity, then the effects of tax or a fall in wage rate will be a diminution of work done and the effects of a bounty or a rise in wage rate will be an increase in work done. If it is less than unity, then the opposite movements are to be expected..."* (p. 126).

The preceding arguments have been the bases for subsequent developments of the labour supply theory. Friedman (1962) provided a refined argument for the backward-bending labour supply within the framework of the indifference curve analysis. He articulated that an increase in wage rate will have two economic effects. First, since the price of leisure is the value of work foregone, the rise in wage raises the price of leisure. Consequently, the worker will now exchange his leisure time for work. This is the substitution effect which at lower wages dominates the income effect. Given the same number of hours of work, an increase in wage rate raises the worker's income. This will allow the worker to buy more of the goods including leisure. This is the income effect which at higher wages dominates the substitution effect. Hence, across the work-wage plane, at lower wages the substitution effect is greater than the income effect and the supply curve slopes upwards. Beyond some point, the income effect will be greater than the substitution effect and the supply curve bends backwards.

King (1990 p. 56) provided a graphical outline of the backward-bending labour supply. In Figure 2.1, for wages below OS_l, the substitution effect is greater than the income effect and work increases as wage rate increases. For wages above OS_l, the income effect is greater than the substitution effect and work declines with increases in wage rate. There are however, distinct variations in the subsequent theoretical developments.

2.3. Modifications on the Neoclassical Model

Foremost among the variations on the neoclassical model is the introduction of the influence of non-work income (Berndt, 1991). In this context however, non-work income is assumed to be an exogenous variable. Hence, its effect is simply to

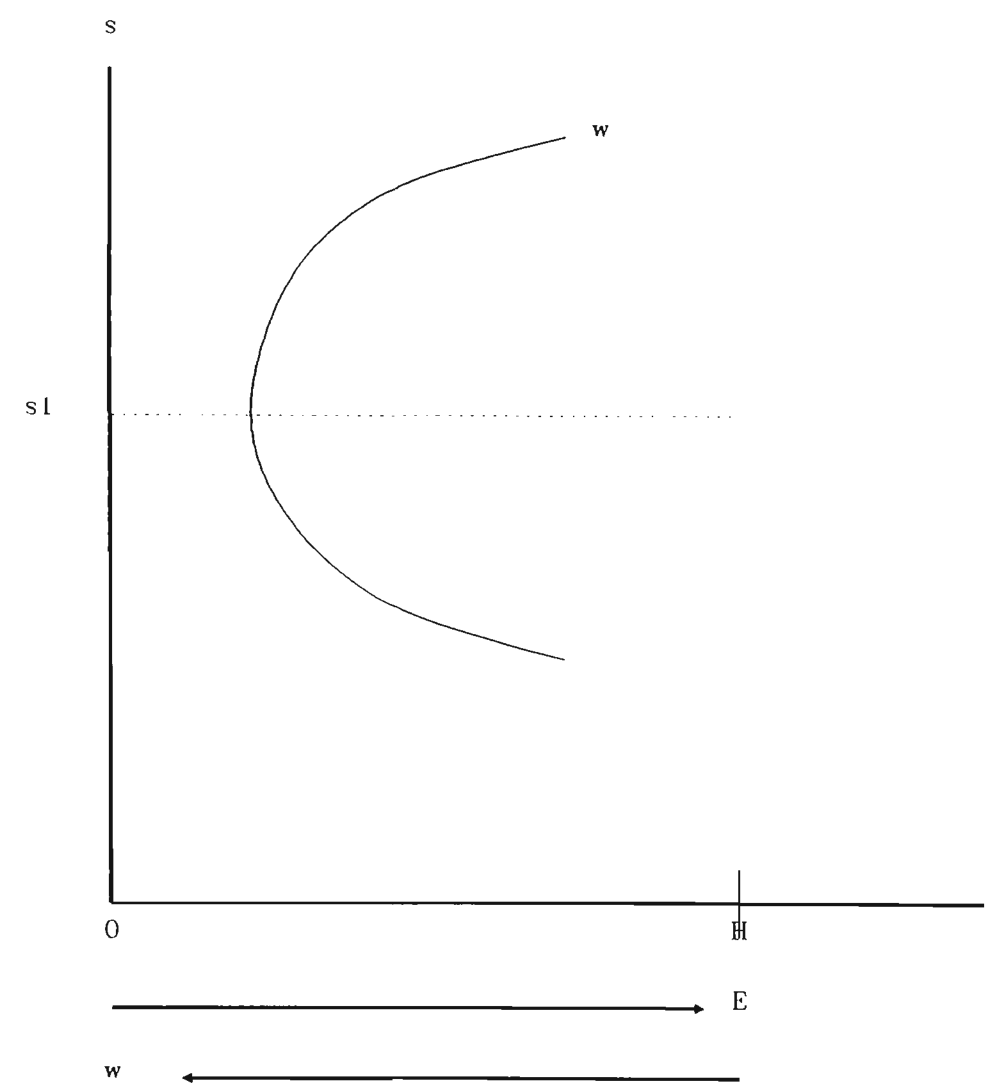

Figure 2.1. The Backward-bending labour supply curve.

shift the budgetary constraint of the conventional neoclassical model. The problem of maximisation remains technically unchanged.

Suppose Y_a is the level of non-work income, then the budgetary constraint can be formally expressed as:

$$Y = (H - E)S + Y_a. \tag{2.1}$$

The Lagrangean function then becomes:

$$L = U(E,Y) + \lambda[S(H-E) + Y_a - Y].$$

Taking the first order conditions:

$$\frac{\partial L}{\partial E} = \frac{\partial U}{\partial E} - \lambda S = 0 \tag{2.2}$$

$$\frac{\partial L}{\partial Y} = \frac{\partial U}{\partial Y} - \lambda = 0. \tag{2.3}$$

Therefore,

$$\frac{\partial U/\partial E}{\partial U/\partial Y} = S, \tag{2.4}$$

So far, the most popular modification of the neoclassical labour supply theory has been the treatment of the household as both producers and consumers of commodities. Becker (1965) modified the neoclassical theory of labour supply and provided an alternative formulation of time allocation behaviour giving emphasis on the importance of non-working time in the household's utility maximising decision process. In his argument, he noted that the utility function is derived from the consumption of basic commodities which are products of combining purchased market goods and time. To illustrate the point, Becker cited examples such as food or meals which can either be bought from the market (ready to eat) without time input or produce solely at home without purchased market goods.

Given the market wage rate, the individual is faced with an allocation problem of his available time, i.e., 24 hours, among home work, market work, and time to be spent for the consumption of goods. If the marginal productivity of market work exceeds that of the marginal productivity of home work, then the individual enters the labour market. The allocation of the remaining time between time for work and time for the consumption of goods will be defined by the utility preference function subject to the budget constraint, that is, based on utility maximising behaviour.

Becker's modified approach has generated interest and considerable following among economists working in labour economics. As Binger and Hoffman (1988, p. 488) noted: "...*The beauty of Becker's household production model is that it allows for an individual to do no homework or no market work. It also provides an understanding of when an individual who has been exclusively working at home will decide to enter the labour market...*"

To illustrate the preceding arguments, consider Figure 2.2. The vertical axis represents the total consumption goods Z and the horizontal axis represents the available time for an individual. The household production of consumption goods is represented by the production possibility frontier (PPF) which indicates the combinations of time and market goods. Given the wage rate S, the budget line is segment LL' and the utility function is represented by the indifference curve U. Points to the left of A represents a relationship where the marginal productivity of working in the market is greater than the marginal productivity of working at home. Hence, point A indicate the starting point at which the individual joins the labour market. The question as to how much should be offered to the labour market is determined by the utility maximum point given the budget constraint

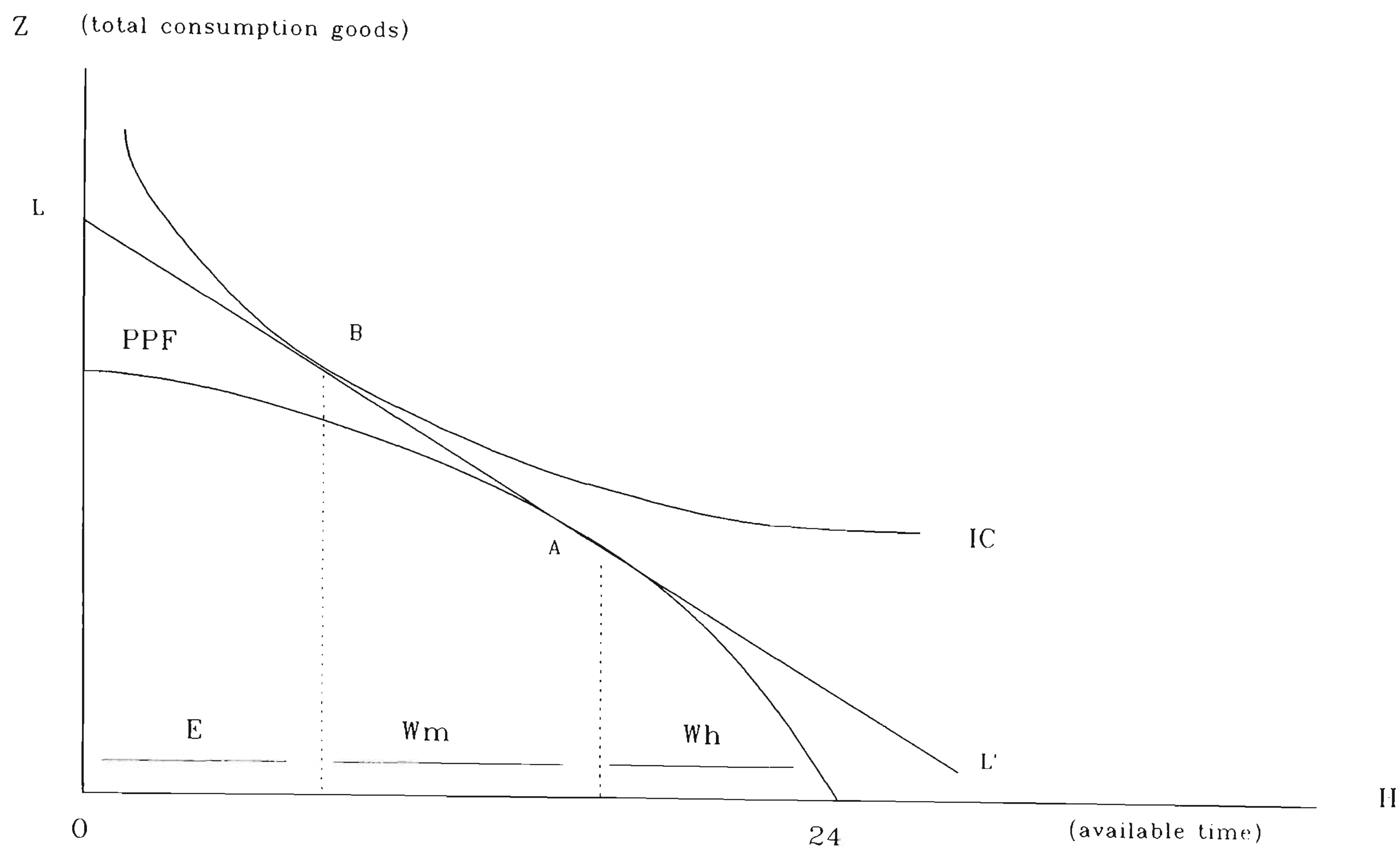

Figure 2.2. The household production model.

LL'. This optimal condition is given at point *B* where the budget line is tangent to the indifference curve. Conceptually, this is the point where the marginal rate of substitution between time and market goods is equal to the wage rate. Therefore, at point *A*, the level of work at home is W_h, and at point *B*, the level of work offered to the market is W_m leaving the residual time *E* for the consumption of goods.

Apparently, as far as work and wage relationship is concerned, Becker's arguments yield results similar to that of the neoclassical model. In Becker's own words (p. 502): "*...The effect of an uncompensated increase in earnings on hours worked would depend on the relative strength of the substitution and income effects. The former would increase hours, the latter reduce them; which dominates cannot be determined a priori...*".

2.4. Critical Views on the Neoclassical Labour Supply Analysis

The argument that the backward-bending labour supply is defined by the relative magnitudes of the income and substitution effects paved the way to some serious criticisms of the theory. From the theoretical formulation there is no apparent constraint that the supply curve will only have one inflection point, that is, there is only one point where the relative magnitude of the income and substitution effects changes. Since there is no strong reason to restrict the supply curve to always start as an upward sloping curve, Perlman (1969, pp. 10-11) contended that:

> *"...In the backward-sloping portion of a labour supply curve, the worker increases his leisure as well as his income. For the curve to turn around and move in a forward direction, as both income and leisure expand, the drive for added leisure must become weaker than the drive for added income...But it is not necessary to argue that the leisure saturation point must be reached before a backward-sloping supply curve bends forward... For the curve to bend forward, it is only necessary that the desire for added income significantly outweighs the desire for added leisure. Eventually, the substitution effect outweighs the income effect, and the labour supply curve bends forward... But the curve may not have ended its tortuous course. After rising forward with higher wages, income goals might again become more like targets than indefinite yearnings for*

> *higher consumption standards, so that the curve may soon bend backwards and so on..."*

To illustrate the preceding argument Perlman showed an illustration as in Figure 2.3. At lower wages, and therefore lower income, the supply curve bends backward as work declines in response to increasing wages. As soon as the substitution effect dominates the income effect, demarcated by point A as the inflection point, the curve turns forward. Eventually, the curve again bends backward as income goals become target levels of aspirations and the income effect becomes dominant over the substitution effect.

While the preceding illustration showing a winding (s-shaped) supply curve seems horrifying, it is not really without good foundations even within the framework of Robbins (1930) argument. As he specifically noted (p. 126): "...*We cannot predict a priori what the effects of a change in taxation or of a change in wage rates will be, we must ascertain the probable elasticity of demand for income in terms of effort of the taxpayer or the wage earner concerned..."* . While Robbins has been widely noted for this argument, in a much earlier work, Jevons (1871) has alluded to a similar point. Jevons argued that there are two effects when the conditions in relation to the products of labour are changed. In his(p.196) own words:

> *"...When labour produces more commodity, there is more reward, and therefore more inducement to labour. If a workman can earn ninepence an hour instead of sixpence, may he not be induced to extend his hours of labour by this increased result? This would doubtless be the case were it not the very fact of getting half as much more than he did before, lowers the utility to him of any further addition. By the produce of the same number of hours he can satisfy his desires more completely; and if the irksomeness of labour has reached at all a high point, he may gain more by relaxing that labour than by consuming more products. This question thus depends upon the direction in which the balance between the utility of further commodity and the painfulness of prolonged labour turns. In our ignorance of the exact form of the functions either of utility or of labour, it will be impossible to decide this question in an a priori manner..."*

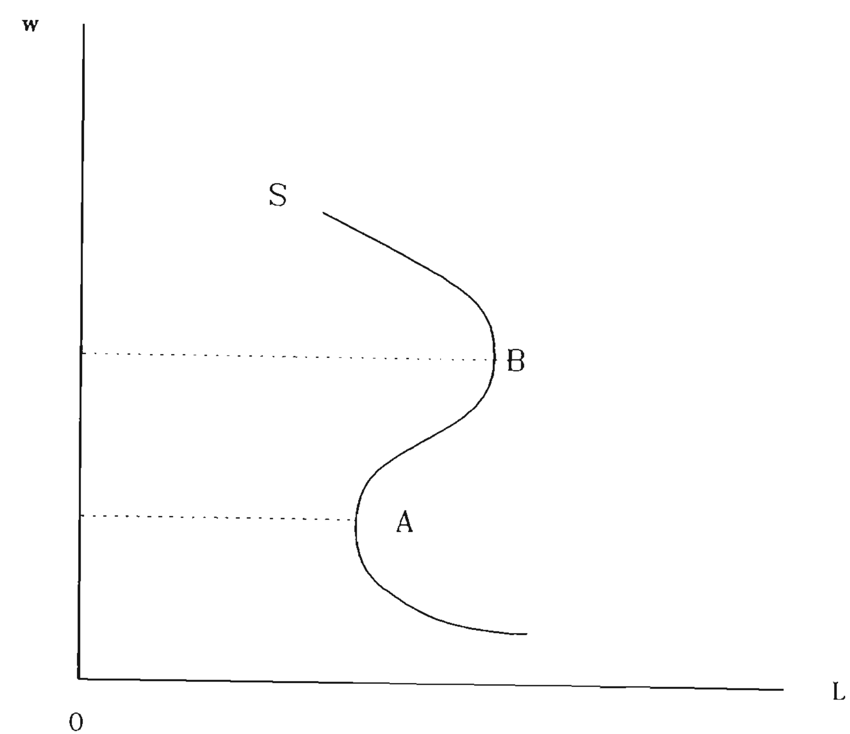

Figure 2.3. Perlman's labour supply curve.
Source: Perlman (1969), p. 12.

This implies that a backward-bending supply is just one of the various shapes in which the curve can behave depending upon the assumed elasticity of demand for income as the reference point. As Perlman has claimed "*...Perhaps the reason that the usual view sees the curve as bending only backwards rather than forward is that it is easier to explain why a positively-sloped curve must eventually bend backward rather than vice versa...*" (p. 17).

Therefore, based on the preceding claim, the fact that the backward-bending supply curve has become the conventional argument is primarily by reason of convenience.

While Robbins, in the 1920s, generated interest among economists on his theoretical formulation of a backward-bending labour supply, in about the same time, a Russian agricultural economist developed a theoretical framework to explain the work allocation behaviour among Russian peasants. Chayanov (1925, pp. 68-69) outlined the following argument:

> *"...The degree of self-exploitation of labour is established by some relationship between the measure of demand satisfaction and the measure of the burden of labour. The economic activity of labour differs from any other activity in that the quantity of values that become available to the person running the farm agrees with the quantity of physical labour he has expended. But the expenditure of physical energy is by no means without limit for the human organism. After a comparatively small expenditure essential to the organism and accompanied by a feeling of satisfaction, further expenditure of energy requires an effort of will. The greater the quantity of work carried out by a man in a definite time period, the greater and greater drudgery for the man are the last (marginal) units of labour expended. On the other hand, the subjective evaluation of the values obtained by his marginal labour will depend on the extent of its marginal utility for the farm family. But since marginal utility falls with growth of the total sum of values that become available to the subject running the farm, there comes a moment at a certain level of rising labour income when the drudgery of the marginal labour expenditure will equal the subjective evaluation of the marginal utility of the sum obtained by this labour... Thus, any labour farm has a natural limit to its output, determined by the proportions between the intensity of annual family labour and the degree of satisfaction of its demand..."*

It is worthy to note the following important elements of Chayanov's theory: 1) the theory is based on the concept of utility; 2) the peasants seek for the solution of the problem of allocating the available human resource labour base on the utility of income and work; 3) it is assumed that there is a diminishing marginal utility of income; 4) there is an increasing disutility or drudgery of work; 5) the measure of the consumer demand pressure is the ratio of the number of consumers to the number of workers; and 6) the household is not seeking for an optimal solution but a satisfactory or good solution based on subjective evaluation of the relationship between the diminishing marginal utility of income and the increasing drudgery of labour.

Figure 2.4 can better illustrate the main arguments of Chayanov's theory. The horizontal axis expresses the amount of money (measured in rubles) earned in a year by the individual operating the farm. Since work is a positive proportion of the total amount of money earned, and based on the assumption of drudgery in work, then a positively-sloped curve can be drawn as income rises which indicates the drudgery attached to a positive marginal change in income. This is represented by curve *AB*. On the assumption of diminishing marginal utility of income, as income increases, a downward-sloping curve which represents this diminishing marginal utility can be drawn. This is depicted in curve *CD*. Obviously, *AB* and *CD* will have to intersect somewhere in the plane. As portrayed in the graph, the point of intersection is at x. This represents the point which Chayanov called "the natural limit to family output". Any level of income below x is indicated by a relationship where the marginal utility of earning an extra ruble is greater than the drudgery of earning it; hence, it is still advantageous to increase work intensity. Conversely, any point above the intersection corresponds to a relationship where the drudgery of earning additional income is greater than its marginal contribution to utility. There is no point in increasing work intensity. Finally, in the context of labour supply analysis, Chayanov introduced two critical elements in his theoretical formulations that the classical model fails to consider. First, is the notion that there is, in fact, disutility in work.

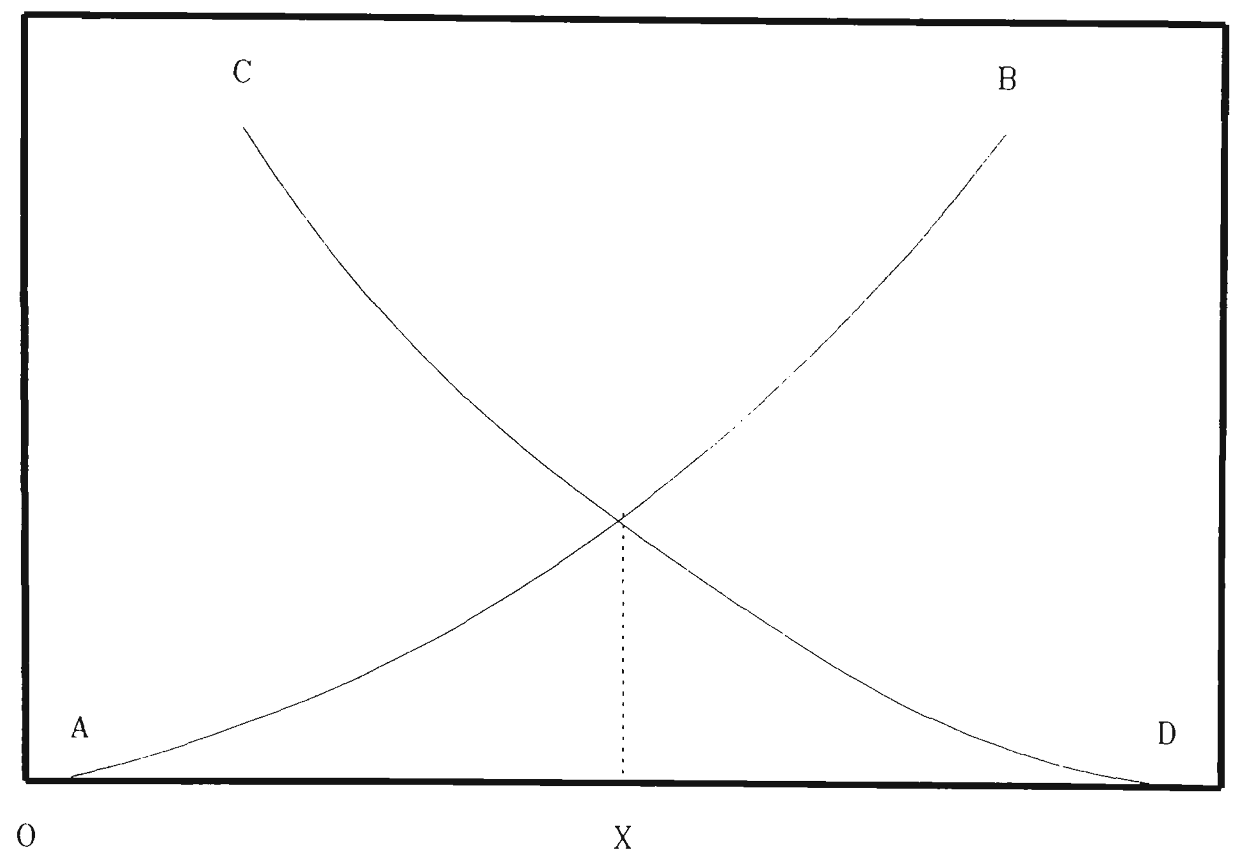

Figure 2.4. The household demand and labour supply.
Source: Chayanov (1925), p. 82.

This proposition is realistic but it cannot be incorporated into the classical framework which is based on the indifference curve analyses of a utility function that is dependent upon income and leisure. Second, is the idea of a subjective equilibrium. This implies that the household, unlike the utility maximising assumption of the classical model, is simply seeking a satisfactory solution to the problem of work allocation. As Chayanov (p. 85.) noted: "*...the net product of the particular labour expenditure may be subjectively recognised by our family as satisfactory or good compared with the subjective evaluation of the drudgery of the same labour...*"

Chayanov's theoretical formulations lay dormant for a considerable time. His arguments, for some reasons, failed to encroach into the mainstream economic literature. It was only in 1966 that his works were translated into English and were brought to the attention of the western world. As expected, more particularly since the arguments deviate from the neoclassical economic thought, criticisms were raised. Chibnik (1987) outlined some methodological problems of Chayanov's theory. However, it must be noted that while the said problems are complicated and difficult, they are not absolute obstacles. These problems are: the measurement of the consumption requirements; the number of workers in the household; and the estimation of the total household product. In a more substantive context, Ellis (1988) forwarded some comments on Chayanov's model, notably the implicit assumption of substitutability of male and female labour in farm work, flexibility in the access to land, and the absence of engagement in the labour market. These concerns limit the applicability of the model. Further, the model's predictive power only lies on the demographic attributes, and the model is incapable of predicting responses to the factors that influence the production function.

The appeal of Becker's argument lies on the assumption that utility is derived from commodities which are a product of combining time and goods. The theoretical formulations following this argument imply perfect substitutability between time and goods. Although the model has some appealing implications, the assumption of perfect substitutability between time and goods is an oversimplification of the utility function. Also, the assumption implies nonjointness of the household production which means that market goods and time can be split up between separate production processes for each output. Pollak and Wachter (1975) argued that nonjointness is a very restrictive assumption. It implies that time spent on the production process can not yield utility or disutility except for the consequence that it takes away time from leisure.

Substitutability allows for the individual to choose between working for a wage and earn income to buy the goods or spend the time at home and produce the same goods. In order for the individual to choose the latter option, it is presumed that there are available resources at home other than time. In the extreme case, for those whose only resource is time, then the production possibility frontier (PPF) may have to be bounded. But more importantly, a considerable proportion of the bundle of commodities that an individual consumes is non-food items, e.g., consumer durables. Becker argues that the actual commodity that enters into the utility function are the services that these capital goods yield. This may seem technically plausible, but actual demand for such goods in reality is not measured in terms of the marginal cost of the services that the goods yield, but in terms of the actual cost of the consumer durables. This would have some significant implications on the decision making process. For example, if an individual wishes to enhance his utility by facilitating his mobility he, has to buy a car or avails of car rental services.

Further, in the case of capital goods or consumer durables, utility is not only derived from the services they yield. For instance, over and above the transport facility that a car offers, mere ownership has its own utility. The brand of the car is another utility issue. Furthermore, households are incapable of producing the service that consumer durables yield. Hence, the marginal productivity comparison which is the basis for the decision breaks down. In this case, there is only one choice, work for a wage in the labour market.

Juster and Stafford (1991) identified some problems in actually defining the basic commodities (Z^i) that enter into the utility function in the household production model of Becker. They cited a couple of examples where the issue of definition is apparently a problem. Is the trip to a movie an input to Z or Z itself? Which one is Z, eating or the prepared meal?

A more extreme criticism has been raised concerning the determination of the solution in the model. Rubin (1973) argued that Becker's model is indeterminate because the individual has to spend a considerable time working out the solution to the allocation problem. In his words: "*...In particular, consider the time which the consumer must spend in actually solving the problem. The consumer must spend time solving the problem before he knows how much time to spend... This does not mean that decisions are not made...what it does imply is that such decisions can not be made optimally...*" (p. 65).

2.5. Alternative Theoretical Framework for Labour Supply Analysis

Almost all of the approaches to the labour supply analysis, including Becker's model, can be classified under the neoclassical framework. This generalisation excludes the propositions forwarded by Knight (1921) and Chayanov (1925). However, in a more basic context, the neoclassical has been subjected to various critical comments.

Central to the argument of the classical analysis is the very notion of individual rationality. At this point, it is worthy to note some basic notions of rationality to avoid confusion in differentiating whether not being rational is to be irrational. For instance, if to be rational is to buy more of a commodity as its price falls, it does not necessarily imply that to do the same as price increases is irrational. This is because rationality denotes a type of behaviour that is appropriate to the achievement of goals within the bounds of given constraints (Simon, 1964).

In the neoclassical framework, rationality is defined in the following context. First, it is assumed that there exists a utility function which is dependent upon the consumption of commodities. Second, it is assumed that the individual has perfect knowledge of the various possible combinations of such commodities and their prices as well as the ability to consistently evaluate that one choice is as good, better, or worse than any other. Third, the individual's choice is limited by his income or budget. Finally, being rational, the individual maximises his utility by choosing within the limit of his income the combination of commodities that yield the highest utility. As a maximiser, Simon states that the individual settles for nothing less than the best. The solution to this problem of choice is unique and precise at the equilibrium condition where the marginal rate of substitution between commodities is equal to the ratio of their prices.

The classical solution to the behavioural problem of choice seem fairly straightforward. However, a closer look both at the explicit and implicit assumptions of the classical framework would reveal that in the analysis, the individual is subjected to very restrictive conditions. The explicit assumption of perfect knowledge is impossible both in the context of the cost of acquiring the information and the time required to have them. Further, the analysis implies that the individual possesses the mathematical skill to perform the necessary calculus in the determination of the maximum solution!

The preceding arguments have been the bases for some of the criticisms of the classical framework. Most economists are aware of and have recognised these limitations of the theory but apparently have come to terms that the elegance of mathematical precision outweighs the validity of the criticisms.

However, some scholars have ventured into the path of exploring alternative approaches to the behavioural problem of choice and allocation in economics incorporating some limitations to the classical notion of global rationality. The theoretical formulations of these alternative approaches are often categorised under the "theories of bounded rationality" which refers to the incorporation of the constraints to the capability of the decision maker to collect and process the information and modification of the goals of the decision maker.

Baumol (1959) provided a theoretical model of a case where the goals of the firm are changed. Instead of the firm working to achieve for maximum profit subject to the cost constraints, the firm maximises sales or revenue subject to the constraint that profit should not be less than some acceptable or "satisfactory" level.

There are alternative ways in which boundaries to rationality can be explored. Simon (1972) outlined three models of bounded rationality: 1) a case where risk and uncertainty is involved; 2) when decision makers have limited information about alternatives; and 3) a case where there is a limit to the individuals capacity to perform the complex calculation in search for the best choice.

In an earlier work, Simon (1955) developed a behavioural model of rational choice which incorporates limits to global rationality. In particular, the model assumes that the decision maker can not have the perfect knowledge of the choices available and that in reality, the decision maker does not consistently evaluate all the choices as to whether one alternative is as good, better, or worse than any other before the actual decision is made.

In his theoretical formulation, Simon provided some simplified assumptions that make the definition of rationality more realistic - a bounded rationality. First, in the case of the classical framework, the individual is assumed to have perfect knowledge of all alternative choices and all choices are evaluated simultaneously before a decision is made. This can be simplified by assuming that the knowledge of alternative choices is limited and the choices can be interpreted as either "satisfactory" or "unsatisfactory".

Second, the goal of the decision maker is different. Instead of assuming that the decision maker aims for the global maximum (maximiser), the goal is simply to achieve a good or "satisfactory" solution or aim for a "satisficing" condition.

Third, choices are not evaluated simultaneously. Instead, alternatives are considered sequentially whether one is "satisfactory" or "unsatisfactory" relative to an aspiration level.

Simon illustrated that a chess game is analogous to the actual process in the decision of choice in economics. He noted that a game of chess, on the average, last for about forty (40) moves. At any given position, there are about thirty (30) legal moves; and for a move and its replies, there are about 10^3 continuations. Then, there are about 10^{120} possible games of chess!

Each move in a game can be precisely evaluated whether it is a "won", "draw" or "lost" position by going back to the choice set of 10^{120} elements. Obviously, evaluating each choice is highly improbable.

In reality, chess players categorised positions as "clearly lost", "clearly drawn", "clearly won", "won or drawn", "drawn or lost", etc., depending on the player's ability to map the choice set. If the relevant set is the "won" positions, then evaluations are done to see whether a position can be transformed into a "clearly won" position.

In an experiment, Simon established that in the actual game of chess the choice set is actually simplified. Considering a middle-game, he evaluated a sequence of eight moves by each player. This sequence could yield about 10^{24} legal variations. Following the decision process discussed above, the line of play actually examined was reduced to 100 variations. This is a significant simplification from the ideal decision process to what is practical and actual.

Another illustration of a "satisficing" behaviour is an individual selling a house (Simon, 1955). In any given day, the person sets an acceptance price. If the individual receives one or more offers above the acceptance price, the highest offer is accepted. Otherwise, a new acceptance price is set the next day. In the classical framework, if the person has complete knowledge of the probability distribution of offers in each day, the acceptance price can be set to maximise the expected value of the sales price.

At this point, there is the main question of obtaining a unique solution to the problem of choice. What would be the limit to the choices above the satisfactory level? Suppose an individual who is initially setting an acceptance price is faced with several offers above it. How far should the individual wait for other offers before the settlement is done at the highest offer? This situation is quite different from the classical theory where the solution is very precise to the last decimal point and the said solution is unique. In the case of the consumer behaviour, the choice is at the point when the marginal rate of substitution between commodities is equal to the ratio of their prices.

Simon (1955) further argued that in the case of the "satisficing" behaviour, the unique solution is approximated by allowing the level of aspirations to move. If the aspiration level is readily achieved, then the person adjusts the aspiration upwards. Conversely, if the individual finds it difficult to achieve the aspired level, then the aspiration is lowered. This is sometimes referred to as the "learning rule". This notion of an approximated unique solution is analogous to the subjective equilibrium condition earlier forwarded by Chayanov.

In their research, Baumol and Quandt (1974) explored some "rules of thumb" that are often used by firms in decision making which are outside the classical framework of maximisation. They argued that: "*...Since all real world decisions are made under conditions of imperfect information, calculations down to the last decimal point is pointless in any event. One can easily formulate the appropriate marginal conditions for what one may call an optimally imperfect decision...*" (p. 23).

For the case of the learning rule, they have established that the solution to this technique converge and is in fact globally stable.

Most literature in mainstream economics adhere to the assumption of a simple and perfect world. Consequently, economic analyses, in most cases, do away with questions concerning the behaviour of an individual in an imperfect and constantly changing world. Likewise, as result of the said framework, the available standard tools and theoretical models are ill-equipped to address these questions. The main question is to set the parameters of an approach that would somehow embody the precision and the mathematical elegance of the classical framework and at the same time possess some flexibility. This is necessary to reconcile the maximising behaviour based on global rationality to that of the real status of the decision maker who actually has limited capability and information and is incapable of achieving the maximum solution to the problem of choice.

The advancement of computer technology has allowed researchers to work out models that are based on behavioural rationality and learning "rules-of-thumb". In a simple pay-off experiment involving student volunteers, Herrnstein (1991, p. 360) established that: "*...the subjects made choices in a way that* *supports the idea that choice is governed by a principle that does not necessarily maximise utility, as the subjects themselves would reckon their utility...*"

Holland and Miller (1991) outlined some advanced models towards an artificial adaptive agent (AAA). The main rationale for such models is that they possess the precision and consistency of the mathematical models and at the same time are as flexible as the corresponding linguistic models.

A step further, Arthur (1991) designed an artificial economic agent that act like a human agent. He developed an algorithmic behaviour model that, in his words: "*...reproduces statistically the characteristics of human choice, including the distinctive errors or departures from rationality that humans make...*" (p. 354). In the conclusion of the research, Arthur established that the artificial agent showed learning behaviour similar to human behaviour, particularly in the concerns of rationality. He concluded that the artificial learning agent exhibit the behaviour of humans, that is, "*...with frequency-dependent pay-offs, humans meliorate rather than optimise and there is a threshold in discrimination among pay-offs below which humans may lock in to suboptimal choices...*" (p. 359).

Some other significant parameters of the classical model in the analysis of labour supply have been subjected to critical comments, notably, the budget line and the wage rate. Deaton and Muelbauer (1980) argued that in reality the budget line is not actually linear as is assumed in the classical framework. Further, they noted that even if workers are equally aware of the chance of unemployment, their differences in attitudes toward risk and job attributes may give rise to wage differentials. This implies that wages can not be assumed as exogenous.

2.6. Empirical Examples of Labour Supply Analyses

In the last 50 years, a great deal of research has been done on labour supply estimation. One of the exhaustive survey of the literature on labour supply analysis was done by Killingsworth (1983). Killingsworth divided the empirical studies into two categories: the first generation studies and the second generation studies. The first generation studies were characterized as those that relied on OLS estimation of the parameters in forms chosen arbitrarily and not derived from the utility maximizing framework. The second generation empirical studies were characterized as those that estimated parameters of models derived from the neoclassical constrained optimization framework. Further, second generation studies considered specification and estimation issues. For instance, there have been studies that considered dynamic modes and models that incorporated unobservable variables. In his review, Killingsworth noted the large variability of the parameter estimates across the vast array of empirical studies. However, he is still optimistic about the applicability of the neoclassical paradigm as indicated in his concluding statement: "*...at least temporarily, then, uncertainty about and variation in actual magnitudes of labour supply estimates seem larger than it used to be...*"(page 432).

Pencavel (1986) also made an exhaustive review of literature on labour supply analysis including the work done by Killingsworth (1983). But, Pencavel is not as optimistic as Killingsworth about the standard neoclassical utility maximization framework. Pencavel noted that the empirical studies based on the static and the life-cycle models, in a number of instances, yield results that violate the model and consequently cast doubt on the empirical relevance of the neoclassical models. Of course these anomalies can be readily written off by justifying that there is nothing fundamentally wrong with the theory but rather the violations are in terms of the auxiliary assumptions like specifications and measurement of variables, among others. Hence, few scholars have conducted empirical studies to test the theory. Most empirical studies are exercises to quantify a relationship that is presumed to be the truth.

Finally, Pencavel concluded (p 95) that: "*...As a by-product of this concern about measurement, they have turned up a number of instances in which the behavioural responses take on values that violate the theory's predictions. Under these circumstances, the scientific procedure is surely to regard the theory as it has been formulated and applied to date as having been refuted by the evidence...*"

Despite the fact that the classical framework has some serious limitations and despite the availability of alternative approaches to the analysis of labour supply, most empirical works derived their theoretical base from the classical framework. Although the empirical models are either of the conventional income-leisure model or of the household production model (hpm), e.g., Becker's model, they are categorised within the classical framework.

For the purpose of establishing the fundamental arguments of this thesis, it is helpful to cite some specific empirical studies on labour supply analysis. For instance, the common argument forwarded to explain the dominant evidence of a negatively-sloped supply curve of labour in poor agrarian communities is the notion of "limited aspiration and target income". As Taft (1955, p. 280) argued, "*...It has been observed in underdeveloped areas in countries which are not highly industrialised, that an increase in wage will at least in the short-run, lead to a reduction in supply. The worker appears to be interested in a given total income, and will reduce his days of work if it can be earned in a shorter period of time...*"

A broader application of the negatively-sloped supply curve of labour has been forwarded by Wiles (1956). He articulated that all individuals have a limit to the standard of living and as the standard is achieved, individuals tend to avoid work. This behaviour is universal. It is not confined to the semi-tribal Africans or to the British miners.

In 1965, Berg made a study to determine the validity of the "target income and limited aspiration" hypothesis in the case of dual-economies in Africa. He concluded in an argument that for the case of the individual labour supply, the hypothesis applies only for the period covering the early years of African history. In contemporary Africa, it is no longer appropriate to "committed" workers as wants increased in size and flexibility.

Relatively recent empirical studies by Berg established that in subsistence-oriented areas, the labour supply curve is backward-sloping. It has been the standard practice in empirical works on labour supply analysis and time allocation studies particularly in poor agrarian societies to incorporate other parameters in addition to wage rates. Notably, variables along economic, socio-economic, socio-cultural, demographic, geographic, and others.

Bardhan (1984) and Sharif (1990) conducted empirical works with strong emphasis on the agrarian structure, i.e., land tenure. Ault and Rutman (1992) considered wealth, demographic and skill factors. Lass and Gempesaw (1992), in addition to wealth and other factors, introduced the possible impact of locational factors. Henreich Becker (1990) explored the implications of changes in production technologies into labour input decisions. Finegan (1962) and Rosenzweig (1978) both considered race as an important factor in labour supply analysis but Rosenzweig went further in incorporating climatic factors and the over-all economic state of the community.

Finally, it must be noted that for all of these few empirical works cited, all of the variables, notably wage rate and wealth, are treated as exogenous variables. The functional relationship must also be noted. For instance, the works of Sharif (1990), and Rosen and Welch (1971) modelled a quadratic functional relationship between work and wage rate which is indicative of the attempt to verify the existence of a backward-bending labour supply.

2.7. Chapter Summary

This Chapter outlined the conventional theoretical foundations of labour supply analyses which is anchored on the methodology of constrained optimisation. This include the income-leisure model and the variations incorporating non-work income as an exogenous variable and the household production model. Some critique of the neoclassical labour supply model were then presented including some alternative theoretical framework notably, the bounded rationality model. Finally, examples of some of the empirical works on labour supply analyses were presented.

CHAPTER 3

CONCEPTUAL FRAMEWORK

3.1. Introduction

Any research effort will have to be based on some basic theoretical foundations. Considering the limitations of the neoclassical model for labour supply analysis particularly its inadequacy in explaining the empirical evidence that work is inversely related to the level of wage rate, it is necessary to formulate an alternative theoretical framework. In the previous chapter, several arguments critical to the neoclassical models were highlighted. However, the following conceptual framework will mainly be based on the *theory of the hierarchy of needs* and on the *theory of bounded rationality*.

3.2. The Theory of Bounded Rationality

The main arguments that will be raised from now on are centered on the idea that the actual decision process in time allocation behaviour of individuals or households is a lot simpler than what has been advocated under the neoclassical framework be it in the conventional income-leisure models or in the household production models (HPM). As noted in the earlier arguments, the behavioural assumption of global rationality in the neoclassical paradigm is in essence too much of an expectation from the individual. It really should not be very difficult to embrace the idea that in reality, the actual time allocation behaviour is not based on the assumption of utility maximisation, that is, the decision parameters are based on the determination of the slope of the indifference curve between income and leisure. The individual is incapable of determining the slope of the indifference curve through differential calculus and set that slope equal to the slope of the budget line. This is not being done because the ordinary decision makers on the streets, in the farm fields, and in their homes have constraints other than their budget. They do not have the complete information of all the alternative choices between income and leisure in order to generate a smooth and strictly concave indifference curve. As Bausor (1988) noted: "*...Knowledge does not simply happen or magically come to a person, but must be constructively assembled...*" (p. 29). Further, individuals do not posses the mental capability to process the information in accordance to the utility maximisation behaviour.

In particular, it is impractical to think that in order for an individual to decide how much time he will allocate for home work and market work, he has to estimate and compare the marginal productivity of his home time vis-a-vis the marginal productivity of market work time.

Similarly, as argued in Becker's household production model, the husband may not read a book in bed while his wife is asleep because the estimated utility (assuming it can be estimated) of reading exceeds his perceived disutility of the wife not being able to sleep properly. Simple non-economic decision rules are applied to such choices in the household. Probably, family politics is applied.

The decision to work and how much time should be made available to the labour market can be simplified. An individual, given his attributes like stock of productive assets and skills, would have a rough notion as to how long he will have to work and at what level of wage rate. This argument however, should be properly considered because it has some critical implications in terms of its theoretical and analytical framework. At the outset, this implies endogeneity of work, wealth and wage rate. Further, the allocation decision will not be optimal in the neoclassical sense.

To probe deeper into the theoretical basis for the above argument, the empirical studies on labour supply and time allocation in poor agrarian societies have to be reconsidered. For purposes of illustration, the empirical work by Sharif (1990) in the case of Bangladesh can be scrutinised.

Sharif forwarded an argument that a segment of the labour supply curve for workers in poor agrarian communities is actually negatively sloping. Sharif calls it "forward falling" supply function to distinguish it from the "backward-bending" supply curve. He argued that this behaviour is logical considering that poor workers in depressed agrarian communities are subjected to very low wages. Hence, the lower the wage rate the higher the number of hours required to maintain the survival income at which the poor workers live.

Sharif found some evidence of this argument for the case of Bangladesh. Considering 269 households in three villages, it was found out that the supply functions of workers with little or no land display a forward falling behaviour; that is, the supply curve slopes downward at lower wages and upward at higher wages.

Specifically, Sharif's estimated equation of the labour supply function in so far as wage rate is concerned, *ceteris paribus*, is:

$$L = \beta_0 + \beta_1 R_w + \beta_2 R_w^2 \qquad (3.1)$$

where,

L - labour

R_w - real wage

The estimated parameters are:

$$L = 11.15 - 2.42 R_w + 0.14 R_w^2 \qquad (3.2)$$

In the conventional presentation, the estimated equation can be depicted in Figure 3.1. But, to be consistent with the earlier illustration of the derivation of the classical labour supply, the curve is reversed as in Figure 3.2.

There are some points that need to be verified with regard to the arguments referring to the forward-falling supply curve. The conventional definition of labour supply implies that there is a direct functional relationship between the level of work and the level of wage rate. If the definition is accepted then the evidence, as indicated in Sharif's estimated equation, needs to be re-examined.

The attempt to relate wages and work in this context will have some drawbacks. First, how far could wages fall? Second, can wages fall to zero? If workers are motivated mainly to maintain the level of subsistence living, then the downward sloping supply curve will continue to move downwards as long as wages keep falling down. Third, the assumption that workers' motivation is to maintain a standard of living, which implies working more as wages fall and less as wage rate increases, is not really very appropriate at this juncture of economic development. Except for the case of nomadic tribes, the issue of subsistence level of existence is

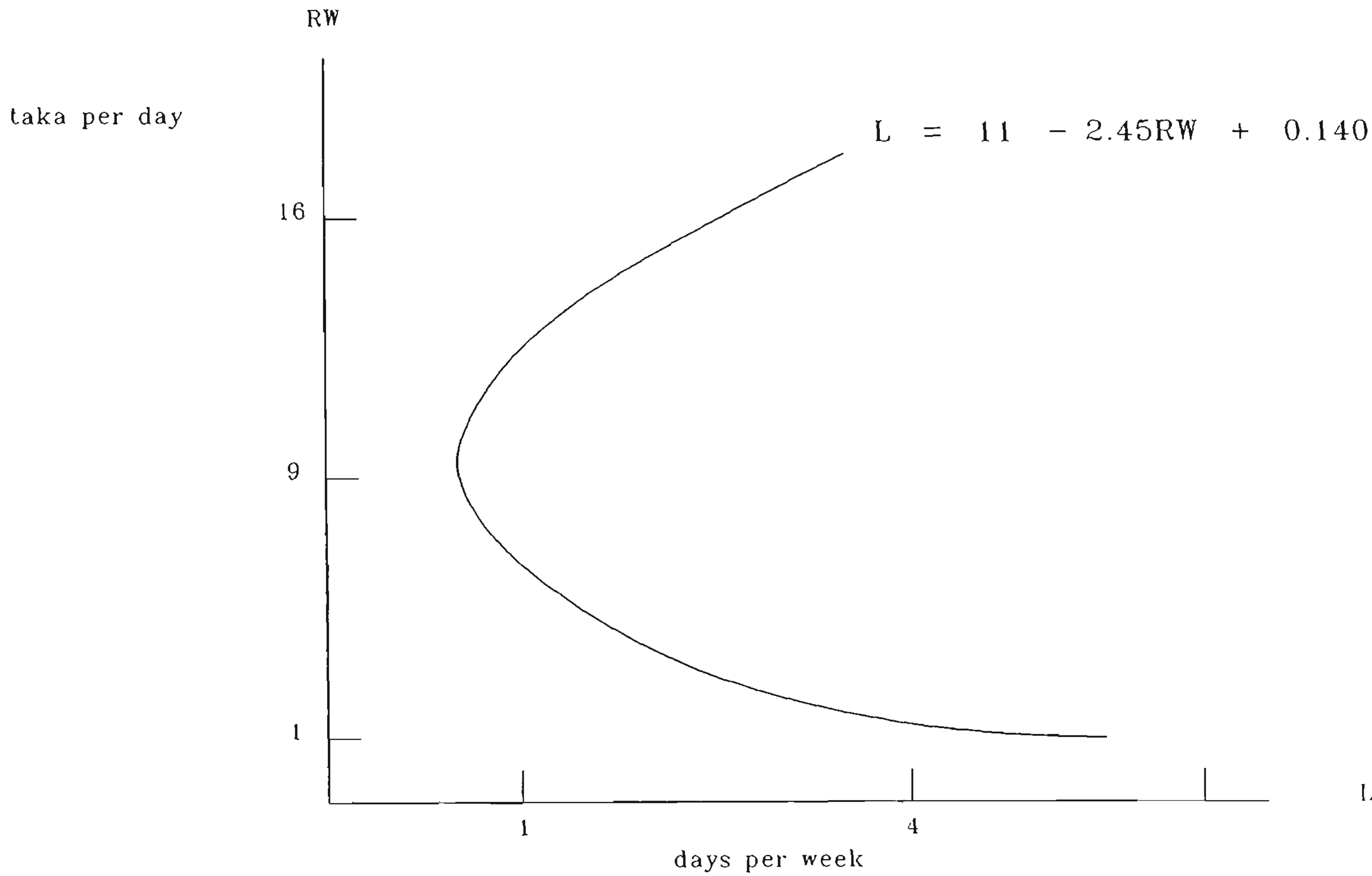

Figure 3.1. The forward-falling labour supply curve.

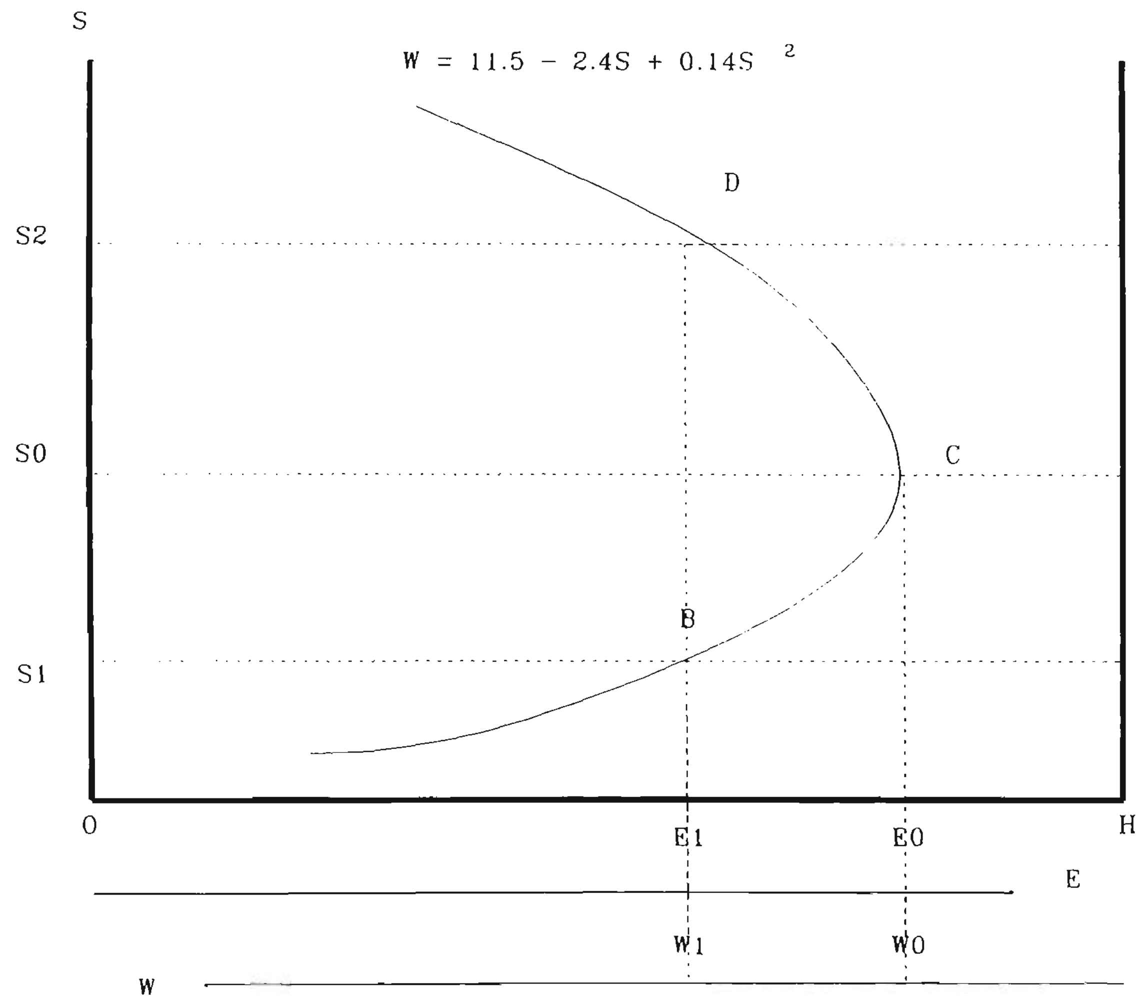

Figure 3.2. The inverted forward-falling labour supply.

no longer defined as the complete absence of access to and influence by the formal market institutions. Consequently, the general demand for other goods has expanded and become more flexible.

Considering segment *CB* in Figure 3.2, it is apparent that in this range $\partial W/\partial S<0$, that is, as wage rate falls from S_0 to S_1 work increases from W_0 to W_1. If the movement from *B* to *C* is considered, it implies that an increase in wage rate from S_1 to S_0 will mean a reduction in the number of hours worked form W_1 to W_0 to maintain the same level of income. Why should work decline as wage rate increases in order to maintain a subsistence level of income? Why not aspire for a higher income and subsequently increase work as wage rate increases? If the upward segment *CD* is considered, at wage rate S_2, the level of work is ambiguous. Why should the supply curve behave in a sagging motion through segment *BCD* when in the first place labour supply is available at W_1 given the wage rate S_1. There are actually two solutions: the individual is willing to work at W_1 given the wage rate of S_1 and S_2.

The irony is, most of the empirical works which have indicated that in subsistence economies the relationship between wage rate and labour supply is negative, is derived from the neoclassical framework. Given the assumption of global rationality the individual behaves as a utility maximising agent. Then when empirical data indicated an inverse relation, the justification is shifted to a more constrained rationality - the agents behave as in the "limited aspiration and target income" hypothesis. The basic theory from which the empirical work has been conducted seemed inconsistent with the behavioural justification of the empirical results. Therefore, how can we account for the downward sloping supply curve? It can be argued that the variations in the amount of work can not be attributed directly to variations in wage rates. Rather, these variations can be the result of the inequitable access to employment opportunities and to other economic, social, demographic, cultural and political attributes of the worker and the community. It can also be argued that wage rate is not determined through the labour market. Further, the existing labour markets in rural and depressed agrarian communities in the Philippines may not be appropriately fitted for a classical framework of economic analysis. Workers may have differential access to employment opportunities and wages may be negotiated by the worker and the employer on an individual basis.

As it is, there are some ambiguity as to whether the equation (3.2) is actually a supply curve. In Vatter's (1961, p. 579) words: "*...It will be argued that if there were such short-run backward-sloping curves relating quantity changes to price changes, such curves would be realistic only for price decreases and not for price increases. Therefore, they are not supply curve in the ordinary sense...*".

3.3. Labour Supply in a Bounded Rationality Model

Hence, there is the need to provide for an alternative theoretical basis for the problem of time allocation, particularly in the context of rural labour where evidences strongly indicate an inverse relationship between work and wages. In order to do this, the assumptions of the classical framework have to be modified and some other distinct assumptions have to be introduced.

3.3.1. Bounded Rationality

The following argument by Simon (1979, p. 503) will serve as the basic foundation for this alternative theoretical framework:

> "*...As an alternative, one could postulate that the decision-maker had formed some aspirations as to how good an alternative he should find. As soon as he discovered an alternative for choice meeting his level of aspiration, he would terminate the search and choose the alternative. I called this mode of selection 'satisficing'...*"

This is a radical departure from the neoclassical global rationality which yields the utility maximising behaviour. Within the bounds of this argument, the basic mechanics in the determination of the solution to the problem of choice and allocation are embodied on the *learning rule*" based upon some "rules-of-thumb" or more formally referred to as *heuristic* approach to decision making. While the analytical framework in this behavioural model may not result in a global maximum solution, it certainly is much closer to the actual decision process compared to the neoclassical analytical framework. In fact, it can be suboptimal as established by Arthur (1991) and Herrenstein (1991). Bounded rationality in this context implies that the information required by the individual to reach a decision is reduced to the level of the human information processing and analytical capacity, and the decision rule is based on the levels of aspiration.

Implicit in the framework of bounded rationality is the notion that rational behaviour is exhibited at different dimensions: the individual rationally set the constraints of the model and the decision maker determines the rational choice within the boundaries of the constraints. To illustrate the arguments of bounded rationality, the theoretical framework developed by Simon (1955) for the case of an individual selling a house can be readily employed analogous to the process of deciding whether or not to offer a certain amount of work at a given wage rate.

Suppose that an individual is looking for work. Each day (or any other unit of time), he sets an acceptable wage rate, say, $d(k)$ for the kth day. If he sees offers above the $d(k)$ on the day in question, then he takes the highest offer. If there are no offers greater than $d(k)$, then he goes home and set a new acceptable wage for the search the next day, say, $d(k+1)$. If the individual has exact information on the probability distributions of offers on each day, he can set an optimal wage rate in a sense that it will maximise the expected value, $V[d(k)]$ of his salary or wage income.

Let $p_k(y)$ be the probability that y will be the highest wage rate offered on the kth day. Then,

$$P_k(d) = \int_{d(k)}^{\infty} p_k(y)dy \tag{3.3}$$

is the probability that the individual accepts a job on the kth day if he has not been employed the day before. And,

$$\epsilon_k(d) = \int_{d(k)}^{\infty} yp(y,k)dy \tag{3.4}$$

will be the expected value received by the worker on the kth day if he has not been employed earlier. Taking into account the probability that the worker was not employed before the *k*th day,

$$E_k(d) = \epsilon_k(d) \prod_{j=1}^{k-1} (1 - P_j(d)) \tag{3.5}$$

will be the unconditional expected value of the worker's wage on the kth day, and

$$V(d(k)) = \sum_{k=1}^{\infty} E_k(d) \tag{3.6}$$

will be the expected value of the wage rate. Then set $d(k)$ for each k at the level which will maximise equation (3.6). The k components of the function $d(k)$ are independent. Differentiating V partially with respect to each component,

$$\frac{\partial V}{\partial d(i)} = \sum_{k=1}^{\infty} \frac{\partial E_k(d)}{\partial d(i)} \quad (i = 1 \ldots, n) \tag{3.7}$$

But

$$\frac{\partial E_i(d)}{\partial d(i)} = \frac{\partial \epsilon_i(d)}{\partial d(i)} \prod_{j=1}^{i-1} (1 - P_j(d)) \tag{3.8}$$

and

$$\frac{\partial E_k(d)}{\partial d(i)} = \epsilon_k(d) \prod_{j=1}^{k-1} (1 - P_j(d))(-\frac{\partial P_i(d)}{\partial d(i)}) \quad for \quad i < k; j \neq i \tag{3.9}$$

$$\frac{\partial E_k(d)}{\partial d(i)} = 0 \qquad for \quad r > i \tag{3.10}$$

Hence, for maximum,

$$\frac{\partial V}{\partial d(i)} = -d(i)p_i(d)\prod_{j=1}^{i-1}(1-P_j(d)) + \sum_{k=i+1}^{\infty}\epsilon_k(d)\prod_{j\neq i}^{k-1}(1-P_j(d))p_i(d) = 0 \tag{3.11}$$

Factoring out $p_i(d)$

$$d(i) = \frac{\sum_{k=i+1}^{\infty}\epsilon_k(d)\prod_{j\neq i}^{k-1}(1-P_j(d))}{\prod_{j=1}^{i-1}(1-P_j(d))} = \sum_{k=i+1}^{\infty}\epsilon_k(d)\prod_{j=i+1}^{k-1}(1-P_j(d) \tag{3.12}$$

Equation (3.12) says that the rational acceptance wage on the *kth* day is equal to the expected value of the wage rate if the worker has not been employed on the *kth* day and the acceptable wage is set optimally for the subsequent days.

But the individual can not have perfect knowledge, hence, he has to settle for a satisfactory solution by initially setting an acceptable wage rate and evaluate how the offers are going in relation to the acceptable wage rate.

Suppose there is an individual looking for work. As the person leaves the home to look for a job or work, he is not actually starting from scratch in so far as the parameters in his decision making process is concerned. Based on his assessment of his personal attributes, such as wealth, skills, among others, he sets some rough estimates of the parameters. The individual would have a rough notion as to how long he will have to work and a notion of the level of wage rate that he is willing to accept.

If he finds an employer offering a wage rate above his acceptable rate, the job is accepted. Otherwise, he returns home and set a new acceptable wage rate for the next job-search-day.

If only the individual seeking for work is "all-knowing" as has been assumed in the neoclassical model, then complete knowledge of the probability distribution of job offers can be the basis of a definitive solution to the search. The individual can simply set his acceptable wage rate in a day in such a way that the expected value is maximum. However, to have the complete knowledge of such probability distribution is practically impossible. Consequently, the individual has to make some rational changes. Foremost is to reduce the time frame of the planning horizon and set a rational acceptance wage rate. Then, the person goes for a search and gather information. Given the information, however limited, the person adjusts his acceptance upwards or downwards depending upon the distribution of the wage offers. If the offers are distributed in a way that his acceptance wage is readily achieved, then an upward adjustment is made. Conversely, if he finds difficulty in finding an offer above his acceptable wage, he lowers his aspiration. The rational adjustment goes on within the time frame of the planning horizon. Given this mechanism, the decision can be made without the complete knowledge of the distribution of the wage rate offers. This, in Simon's words (p. 118): *"...is the kind of rational adjustment that humans find 'good enough' and are capable of exercising in a wide range of practical circumstances..."*.

3.3.2. Absolute Poverty Threshold

In most subsistence household living in depressed agrarian communities, labour is the only productive resource. Therefore, in order to survive, the able-bodied members of the household will have to work and earn the income required to purchase the goods barely for survival, such as, food and shelter. In so doing, the worker will have to expend some form of energy. Hence, if the worker is to receive a level of income from work which is not even sufficient to replenish the energy expended in doing the work, then he is better off not working. The argument suggesting the relationship between the amount of work and the person's energy level, health and his vitality which in turn depends upon his consumption level, has been alluded to in the earlier works by Leibenstein (1957) and Rodgers (1975). Leibenstein referred to the wage rate that corresponds to the level of subsistence income as the "minimum sustenance wage". In contemporary labour economics literature, this minimum wage is referred to as the reservation wage (Berndt, 1990).

3.3.3. Relative Poverty Threshold

In the conventional argument, individual consumer behaviour is derived from the utility function which is assumed to be independent from the utility function of another. Hence, the changes in utility and therefore the level of satisfaction, is only attributed to the changes in the level of consumption of commodities in isolation from the rest of the world. In reality, the level of satisfaction is relative to the consumption patterns of the community. For instance, the level of satisfaction that the Thomases derive from owning a four-wheel drive Toyota Land Cruiser is more than the transport facility that the vehicle yields. The level of satisfaction is enhanced by the fact that the Joneses have a four-wheel Toyota Land Cruiser too. This behaviour has been usually referred to in economics as "keeping up with the Joneses". A more profound argument on this concept has been articulated by Duesenberry (1949) in what has been popularly known as the relative income hypothesis. To consider this behaviour would have some profound implications to the neoclassical utility analysis of consumer behaviour.

This argument of course is not new. As was noted in Baxter (1988, p. 128): *"Marshall (1890) claimed that there was a hierarchy of wants and that wants are altered over time... subsequent research (Maslow 1954) has suggested that there are probably only two principal categories, with lower order needs (physiological and security) and higher order needs (esteem and self-actualisation) clustering independently..."*

It is this cluster of higher order needs that provide another dimension of the level of satisfaction that consumer derive from the consumption of goods. Therefore, the utility that the individual consumer derives from income is not measured directly by what it can buy but more importantly by the goods that it can buy relative to what the other members of the community are buying. This relative income is the level of aspiration that an individual sets as the goal in an economic society. In Solow's (1990, p 6) argument:

> *"...We live in a society in which social status and self esteem are strongly tied both to occupation and income...It seems undeniable to me that both occupation and income are significant variables. The way others look at us, and the way we look at ourselves, are both income related, and both are job related at given income. Employment and income it brings are not simply equivalent to a set of bundles of consumer goods...".*

Consequently, there has to be a corresponding aspired level of wage rate that will generate the aspired relative income - the relative poverty threshold. As Marshall (1925, p. 213) noted:

> *"...The basis of the notion that there should be given a fair day's wage for a fair day's work is that every man who is up to the usual standard of efficiency of his trade in his own neighbourhood, and exerts himself honestly, ought to be paid for his work at the usual rate for his trade and neighbourhood; so that he may be able to live in that way to which he and his neighbours in his rank of life have been accustomed..."*

3.3.4. Aversion to Work

In modern societies, it has been a common expression that "to be happy is to find a job you love". But in reality, work can be tedious, repetitive, boring, and back-breaking. This can be safely said in a general sense to almost all types of job. Hence, it should not be very difficult to imagine people avoiding farmwork (given the choice) because farm work is perceived to be demeaning in addition to being tedious, boring, repetitive and back-breaking.

The preceding argument imply that there is in fact disutility in work. This basic notion of work disutility has been alluded to in the earlier works of Jevons (1871), Knight (1921) and Chayanov (1925). The problem is that this behavioural issue can not be incorporated in the existing neoclassical model of the labour supply analysis.

3.3.5. Utility Function

In the neoclassical labour supply analysis, utility is assumed to be a function of the level of consumption of goods and the amount of leisure time in order to derive the labour supply curve. However, it may not be necessary to explicitly consider leisure and treat is as a distinct commodity similar to ordinary goods. The utility function can be constructed simply by following the argument on the hierarchy of needs, earlier forwarded by Marshall (1890) and later refined by Maslow (1954) as the motives behind consumer behaviour.

Maslow's theory of motivation forwarded the argument that behind an individual's economic behaviour is a universal motive to satisfy a hierarchy of needs, namely, physiological needs, safety needs, belonging needs, esteem needs, and the need for self actualization. As noted earlier, Maslow argued that the hierarchy of needs can be clustered independently between the lower order needs and the higher order needs. The former refers to the cluster of those needs that satisfy the physiological and safety requirements and the latter to those that satisfy esteem and self actualization. This theory of motivation can serve as the foundation in the construction of an economic model of consumer behaviour. A more recent attempt to construct an economic model from Maslow's theory was done by Seeley (1992). However, Seeley's argument goes back to the neoclassical assumption of global rationality, that is, the individual is able to search for the optimum solution by maximising utility.

The utility function that is being considered here will be analogous to the argument forwarded by Lancaster (1966) where it is supposed that it is not the goods *per se* which is the object of utility but rather the attributes of the goods from which utility is derived. For instance, a car provides not only the satisfaction to an individual of facilitating mobility but also a host of non-economic attributes such as color preferences and model design. Hence, a commodity is defined as a composite of these economic and non-economic attributes. This consideration is very important because each individual product has its own distinct set of attributes. It may not be necessary to assume homogeneity of products. In some cases, the brand name would be sufficient to categorise commodities to have more or less similar composition of attributes that satisfy the desires of individuals irrespective of whether it is of higher or lower order need. In most cases, however, the brand name is not sufficient for purposes of classification in relation to the composite attributes that satisfy the need.

It may be necessary to specify the specific model or make of the commodity. For instance, a Filipino consumer puts a higher price premium for eggs laid by the native chicken variety as compared to those laid by hybrid commercial chicken. Also, the attributes of an IBM desktop computer across models have a very wide variety of composition. Each model has to be specified according to each attributes such as the RAM capacity, CPU processing speed, the capacity of the hard disk drive, and the type of floppy disk drives among others. Any combination of these attributes caters to various levels of need and subsequently implies a different level of satisfaction for an individual consumer.

To formally illustrate this arguments, let:

l_i - be the composite of attributes embodied in commodity i which caters to the lower order needs of the individual;

P_l - the price of the l_i;

h_j - be the composite of attributes of commodity h which caters to the higher order needs;

P_j - the price of h_j.

Further, following the structure of Lancaster's linear attributes model, it is reasonable to let Y_b. be a symbolic representation of the absolute poverty threshold This is simply the sum of all the commodities at their market prices that cater to the lower order needs, that is,

$$Y_b = \sum l_i P_i \tag{3.13}$$

Furthermore, let Y_r to be a symbolic representation of the relative poverty threshold which is simply the sum of all commodities at their market prices that cater to the higher order needs, that is,

$$Y_r = \sum h_j P_j \tag{3.14}$$

Hence the utility function can simply be formulated as a function of both the lower and higher order needs. That is,

$$U = f\left(\sum_{i=1}^{n} l_i P_i \ , \ \sum_{j=1}^{m} h_j P_j\right) \tag{3.15}$$

or

$$U = f(Y_b, Y_r) \tag{3.16}$$

From these assumptions, it can be argued that an individual looking for work assesses his own attributes and sets his aspirations on how long he will have to work and at what level of wage he is willing to accept.

The model developed here draws heavily from Seeley's (1992) attempt to construct an economic behaviour model based upon Maslow's *motivation theory*. However, for the purpose of deriving the labour supply behaviour from the utility function, it is sufficient to characterize commodities as composite goods instead of a much basic construction as Seeley's *need technology* or Lancaster's *consumption technology*. Further, the model being constructed here differs in terms of the individual rational behaviour. Previous economic models assume global rationality and subsequently assume that the individual is a utility maximiser. The present model is developed within the framework of *bounded rationality*, hence, the individual is unable to choose optimum solution but is only able to search for a satisfactory solution based on some levels of aspiration.

In order to be consistent with Maslow's argument that unless the lower order needs are satisfied, the higher order needs are non-motivating, it is necessary to assume that:

$$U = f(0, Y_r) = 0.$$

Further, assume that:

$$\frac{\partial U}{\partial Y_b} > 0 \quad for \quad Y_b > Y_b^*,$$

$$\frac{\partial U}{\partial Y_r} > 0,$$

and

$$\frac{\partial^2 U}{\partial Y_b^2}\ ,\ \frac{\partial^2 U}{\partial Y_r^2} \quad < \quad 0,$$

where Y_b^* is the absolute poverty threshold.

Following Lancaster's linear attributes assumption, that is, goods are viewed as additive functions of their attributes, then,

$$U = f(Y_b + Y_r) \qquad (3.17)$$

What is implicit in the above equation is that the utility function is dependent upon the income outlay that is required in order to achieve both the lower order needs or the absolute poverty threshold (Y_b) and higher order needs or the relative poverty threshold (Y_r).

Within the bounded rationality framework, the individual is only able to search for a satisfactory level of utility relative to the aspired level of both the lower order needs and the higher order needs subject to the income constraint given as:

$$Y = Y_a + Y_w. \qquad (3.18)$$

Hence, the decision criteria include the following elements:

1. Satisfice: $U = f(Y_b\ ,\ Y_r)$

   s.t.

   $Y_b = Y_b^*$

   $Y_r = Y_r^*$

   $Y = Y_a + SW$

2. Satisfice: $Y_b = \sum_{i=1}^{n} l_i P_i$

   s.t.

   $Y = Y_b + Y_r$

   $Y = Y_a + SW$

3. Satisfice: $Y_r = \sum_{i=1}^{m} h_j P_j$

s.t. $Y = Y_b + Y_r$

$Y = Y_a + SW$

Assuming that U is a monotonically increasing function of Y_b and Y_r then searching for a satisfactory solution of the value composite goods Y_b and Y_r is sufficient to identify the satisfactory solution of the objective utility function.

At this point it is necessary to recall the assumption that there exists an individual inherent aversion to work, and that degree of work aversion is determined by the level of non-work income or any form of latent income from which the individual can draw from present consumption requirements in relation to the relative poverty threshold. That is, for any given ratio of the non-work income to the relative poverty threshold, the individual sets a desirable level of work at W^o.

Hence, the decision criteria is condensed to:

1. Satisfice: $Y_b = \sum_{i=1}^{n} l_i P_i$

s.t. $Y = Y_r + Y_b$

$Y = Y_a + SW$

$W = W^o$

2. Satisfice: $Y_r = \sum_{i=1}^{m} h_j P_j$

s.t. $Y = Y_b + Y_r$

$Y = Y_a + SW$

$W = W^o$

The preceding model simply argues that an individual, given a certain level of non-work income or assets from which present consumption can be drawn from, because of the inherent work aversion, sets an aspired level of work and searches for a satisfactory high wage rate in order to achieve the desired level of relative poverty threshold provided the absolute poverty threshold is being satisfied. It is apparent in the model that there exists simultaneous relationships among the level of work, the level of wage rate, the ratio of asset to the relative poverty threshold, and work aversion.

To illustrate further the entire argument of a labour supply function in a bounded rationality model, consider Figure 3.3, where H is the total available time, S is the wage rate, and W is the level of work.

Further, it is assumed that utility is a positive function of income, that is, $\partial U/\partial Y > 0$. However, the marginal utility of income is diminishing ($\partial^2 U/\partial Y^2 < 0$).

Suppose that there exists a level of income barely sufficient to compensate for the energy expended for work and the basic necessities for survival, such as food and shelter. This cluster of needs is what has been referred to earlier as the lower order needs. Heretofore, this level of income will be referred to as the absolute poverty threshold (Y_b). This is equivalent to the area bounded by points *OahH* in Figure 3.3. Suppose further that there exists a level of income that is sufficient to provide for the consumption of goods in order to keep up with the lifestyle of the neighbourhood. This cluster of consumption goods is what has been referred to earlier as the higher order needs. From now on, this level of income will be referred to as the relative poverty threshold (Y_r).

This level of income is also the primary basis of the decision rule in the allocation of time. This is the level of aspiration. This income is represented by the area bounded by points *OcdH.*

In order for the worker to achieve the absolute poverty threshold all of the total time available (H) should be allocated for work at minimum sustenance wage S_b. Thus, at any wage rate below S_b the worker is better off not working and instead lay idle and conserve energy.

Suppose S_b increases to S_l. If the workers' motivation is to maintain the subsistence level of income then work should decline to W_l and income is equal to

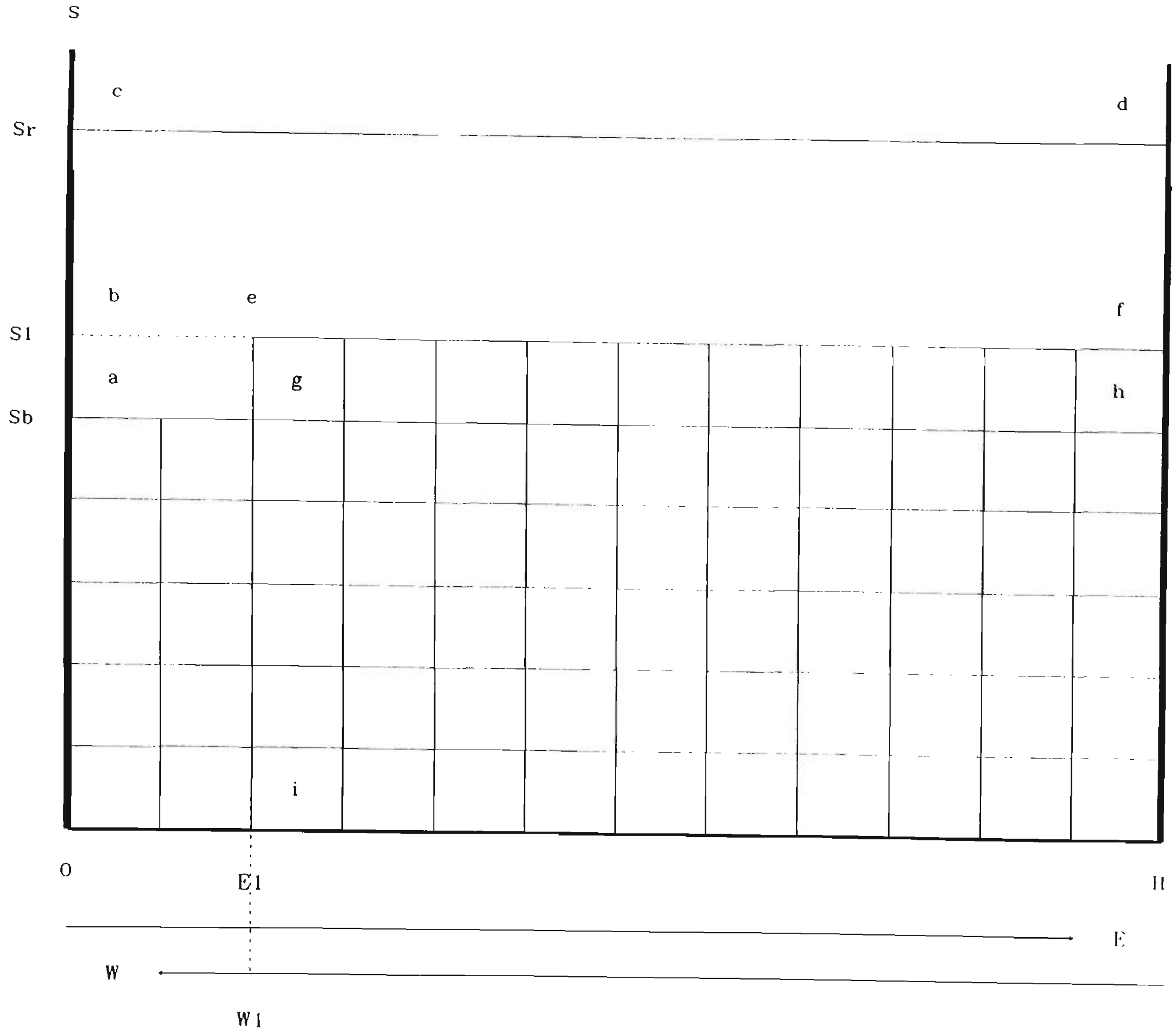

Figure 3.3. Income threshold and labour supply.

area *iefH* equal to area *OahH*. However, under the assumption that $\partial U/\partial Y > 0$, workers are motivated to increase their income, then all of *H* will still be used for work and the income level is at *ObfH*, higher than *OahH* and closer to the relative poverty threshold. As argued earlier, the motivation of an individual to work is governed by the cluster of needs at two levels. Only at wage rate S_b which is sufficient to provide for survival will the individual start to work. Beyond S_b, the individual will try to keep up with the living standard of the community and aspire for the relative poverty threshold income (Y_r) which can be achieved at wage rate S_r. Hence, at the range of wages from S_b to S_r, it would seem that the individual will have to work all of *H*. Therefore, it appears that the supply curve is the vertical line segment abc for the relevant wage rate range S_b to S_r. But this is not so because S_r becomes the aspired level of wage rate or the target wage. Thus, the relevant point is *c*.

Therefore, how can one account for the downward sloping supply curve? It can be argued that the variations in the amount of work can not be attributed directly to variations in wage rates. Rather, these variations can be the result of the inequitable access to employment opportunities and to other economic, social, demographic, cultural and political attributes of the worker and the community. It can also be argued that wage rate is not determined through the labour market. The existing labour markets in rural and depressed agrarian communities in the Philippines may not be appropriate for an analysis based on the classical framework. Workers may have differential access to employment and wages may be negotiated by the worker and the employer on an individual basis.

Most of the factors outlined in the preceding paragraph can be treated as exogenous influences. What is crucial in the main argument of this alternative approach is the role that non-work income plays in the labour supply decision of an individual. The assumption of work aversion (based on the disutility of work) will be recalled at this point. For the purpose of this argument, work aversion is defined as "the ratio on the available hours spent on non-work activities *E* to the total number of hours *H*". Further, it is assumed that the aversion to work is an increasing function of the ratio of the asset income to the absolute poverty threshold.

Recall the assumptions made earlier of the existence of an absolute poverty threshold and relative poverty threshold. Then let:

$Y_b = S_b W$ - absolute poverty threshold

$Y_r = S_r W$ - relative poverty threshold

$A_w = E/H$ - aversion to work; $0 \leq A_w \leq 1$,

where S_b refers to the minimum sustenance wage rate and S_r refers to the aspired level of wage rate or the target wage rate.

Since it is assumed that total income (Y) can be derived from work (Y_w) and from assets (Y_a), then:

$$Y = Y_a + Y_w \qquad (3.19)$$

where

Y_a is the asset income and

Y_w is the income form work

Suppose an individual, in Figure 3.4, has no assets ($Y_a = 0$), then $Y = Y_w$ (all income is derived from work). In this case, the individual has to work all of H at wage rate S_b to achieve the absolute poverty threshold and work at the same level at a range of wage rates up to S_r to attain the relative poverty threshold. At this point work aversion, $A_w = 0$ ($A_w = E/H$; $E=0$). This can be called absolute preference for work or zero work aversion. Therefore, the vertical segment *cd* represents a supply curve at $Y_a = 0$. The level of wage rate S_r becomes the aspired level of wage that corresponds to the level of income that the individual can relate to the rest of the community.

It would seem that this vertical segment can extend upwards at various wage rates. However, as income rises above the absolute poverty threshold, the cluster of consumption goods will be more of the higher order needs. This higher order consumption goods allows the individual to draw, against their current market value, present consumption requirements. In other words, these higher order goods can be treated as assets. Implicitly, non-work income will be positive ($Y_a > 0$). Since the individual is assumed to exhibit aversion to work then the level of work will decline. Therefore, the preference for work will no longer be absolute or work aversion will

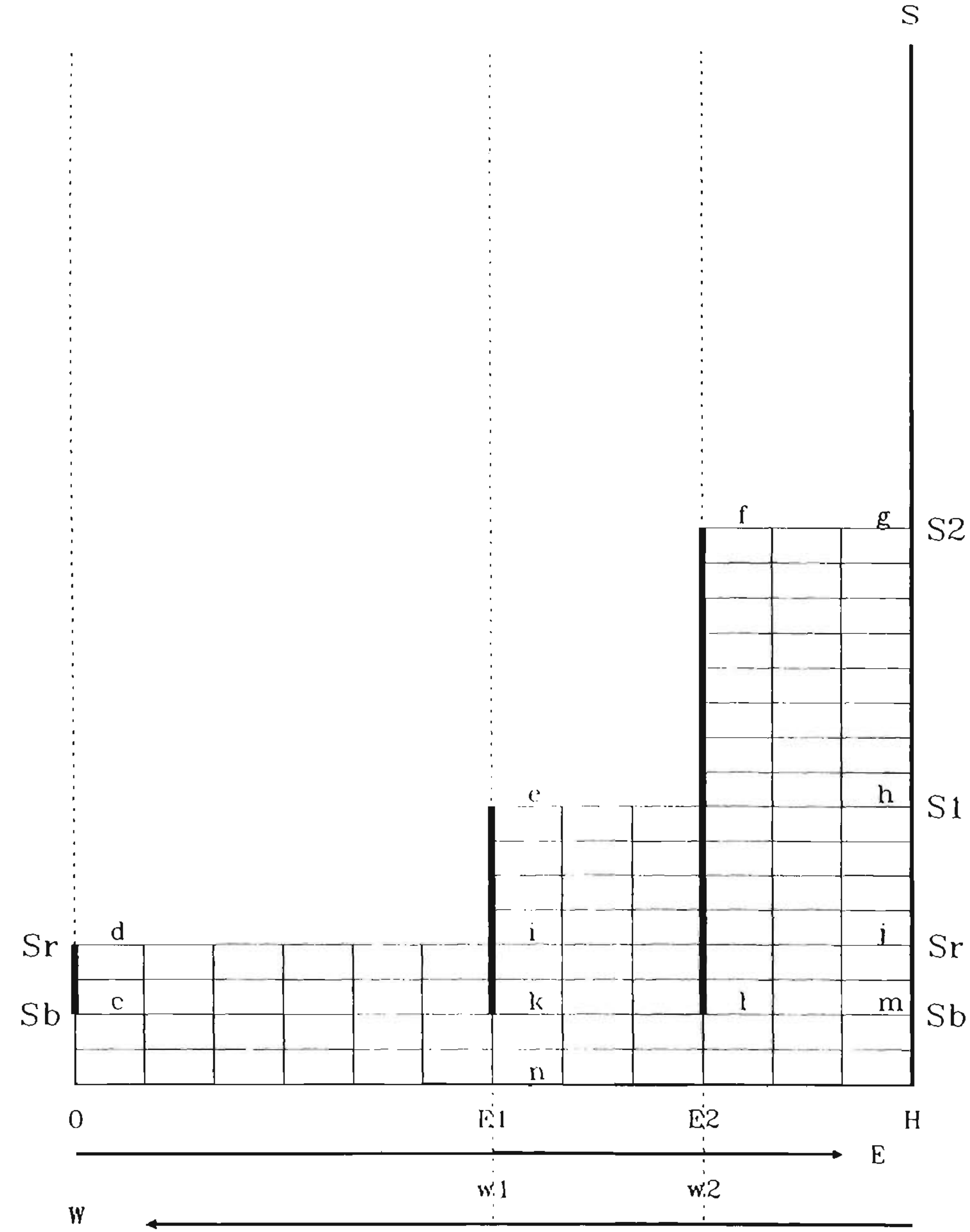

Figure 3.4. Income threshold and work aversion.

no longer be zero ($A_w > 0$; E > 0). Suppose an individual has an asset stock earning an income roughly equivalent to half the absolute poverty threshold; that is, Y_{a1} = *Ockn*. Because there is aversion to work, the individual may work only at W_1. Unlike in the case where asset income is zero, the individual need not allocate all of his available time to work to achieve the absolute poverty threshold given the minimum sustenance wage. Further, the individual with some form of non-work income to fall back on, can afford to be more wage discriminating. The relative wage rate that the individual will try to achieve will be at S_1 corresponding to the relative poverty threshold.

For any subsequent level of $Y_a > Y_{a1}$, such as, $Y_{a2} = .75Y_b$, the individual may work only at level W_2, the work level required to achieve the absolute poverty threshold. Correspondingly, work aversion increased and the individual becomes more wage discriminating. In this case, the aspired level of wage rate is W_2. At the opposite extreme, if the stock of assets earn a level of income equivalent to the entire absolute poverty threshold, then there is absolute aversion to work (A_w = 1; $E = H$). The individual may not work at all. Only if the individual can find a work offering a sufficiently high wage rate will he contemplate on offering work into the labour market.

At this point it would seem that there is no unique solution to the model. In the neoclassical model, the optimum solution is very precise and unique. Work is at the level where the marginal rate of substitution between income and leisure is equal to the wage rate - the point of tangency between the indifference curve and the budget line. In this alternative theoretical formulation, what would prohibit an individual in aspiring for an infinitesimally high wage above the aspired level of wage given a certain work aversion ratio? For instance, in the case where the asset income is half the absolute poverty threshold, what would inhibit the individual from seeking wage rates above S_1 along the dotted line extending from line segment *kie*?

The way out of this predicament is to go back to Marshall's contention that the level of aspiration changes (Baxter, 1988). Further, Simon (1972) argued that from the learning rule, if the individual finds his aspirations readily achieved then the same is adjusted upwards. However, if the aspiration has been difficult to achieve, then the level of aspiration is reduced. The main implication here is that, in this model, the solution to the problem is not very precise or unique. Instead, the solution is an "approximated unique solution".

The points of approximated solution to the model are presented as points *A*, *B*, and *C* in Figure 3.5. Further, a formal structure for this convergence to occur can be formulated. The convergence and stability test conducted by Baumol and Quandt (1974) for the case of the firm's price determination solution can be readily used as an analogy for the case of the determination of the level of work based on the utility function (U).

Given the utility function:

$$U = f(Y), \tag{3.20}$$

$$U = f(Y_a + Y_w) = (Y_a + SW). \tag{3.21}$$

and by the assumption of work aversion, given a certain level of Y_a, work is actually fixed at a certain level W^0. This concept follows the arguments raised by Maital (1988) where he noted that: "...*In many cases, behaviour is a result not of choice of constraints, but rather, the choice of self-imposed constraints in order to maximise utility, where constraints are in fact the key decision variables themselves, and where our well-being often rests on how effective, ingenious and binding our self-imposed constraints are*...(p. 11)". Hence, the utility function is simplified to be dependent only on the level of wage rate. Since the utility function is assumed to be concave then the test for convergence and global stability is readily verified as in the Baumol-Quandt test.

Based on the learning-rule, the work allocation decision can be expressed as

$$S_{i+1} - S_i = \lambda \frac{Y_i - Y_{i-1}}{S_i - S_{i-1}} \tag{3.22}$$

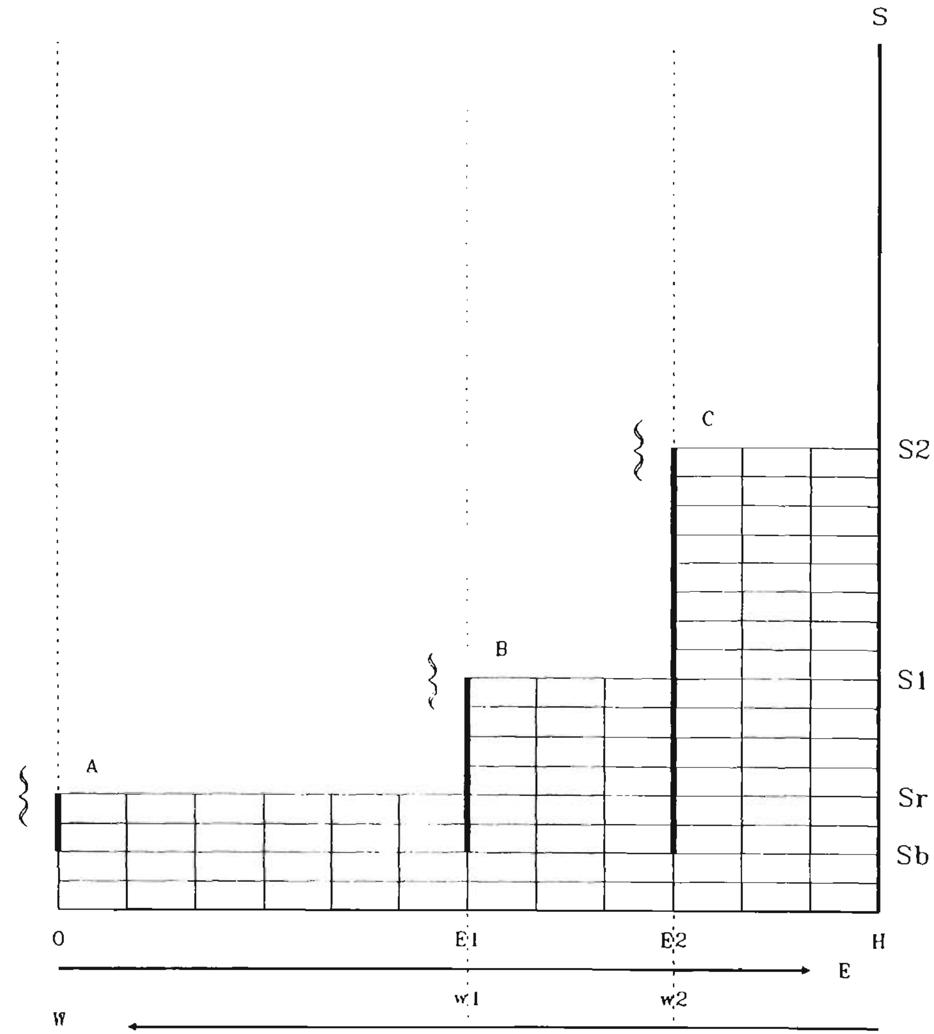

Figure 3.5. Approximated satisficing solutions.

if $S_i \neq S_{(i-1)}$ and $S_{(i+1)} = 0$ and λ is the speed of adjustment parameter.

For a continuous function, the learning model can be re-formulated as follows:

$$\dot{S} = \lambda \frac{\dot{Y}}{S} \tag{3.23}$$

if $S \neq 0$, $S = 0$ otherwise and where the dot symbol denotes the symbol of the first derivative with respect to time. Assuming that the income function is concave and a differentiable function of *S*, that is,

$$Y = f(S) \tag{3.24}$$

and

$$f''(S) < 0. \tag{3.25}$$

Equation (3.23) then becomes

$$\dot{S} = \lambda \frac{f'(S)\dot{S}}{\dot{S}} = \lambda f'(S). \tag{3.26}$$

The stability of equation (3.23) can now be examined from a global perspective. According to Baumol and Quandt (p42): *"...A system is globally stable if it converges to equilibrium irrespective of the initial condition of the system. Stability can be established by showing that the distance between the solution of (3.23) and equilibrium declines monotonically with time..".* Since equilibrium is given by $\dot{S}_i = 0$, then the distance function is the Euclidean norm,

$$V(i) = \frac{1}{2}(\dot{S}-0)^2 \tag{3.27}$$

$V(i) \geq 0$ for all i. If then it can be shown that $\dot{V}(i) < 0$ for all i, then global stability is established.

Differentiating (3.27),

$$\dot{V}(i) = \lambda^2 f'(S) f''(S) \dot{S} \tag{3.28}$$

and since $\lambda f'(S) = \dot{S}$ we have $\dot{V}(i) = \lambda f''(S) \dot{S}^2 < 0$ by the concavity of the utility function and the system is globally stable.

Further, to provide for a substantive or conceptual argument in support to the mathematical test for convergence and global stability, the notion of work aversion and asset income can be closely examined. Any point considerably higher than, say point *B* in Figure 3.5, implies that the individual worker would be earning income above his aspired level of consumption. This condition can be viewed to result in an expected accumulation of assets. Consequently, the ratio of the asset income to the absolute poverty threshold is expected to increase, and work aversion increases. Thus, the individual is shifted to a new position to the right of point *B* corresponding to a higher level of relative poverty threshold and higher level of wage rates and lower working hours. Conversely, any point considerably below point *B* implies over consumption. This results into perceived asset depletion and reduction in asset income and decreased work aversion. The individual will be shifted to a new position corresponding to a lower relative poverty threshold and lower wage rate and higher working hours.

Therefore, points *A*, *B*, and *C* in Figure 3.5 are approximated solutions corresponding to a level of work at a certain wage rate given the work aversion ratio.

Assuming Y_a and W as continuous variables, then it should not be difficult to perceive a locus of points along A, B, and C that corresponds to a level of work and wage rate given a work aversion factor. Connecting all these points yields a downward sloping curve along a wage-work plane. Such a curve is depicted in Figure 3.6. This however, can not be interpreted as a labour supply curve in the conventional sense because of the endogeneity among the level of work, and of wage rate, the ratio of the asset income to the absolute poverty threshold and work aversion.

It has been the explicit assumption that by the learning rule, the level of aspiration varies but converges to the reference relative poverty threshold. However, it has been the implicit assumption that the reference point of the relative poverty threshold is constant. The result is that over the wage-work plane, along the supply curve, the total income is actually not changing and that the aspired level of income is constant across the wage-work plane. This assumption was intended only for the purpose of illustration.

In reality, as the individual accumulates assets and improves his lifestyle, his reference group will also change. As he moves up the social class, his reference will be the next higher group. Therefore, his relative poverty threshold will actually move upwards. Figure 3.7 illustrates this argument.

Consider the individual with asset income about half the absolute poverty threshold. His relative poverty threshold is not actually Y_r (area bounded by $OdjH$ in Figure 3.4) but Y_{r1}. This higher aspiration level will actually require a wage rate higher than S_1. It is S_{1*}. For an asset income roughly equivalent to three-fourths the absolute poverty threshold (Y_b), the relative poverty threshold is not Y_r, or Y_{r1}, but Y_{r2}. The corresponding aspired level of wage rate is S_{2*}. Following the same arguments with respect to the "approximated satisfactory" solution earlier forwarded, the actual curve is steeper than what has been generated in Figure 3.6.

Therefore, what can be derived from this model is a simultaneous relationship among work, wage rate and the ratio between the asset income to the absolute poverty threshold. The ratio between the asset income to the absolute poverty threshold defines the work aversion factor, which in turn defines the desired level of work and the aspired wage rate corresponding to the relative poverty threshold.

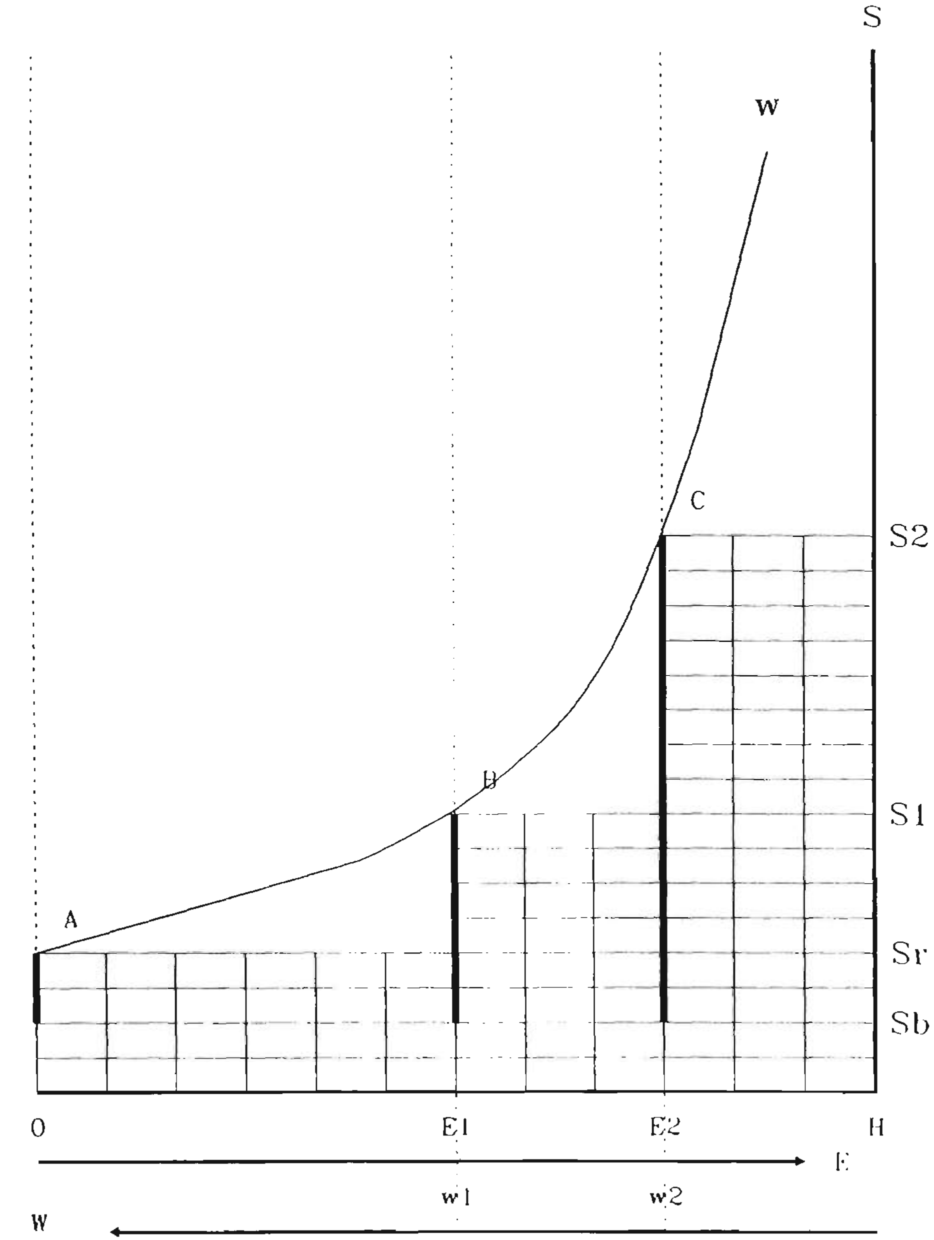

Figure 3.6. Work schedule at constant Yr.

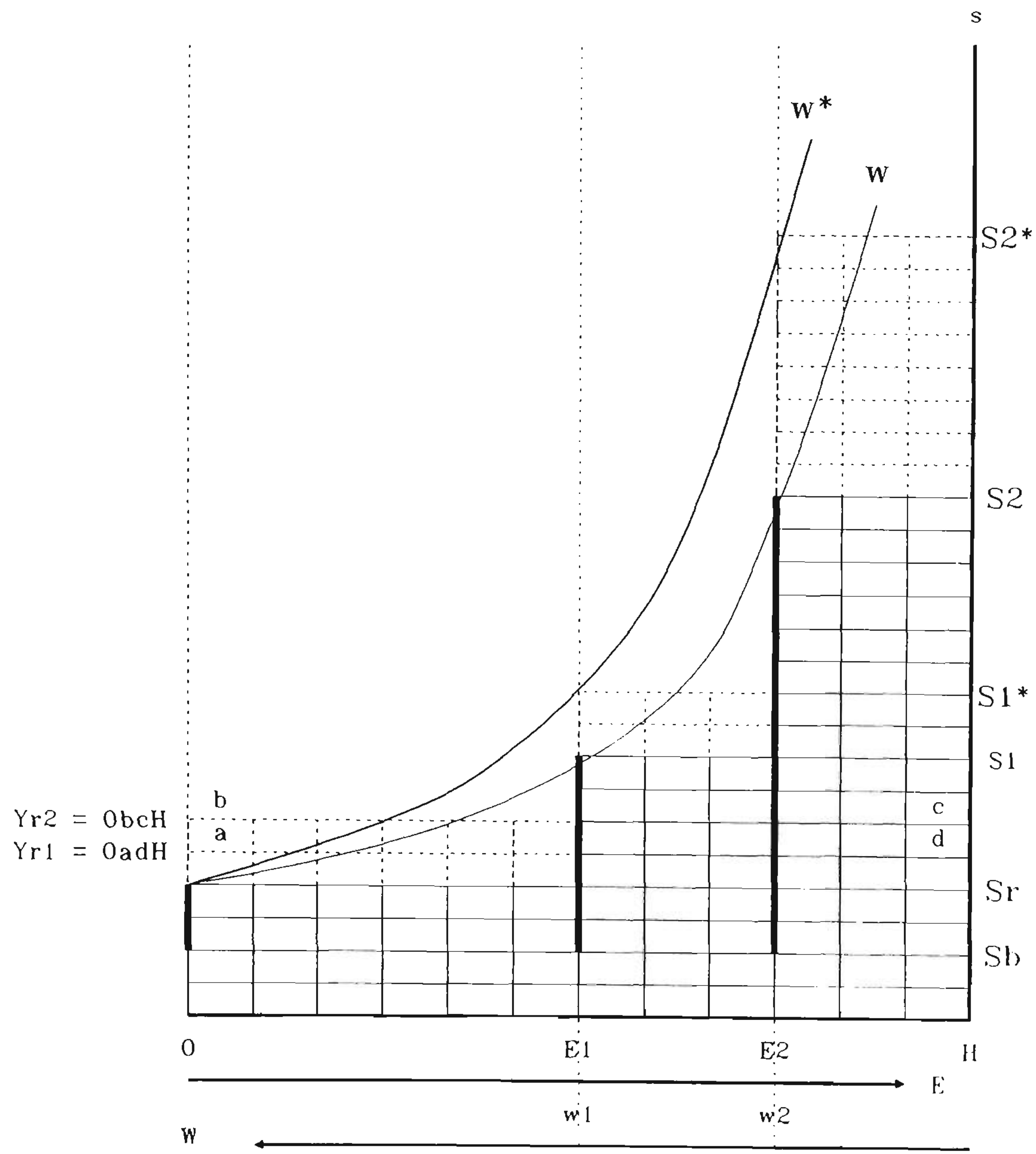

Figure 3.7. Work schedule at changing Yr.

To illustrate this argument further, examine Figure 3.8a, b, c, and d. Let

R_a - the ratio of the asset-income to absolute poverty threshold and

A_w - the work aversion factor

where,

$$R_a = \frac{Y_a}{Y_b}, \tag{3.29}$$

and

$$A_w = \frac{E}{H}. \tag{3.30}$$

Suppose that initially there exists an asset income Y_{a1}. This corresponds to R_{a1} in Figure 3.8d. The initial ratio R_{a1} translates to an aversion factor A_{w1} in Figure 3.8c. In terms of actual nominal ratio (where $A_w = E/H$ and $0 \leq A_w \leq 1$) in Figure 3.8b, A_{w1} corresponds to the amount of work W_1. Further, the initial ratio R_{ai} corresponds to a level of non-work time E_1 which means a level of work at W_1 in Figure 3.8a corresponds to the amount of work required to achieve the aspired level of income (the relative poverty threshold) given the initial asset-income. The amount of work is translated to W_1 in Figure 3.8d corresponding to R_{a1}.

Suppose further that the initial asset-income increases from Y_{a1} to Y_{a2} yielding the new ratio R_{a2} where $R_{a2} > R_{a1}$. Tracing the dynamics through Figures 3.8d, c, b, and a, R_{a2} corresponds to a higher aversion factor A_{w2}. This implies a higher non-work time E_2 and lesser time allocated for work W_2. Thus, translating W_2 from Figure 3.8b yields a work allocation schedule that is inversely related to the asset-income and total income ratio. That is,

$$W = f(R_a), \tag{3.31}$$

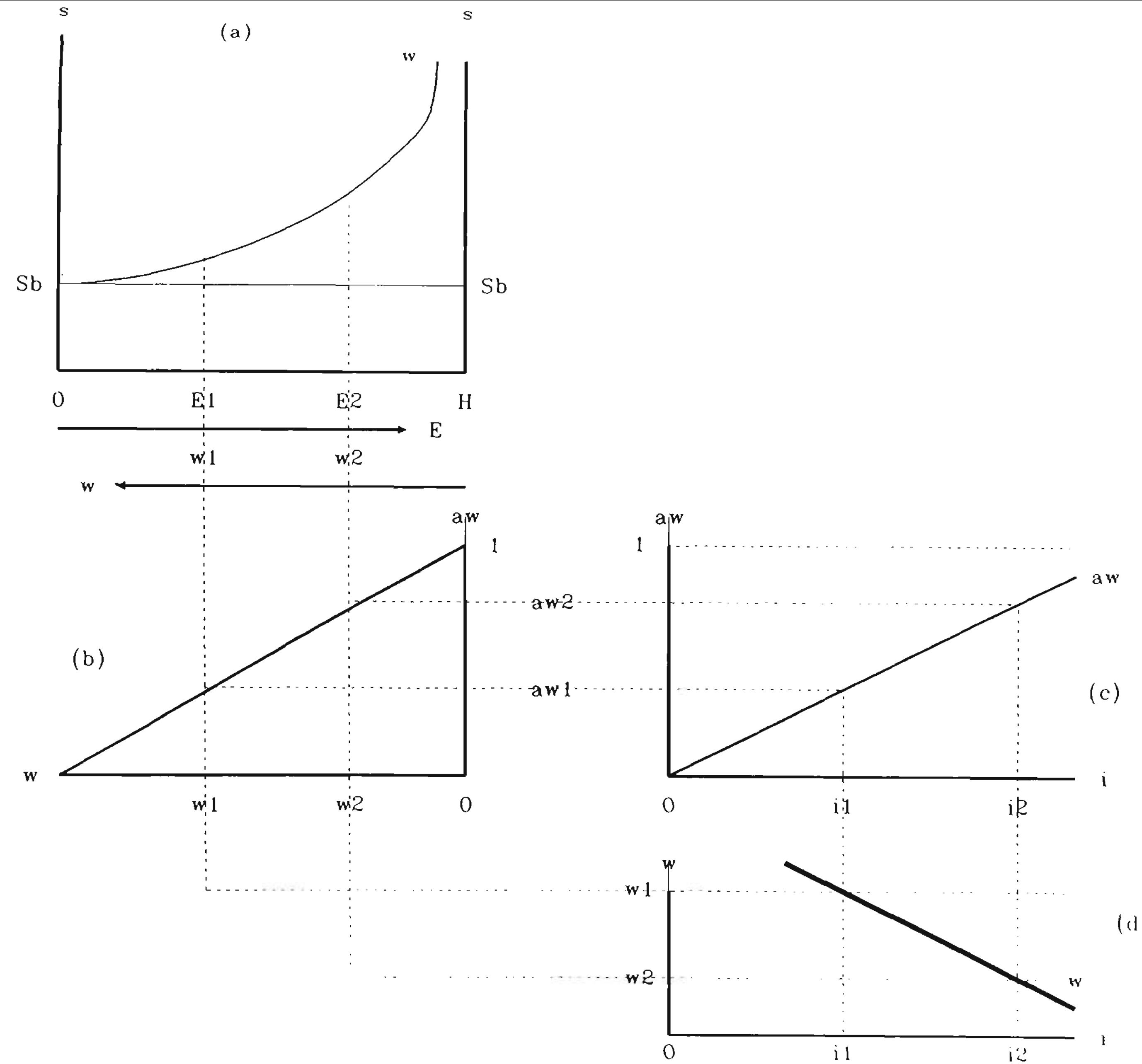

Figure 3.8. Labour supply in bounded rationality model.

where,

$$\frac{\partial W}{\partial R_a} < 0.$$

What has been generated are two important relationships. One is the inverse relationship between work and wage rate. However, this can not be interpreted as a labour supply curve in the conventional sense because it is not actually a direct relationship between work and wage. The other relationship depicts a work schedule that is an inverse function of the ratio of the individuals asset income to the absolute poverty threshold.

This conceptual framework can be viewed within a broader framework as schematically represented in a diagram relating the dynamics of an economic system in a rural society. Figure 3.9 outlines the attributes that defines labour supply and wage rate in the economic system. In turn, the quantity of labour and wage rate measures the level of income. Finally, to complete the cycle, the level of income shapes the character of the individual, the household and the community.

3.4. Chapter Summary

What has been outlined is the basic theoretical foundation of this research. It has been established that the theory of the hierarchy of needs evaluated under the framework of the theory of bounded rationality provides a more flexible analytical framework for labour supply analysis. Eventually, the model that was developed is a system of simultaneous equations relating the levels of wage rate and non-work income relative to the absolute poverty threshold and aversion to work. Also, this model will be evaluated within the broader framework of the rural socio-economic systems. This implies that the analyses will have to incorporate the effects of other relevant social, cultural and demographic factors.

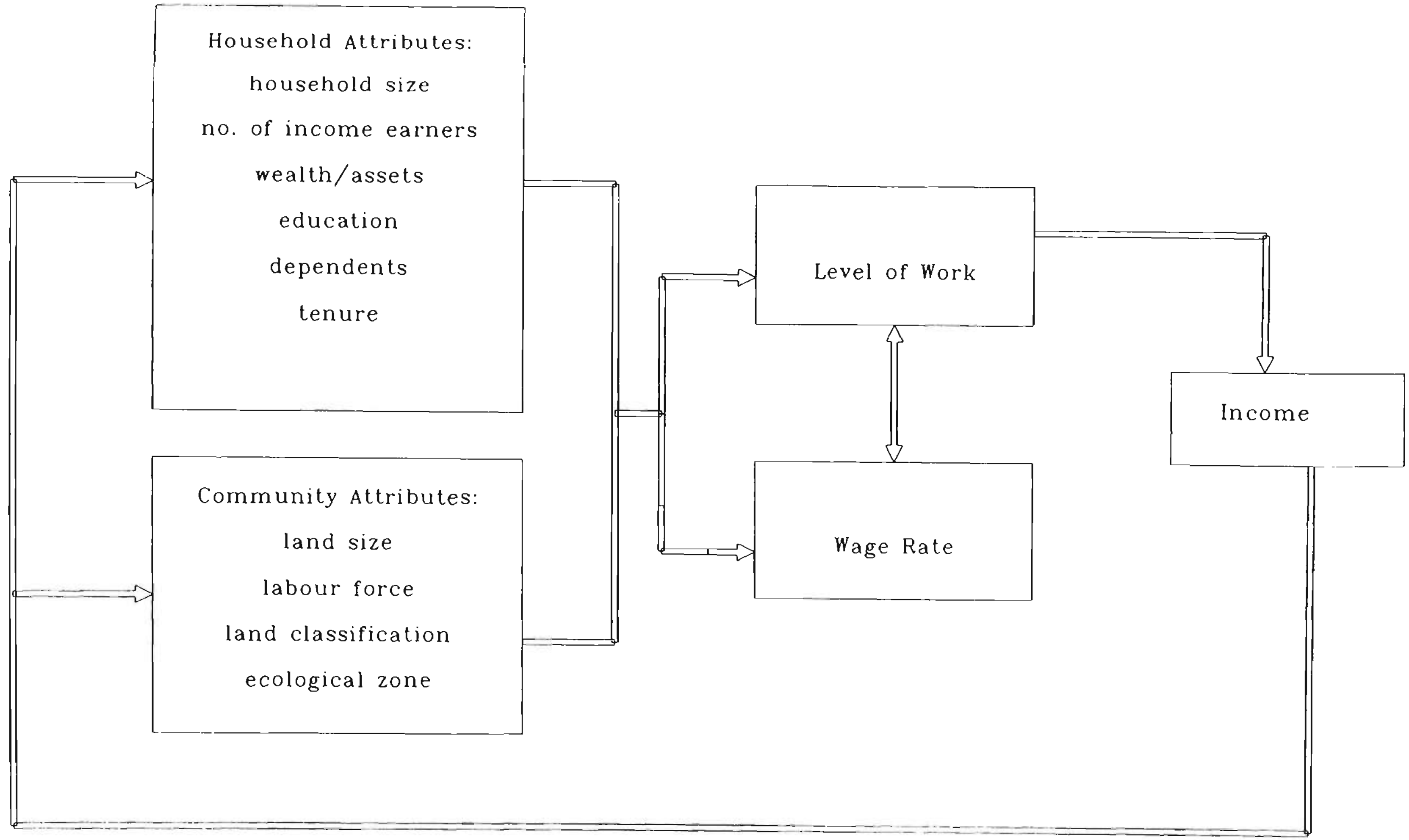

Figure 3.9. Schematic diagram of the determinants of work.

CHAPTER 4

ANALYTICAL METHODS

4.1. Introduction

It has been argued that the significance of this research hinges on the broader understanding of the rural labour conditions in the Philippines. To provide concrete arguments, it is necessary to address the objectives of the research. Since the objectives outlined in the earlier section vary both in scope and in depth of analysis, it is necessary to design analytical tools appropriate for the research objectives. In terms of general categorisation, the analytical tools will both cover descriptive and inferential statistical analysis.

4.2. The Variables

To achieve the objectives of this research, it is necessary to conduct an appropriate analysis of the factors that are relevant to the problem of rural labour allocation. Consequently, it is a pre-requisite in this study to provide the appropriate qualitative or quantitative measures of the attributes both at the individual and community level that affect the choice of rural labour allocation and other relevant issues. In particular, these include the factors that can be categorised as the determinants of rural labour allocation, those that determine the likelihood of individual employment, and those factors that differentiate the workers across the agrarian structure as well as across the types of agricultural employment.

The schematic diagram (Figure 3.9) of the simplified dynamics of the rural economic system can provide an excellent guide to what variables are relevant in rural labour supply analysis. Similarly, the empirical works earlier cited provide some of the specific factors that can be readily employed as relevant factors in the analysis.

The following are the specific qualitative and quantitative variables which will be considered in the analysis of labour utilisation in rural areas in the Philippines:

W - The amount of work that the individual offers measured in terms of the number of days worked in a month;

R_a - The ratio of the value of assets owned and non-work income to the relative poverty threshold;

S - The level of remuneration or wages in Pesos per day;

A_w - Aversion to work measured as the ratio of the time not spent on work to the total in a given time frame, e.g., weekly (where $0 \leq A_w \leq 1$);

Q_w - The quality of work variable which may be measured in terms of a proxy variable that considers the effects of the level of education (expressed as the total number of years spent in school);

F_r - Dependency ratio is a measure of the household pressure to work in relation to the household consumption demand. This is represented by the ratio of the number of workers in the household to the total family size;

L - The average size (in hectares) of landholdings in the area;

F_z - The size of the landholding being operated;

A_n - The estimated labour force in the community (the data generated includes all persons in the community, thus it has to be adjusted to reflect the effective labour force by reflecting the actual age distribution of the sample households) and;

C_l - Land classification is a factor that reflects whether the agricultural land in the area is irrigated or rain-fed.

The variables outlined above are consistent with the framework of analysis outlined in Figure 3.9 as these reflect the attributes of the individuals as well as those of the community. In particular, the level of work and wage rate, the ratio of the value of assets and non-work income to the absolute poverty threshold, the aversion to work, the level of education and the ratio of the number of workers to the total household size, are variables pertaining to the attributes of the individual. The average size of landholdings in the area, the effective labour force, and the classification of the lands are attributes of the community. In terms of their corresponding symbols, this variable grouping can be summarised as in Table 4.1.

Table 4.1. List of variables with notations and characteristics.

Variables	Notation	Attributed to:	Type
Level of Work	W	Individual	Quantitative
Asset-Income Ratio	R_a	Individual	Quantitative
Wage Rate	S	Individual	Quantitative
Aversion to Work	A_w	Individual	Quantitative
Quality of Work	Q_w	Individual	Quantitative
Dependency Ratio	F_r	Individual	Quantitative
Average Farm Size	L	Community	Quantitative
Farm Size	F_z	Individual	Quantitative
Labour Force	A_p	Community	Quantitative
Land Classification	C_l	Community	Qualitative

4.3. Hypotheses

The central argument of this thesis pertains to the choice of the level of work and wage rate. These choices however, will have to be made within the bounds of the attributes of the individual as well as the attributes of the community. Thus, in the search for work, the individual, given his attributes, will have a notion as to how long he will work and how high or low is the level of acceptable wage rate. The preceding argument implies the simultaneity of the following variables: work (W), wages (S), the ratio of the value of assets and non-work income to the absolute poverty threshold (R_a), and aversion to work (A_w). Consequently, in the analysis of rural labour allocation in the Philippines, such a simultaneous relationship must be taken into proper consideration. Therefore, the hypotheses have to be set up based on the suggested simultaneous relationships of some of the variables.

At this point, it is sufficient to simply outline the relationship among the identified variables. First, it is argued here that the amount of work (W) is determined by the endogenous variable S. It is expected that the level of work is inversely related to the level of wage rate. The level of work is also determined by a set of exogenous variables including the ratio of the number of workers to the total household size, land classification and effective labour force. Functionally, this relationship can be expressed as:

$$W = f(S,F_r,A_n,C_l), \tag{4.1}$$

where it is expected that

$$\frac{\partial W}{\partial S}, \frac{\partial W}{\partial F_r}, \frac{\partial W}{\partial A_n}, \quad < \quad 0.$$

Second, the level of wage rate is endogenously determined with the level of work. Further, wage rate is influenced by some independent variables including, the ratio of the number of workers to the total household size, the level of education, and the effective labour force. This relationship can be formally presented as:

$$S = f(W,F_r,Q_w,A_n), \tag{4.2}$$

where,

$$\frac{\partial S}{\partial W}, \frac{\partial S}{\partial A_n} \quad < \quad 0,$$

and

$$\frac{\partial S}{\partial Q_w}, \frac{\partial S}{\partial F_r} \quad > \quad 0.$$

Third, the ratio of the value of assets and non-work income to the absolute poverty threshold is likewise simultaneously determined with the level of wage rate. In addition, this dependent variable is a function of the following independent variables: the level of education, the ratio of the number of workers to the total family size, and farm size. Formally, this functional relationship can be expressed as:

$$R_a = f(S, F_r, Q_w, F_z), \qquad (4.3)$$

where,

$$\frac{\partial R_a}{\partial S}, \frac{\partial R_a}{\partial F_r}, \frac{\partial R_a}{\partial Q_w}, \frac{\partial R_a}{\partial F_z} \quad > \quad 0.$$

Finally, work aversion is perceived to be simultaneously determined with the ratio of the value of assets and non-work income to the absolute poverty threshold. Further, aversion to work is independently influenced by the level of education and the ratio of the number of workers to the total household size. Functionally, this relationship can be expressed as:

$$A_w = f(R_a, F_r, Q_w), \qquad (4.4)$$

where,

$$\frac{\partial A_w}{\partial R_a}, \frac{\partial A_w}{\partial F_r}, \frac{\partial A_w}{\partial Q_w}, \quad > \quad 0.$$

What has been outlined above is the analysis of the determinants of labour allocation in the rural areas in the Philippines which implies the set of hypothesis concerning the estimation of the labour supply function.

There are at least two other critical relationships that this research need to address. One, whether or not the labour supply function across the agrarian structure and cropping pattern are significantly different from each other. The other is the effect of individual and community attributes on the employment status of an individual.

To establish further these hypotheses, it is necessary to provide arguments on a more specific context. For instance, in an underdeveloped country like the Philippines, agriculture plays a major role in rural economic life. This implies that the main productive resource is the land. Agricultural land distribution is so skewed that roughly 30 percent of the landowning class controls about 70 percent of the total landholdings (NCSO, 1990). Among those who are directly dependent on the land, the tenurial status which determines access to the use of land for productive purposes is the primary factor in rural economic decisions and economic behaviour.

While the tenurial systems have a wide range, for the purpose of the arguments in these research, it may be sufficient to broadly classify the tenurial systems into four: landowner-operators, leaseholders, shareholders, and landless workers.

In particular, it is hypothesised that individuals within the higher levels of the tenurial structure will tend to have a higher level of asset accumulation, hence, a higher level of aversion to work. Therefore, the individual will be more discriminating in so far as wage rate is concerned, and it is expected that the labour supply curve will be steeper - along the wage-work plane as in Figure 3.7 - relative to those who are at the lower end of the tenurial structure.

Similarly, it is argued that the labour supply function across the cropping pattern will also have some distinctive variation owing to the fact that particular crops have their own peculiar culture and labour requirements. For instance, coconut farm workers may have different working behaviour considering the fact that coconut is commonly referred to as the *lazy man's crop* relative to other labour intensive crops like rice.

As far as the likelihood of unemployment is concerned, it is expected that the more positive the attributes of the individual and the community are, e.g., higher level of education, smaller labour force and larger average landholdings, the lower is the likelihood of underemployment or unemployment.

4.4. Analytical Tools

The objectives outlined in this research, as reinforced by the established hypotheses, provide the structure of the analytical techniques that can be appropriately used. Generally, the analytical tools can be categorised into two broad categories: descriptive and inferential statistical analysis.

Descriptive statistical analysis can be readily employed to address the objectives of establishing the socio-economic profile of the rural workers in the Philippines, the variety of the type of rural workers and to assess the general level of labour utilisation in the rural areas. In particular, measures of central tendencies may be used for the purpose. Further, measures of dispersion, such as standard deviations and distributions, can also be used to address the same concerns.

The problem of making inferences on the determinants of the labour supply in the Philippine rural areas may be a little bit complex owing to the suggested simultaneous relationships among some of the variables in the system. For such a system of simultaneous equations, a limited information estimation procedure may not be appropriate due to the possible effects of the covariations among the variables (Greene, 1991). Hence, a full information or system estimation procedure will have to be developed. In particular, the three-stage-least square (3SLS) procedure can be employed to compute for the estimators of the parameters in the structural equations.

To assess the degree of likelihood of employment by an individual given his socio-economic attributes as well as the community, a categorical or discrete dependent variable model can be developed. Technically, a maximum likelihood procedure may be employed to estimate the parameters of a logistic probability distribution (logit) model.

The test for structural changes can be readily employed to address the problem of determining the variations in the labour supply function across the agrarian structure and the types of agricultural employment. To achieve this objective, the Chow's test can be utilised. Further, the dummy variable approach can also be employed to complement the Chow's test.

4.5. The Models

The conceptual framework outlined earlier has been centred on four factors, namely: the level of work (W), the level of wage rate (S), the ratio of the value of assets and non-work income to the absolute poverty threshold (R_a) and the ratio of the non-working hours to the total number of hours representing the aversion to work (A_w). These however, do not diminish the significance of the other factors identified to be relevant in the analysis of rural labour supply allocation. It is important to note though, at this point, that some of the other variables are by nature qualitative and can only be incorporated in the analysis as dummy variables. Table 4.1 summarises the list of variables including the corresponding notations, the reference to either the individual or the community and the type of variable.

4.5.1. The Labour Supply Function

It has been one of the main arguments in this research that the level of work, the level of wage rate, the ratio of the value of assets and non-work income to the absolute poverty threshold and the aversion to work are simultaneously determined. Consequently, the ordinary least square (OLS) technique to estimate the parameters may not be applied. Using the OLS technique will result in biased and inconsistent estimates of the parameters (Greene, 1991). Hence, it is necessary to develop the labour supply model into a system of simultaneous equations. The suggested simultaneous relationships among the level of work, wage rate, the ratio of asset income to the absolute poverty threshold and work aversion can best be depicted in a non-linear functional relation, e.g., quadratic. However, this type of non-linearity is only with respect to the variables and not to the parameters. One may not need to resort to complex non-linear analytical tools because non-linearity in the variables can be readily transformed to linear relations for the purpose of the estimation procedure.

The following are the regression models developed to estimate the population parameters. For purposes of illustration, a strictly linear relationship between the dependent and independent variables is considered. However, it must be noted that the actual functional relationship may be appropriately depicted in inherently linear functions.

$$A. = \alpha_\Theta + \alpha_\theta R_\gamma + \alpha_I F. + \alpha_\iota Q. + \epsilon_\Theta \qquad (4.5)$$

$$R_\gamma = \beta_\Theta + \beta_\theta S + \beta_I F. + \beta_\iota Q. + \beta_K F. + \epsilon_\theta \qquad (4.6)$$

$$W = \theta_\Theta + \theta_\theta S + \theta_I A_\varphi + \theta_\iota F. + \theta_K C_\varsigma + + \epsilon_I \qquad (4.7)$$

$$S = \phi_\Theta + \phi_\theta W + \phi_I Q. + \phi_\iota A_\varphi + \phi_K F. + \epsilon_\iota \qquad (4.8)$$

where α_i, β_i, Θ_i, and ϕ_i are the parameters and ϵ_i are the random error terms.

The structural equations outlined above contain four endogenous variables W, R_a, S, A_w and five exogenous variable Q_w, F_r, F_z, A_n and C_l.

One of the basic concerns in the estimation of the parameters in a simultaneous system of equations is identification. This is of critical significance because the status of the identification of an equation determines whether or not the parameters can be actually uniquely estimated (Chow, 1983). As Dhrymes (1980) noted, unless certain *rank* and *order* conditions are satisfied, the parameters of the structural equations could not be defined. Based on the identification procedure (Appendix B), the structural equations satisfy the rank and order conditions.

4.5.2. The Two-Stage Least Square (2SLS)

After having satisfied the identification problem of the structural equations, the next step is to outline the procedure for the actual estimation of the parameters. The labour supply model developed earlier is composed of four structural equations. Three of the four equations are over identified and one is exactly identified. In cases such as this, standard econometric procedures (Annex c) will suggest that the appropriate estimation technique is the two-stage-least-square (2SLS).

4.5.3. The Three-Stage-Least Square (3SLS)

The 2SLS procedure which is basically an application of OLS in two stages yields estimators which are unbiased and consistent. However, because 2SLS is based on a limited information technique, the parameter estimates are less efficient relative to a full information or system method of estimation (Greene, 1991).

One of the analytical techniques that is based on the system method of estimation which would come naturally after a 2SLS procedure is the three-stage-least square (3SLS). As described by Chow, the 3SLS procedure simply adds one more step to the 2SLS in estimating simultaneously the coefficients of the structural equations.

Intuitively, as Greene (p. 633) outlined, the 3SLS technique involves the following steps:

1. Determine the 2SLS estimators δ_j from each equation and compute for the covariance using

$$\hat{\sigma}_{\varkappa\varpi} = \frac{(y_{\varkappa}-Z_{\varkappa}\hat{\delta}_{\varkappa})'\,(y_{\varpi}-Z_{\varpi}\hat{\delta}_{\varpi})}{T}$$

   y - is an M x 1 vector of the dependent variables

   Z - is an M x k matrix of the independent variables in the system

2. Apply a generalised least square (GLS) by transforming the variables including Y_{ϖ} estimated from the first stage of the 2SLS using the computed covariance $\hat{\sigma}_{\varepsilon}$

Hence, for the labour supply estimation, the three-stage least square technique will have to be used in order to overcome some of the limitations of the OLS and 2SLS in a system of simultaneous equations.

4.5.4. Test for Structural Changes

One of the main hypothesis forwarded in this research is that the labour allocation behaviour across the agrarian structure has significant variations. This argument has critical significance particularly in the context of rural development policies. In the past, policies pertaining to rural labour has failed to consider the heterogeneity of the rural agricultural labour. A classic example of such policies is the minimum agricultural wage rate. This legislated wage rate is set to cover all agricultural workers. As mentioned earlier, it is common knowledge that this legislated minimum agricultural wage is virtually not implemented in the actual practice. The inefficacy of said policy is indicative of the failure to tailor policies to specific clientele. The rural labour sector covers so wide a range that policies will be rendered ineffective if such range is not appropriately considered. For the specific problem of rural labour allocation, the heterogeneity of the rural agricultural labour can be critically assessed via the agrarian structure and the type of agricultural employment. This implies the analysis of rural labour allocation across the landholding scale, organisation of agricultural production, and tenurial structure as well as across the various types of agricultural employment. The specific hypothesis forwarded here is that across the agrarian structure and agricultural employment, the labour allocation behaviour significantly differs.

The Dummy Variable approach can be readily employed to test the differences in the labour supply function across various qualitative attributes. The advantage of the Dummy Variable approach relative to some other test for structural changes like the Chow's Test is that using dummy variable the differences can be easily isolated whether it is due to intercept differential or slope differential. Suppose, for purposes of illustration, we wanted to test the difference in farm work behaviour between landless workers vis-a-vis those who have more secure access to land. The test can be done by representing a tenure dummy variable T where T is equal to zero if the worker is landless, otherwise, T=0. Then equation can be expressed as:

$$S = \phi_{\Theta} + \phi_{\theta} T + \phi_{I} T(W) + \phi_{\iota} W + \phi_{K} Q_{\cdot} + \phi_{\kappa} A_{\varphi} + \phi_{\Lambda} F_{\prime} + \epsilon_{\dot{x}}$$

Therefore, if T=0, the labour supply function reverts back to the original form of the equation. Otherwise, if T=1 then,

$$S = (\phi_{\Theta}+\phi_{\theta})+(\phi_{I}+\phi_{\iota})W+\phi_{K}Q_{\cdot}+\phi_{\kappa}A_{\varphi}+\phi_{\Lambda}F_{\prime}+\epsilon_{\chi}$$

Apparently, whether the effect is in the intercept or in the slope can be easily determined. If $\phi 2$ is statistically significant, then there is an intercept differential and if $\phi 3$ is significant then there is a slope differential or both if $\phi 2$ and $\phi 3$ are statistically significant.

4.5.5. The Logit Models

Attempts to determine the critical factors that influence the choice concerning rural labour allocation will have profound implications toward programs, strategies and policies for rural development particularly in the context of a less developed country like the Philippines.

Equally important among the concerns of labour utilisation in particular, and rural development in general, is the issue of determining the likelihood that an individual may be able to access gainful employment given his own attributes as well as the community. In this regard, the determinants of labour allocation can also be explored to establish the likelihood that an individual can be gainfully employed.

Conceptually, access to gainful employment can be viewed as a function of some individual attributes as well as community attributes, such as the wage rate, the ratio of the value of assets and non-work income to the absolute poverty threshold, the level of education, the revenue classification of the community, etc. This problem can be translated into estimating the likelihood of being employed or unemployed. A problem such as this can readily be classified into what has been referred to in econometrics as qualitative response (QR) models (Amimiya, 1981).

At this point, it is mathematically convenient to define a dichotomous variable *M*, which takes on values 0 and 1: 0 if unemployed and 1 if employed. It is however worth noting that the choice of values 0 and 1 for the binary variable *M* is arbitrary. The choice of 0 and 1 is especially convenient although, according to Amimiya, any two real numbers may be used.

In actual terms, the model relates the probability of the event that M takes on the value 0 or 1 as a function of the individual and community attributes. The earlier forms of qualitative response models frequently used were the linear probability models (LPM). These models however, have serious limitations. From a more technical perspective, in actual practice, the probability estimates in an LPM could possibly lie outside the admissible 0 to 1 range (Amimiya, 1991). Further, in the context of the employment problem, the LPM implies that the likelihood of gaining access to employment is a linear function of the independent variables. For instance, the likelihood of gaining employment in an LPM model is expected to increase at a constant rate as the level of education increases. A better hypothesis is to expect that the likelihood of gaining employment increases at an increasing rate as the level of education also increases. This implies a non-linear relationship. Conversely, the probability of employment decreases at an increasing rate as the level of education declines. In general terms, it should be expected that the changes in gaining access to employment is not constant with respect to the changes in the level of education. Such a model is based on the argument that the likelihood of gaining employment approaches 1 at a slower rate as the level of education gets extremely high. Conversely, the likelihood or the probability of employment approaches 0 at a slower rate as the level of education gets extremely low.

The models that exhibit the above behaviour resembles the cumulative density function (CDF) of a stochastic variable. The most often used CDF models are the logistic probability distribution (logit) models and the normal probability distribution (probit) models. Between the logit and probit models, Maddala (1983) noted that the logit and probit models are so close to each other that it is less likely to get different results. Further, Gujarati (1988) concluded that: "*...the chief difference being that the logistic model has slightly flatter tails...Therefore, the choice between the two is one of (mathematical) convenience and ready* *availability of computer programs*". Based on the preceding assertions, the logit model will be employed to analyse the likelihood of an individual's access to gainful employment in relation to his attributes as well as the attributes of the community.

For purposes of notation, let M be the dichotomous dependent variable taking on the value 1 if employed or 0 if unemployed and let P_i be the probability of being employed. Then the probability of being employed can be expressed as (Pindyck and Rubinfeld, 1981):

$$P_x = E(M=1|X_x) = \left(\frac{1}{1+e^{-P_i}} \right), \tag{4.9}$$

Where, e is the natural logarithm, and:

$$C_i = \alpha_1 + \alpha_2 R_a + \alpha_3 Q_w + \alpha_4 F_r + \alpha_5 L + \alpha_6 A_n + \alpha_7 Z_1 + \alpha_8 Z_2 + \alpha_9 T_1 + \alpha_{10} T_2 + \alpha_{11} T_3. \tag{4.10}$$

By formulation, $-\infty \leq C_i \leq \infty$, $0 \leq L_i \leq 1$, and the likelihood of employment is not a linear function of the attributes.

However, there is a major limitation in equation (4.9) in so far as the OLS technique is concerned. The probability of being employed (L_i) is not linear in the explanatory variables and to the parameters. This problem can be readily resolved by intuitive mathematical manipulation.

From equation (4.9), the likelihood of employment is given as

$$P_x = \frac{1}{1 + e^{-P_i}} \tag{4.11}$$

Therefore, the likelihood of unemployment is simply $(1 - L_i)$. Hence

$$1 - P_x = 1 - \frac{1}{1+e^{-P_i}} \tag{4.12}$$

and

$$1 - P_i = \frac{1}{1 + e^{C_i}} \tag{4.13}$$

Dividing (4.9) by (4.13) yields:

$$\frac{P_i}{1 - P_i} = \frac{1}{1 + e^{-C_o}} \div \frac{1}{1 + e^{C_i}}. \tag{4.14}$$

Then

$$\left(\frac{P_i}{1 - P_i}\right) = \frac{1 + e^{C_i}}{1 + e^{-C_i}} = e^{C_i}. \tag{4.15}$$

Equation (4.15) is simply the likelihood ratio in favour of employment. The natural logarithm of equation (4.14) yields,

$$R_i = \ln\left(\frac{P_i}{1 - P_i}\right) = C_i. \tag{4.16}$$

Where R_i is the natural logarithm of the likelihood ratio, that is, the ratio of the odds of obtaining employment as against the odds of unemployment. Then from 4.10,

$$R_1 = \ln\left(\frac{P_i}{1-P_i}\right) = \alpha_1 + \alpha_2 R_a + \alpha_3 Q_w + \alpha_4 F_r + \alpha_5 L + \alpha_6 A_n + \alpha_7 C_l + \alpha_8 Z_1 + \alpha_9 Z_2 + \alpha_{10} T_1 + \alpha_{11} T_2 + \alpha_{12} T_3. \tag{4.17}$$

Finally, equation 4.17 provides an interesting result. R_i is linear in both the explanatory variables and the parameter. For purposes of estimation, 4.17 can be expressed as:

$$R_i = \alpha_1 + \alpha_2 R_a + \alpha_3 Q_w + \alpha_4 F_r + \alpha_5 L + \alpha_6 A_n + \alpha_7 C_l + \alpha_8 Z_1 + \alpha_9 Z_2 + \alpha_{10} T1 + \alpha_{11} T_2 + \alpha_{12} T_3 + \epsilon_i. \quad (4.18)$$

However, for a model such as in equation 4.18, Gujarati noted that the random error term follows the normal distribution with zero mean but the variance is non-homoscedastic, that is,

$$\epsilon_i \sim N\left[0, \frac{1}{N_i P_i (1 - P_i)}\right] \quad (4.19)$$

Apparently the variance of ϵ_i is not constant. The variance changes with the changes in N. Hence, OLS may not be applied because of the consequence of heteroscedasticity.

To avoid this problem, the weighted least square (WLS) technique can be applied. For the specific problem of estimating the above equation the weight factor g_i can be used (Gujarati). This weight factor is expressed as:

$$g_i = \sqrt{N_i \hat{P}_i (1 - \hat{P}_i)},$$

where,

$$\hat{P}_i = \frac{n_i}{N_i}.$$

N_i represents the total number of respondents falling into the value X_i among which n_i respondents are employed.

Using the weight factor g_i, equation 4.18 can be transformed as:

$$g_i R_i = \alpha_1 g_i + \alpha_2 g_i R_a + \alpha_3 g_i Q_w + \alpha_4 g_i F_r + \alpha_5 g_i L + \alpha_6 g_i A_n + \alpha_7 g_i C_l + \alpha_8 g_i Z_1 + \alpha_9 g_i Z2 + \alpha_{10} g_i T_1 + \alpha_{11} g_i T_2 + \alpha_{12} g_i T_3 + \epsilon_i g_i \quad (4.20)$$

Then

$$R_{\varkappa}^{*} = \alpha_{\Theta}g_{\varkappa}+\alpha_{\theta}S^{*}+\alpha_{I}R_{\gamma}^{*}+\alpha_{\iota}Q_{;}^{*}+\alpha_{K}F_{;}^{*}+\alpha_{\kappa}L^{*}+\alpha_{\Lambda}N^{*}+$$
$$\alpha_{\lambda}R_{\bar{\gamma}}^{*}+\alpha_{M}D_{;}^{*}+\alpha_{\Theta\eta}I^{*}+\alpha_{\Theta\Theta}C_{s}^{*}+\alpha_{\Theta\theta}Z^{*}+\alpha_{\Theta I}T^{*}+\epsilon_{\varkappa}^{*} \tag{4.21}$$

Where the symbol "*" represents the original value weighted by g_i.

The ordinary least square technique can now be employed to estimate the parameters. Provided that the sample size will be sufficiently large, the estimates will be unbiased and efficient.

4.6. The Data Set

The data set utilised in this research is part of the Benchmark Survey for the Comprehensive Agrarian Reform Program (CARP) of the Philippines conducted in 1990 by the Institute of Agrarian Studies, University of the Philippines at Los Baños. The survey targeted 10,000 respondents from 400 *Barangays* in 43 Provinces across 13 Regions. The actual survey, however, covered only about 8,900 respondents from 341 *Barangays*. The shortfall was attributed to the socio-political instability of the countryside. During the conduct of the survey, the New Peoples Army (NPA), the armed faction of the Communist Party of the Philippines, had exercised control over some of the *Barangays*. For the case of the areas under the influence of or controlled by the NPA, the military establishment advised the researchers not to cover the areas for the survey.

For the purpose of analysis, the data set has been packed to trim off missing observations of relevant variables. Hence, for the descriptive statistics, the data set has been reduced to about 7900 respondents. However, for each individual variable considered in the inferential statistical analysis, the actual sample size depends on the number of respondents with valid responses. For the case of the labour supply and the logit models, the data set is restricted to those who have actually worked with the corresponding quantified level of wage rate. The level of work covers only the quantity of farm work but can be further classified with respect to supplemental income derived from either off-farm or non-farm work.

4.7. The Socio-economic Profile of Rural Workers

4.7.1. Demography

In the Philippine Rural areas, the household head is predominantly male (96%). In terms of civil status, married respondents comprised about 90 percent and about 6 percent consisted of widows/widower. Being a predominantly Roman Catholic nation has contributed a lot to the structure of the civil status of rural households. From both spiritual and legal standpoints, divorce is not allowed in the country. Also, couples living together without the benefit of either a church or civil law marriage faces a strong social sanction. Hence, majority of the households are married and stay married in order to avoid both legal and social sanctions.

Characterised by the median, the age of the husband, wife and children are 46 (Table 4.2), 44 (Table 4.3), and 5 (Table 4.4) years respectively. It is interesting to note the significant differences in the age structure of the household members in the context of the ecological zone which is indicative of the geographic distribution of the farming settlements. For instance, the F-ratio of the ANOVA for the mean age by ecological zone for husbands, wives and children are 21.1, 18.0, and 2.4, respectively (Appendix D). The age structure of either the household head, the spouse or the children is slightly higher in the coastal and lowland areas relative to the upland areas. This could be possibly explained by the geographic nature of the country being archipelagic. The country is made of thousands of islands (about 7,100), hence, settlements would naturally start from the coastal areas of the islands. As the population pressure relative to the land area increases, settlements move inland to the lowlands and eventually into the uplands. Moving to the uplands would mean settlement to the marginal lands at the forest frontiers. This involves accepting an element of uncertainty and risk. In cases such as these, considering other elements to be similar, younger and less

Table 4.2. Descriptive statistics on husband's age by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	46.7	46	13.0	46.3	45	13.1	45.9	45	12.9	47.0	47	13.2
CAR	43.9	44	10.6	42.1	39.5	13.2	-	-	-	43.3	43	11.5
I	48.2	48	13.3	48.5	47	13.1	-	-	-	48.3	47	13.2
II	45.1	44	12.8	-	-	-	-	-	-	45.1	44	12.8
III	49.5	50	13.1	5.8	51	14.9	49.0	49	10.7	49.8	50	13.5
SL	48.0	48	14.0	47.3	47	14.2	47.4	48	14.2	48.2	48	14.4
IV	47.0	47	14.6	46.1	47	13.6	48.5	50	14.9	47.1	47	12.8
V	50.1	49	13.0	49.0	47	12.8	49.6	50	12.3	49.8	49	13.5
VS	47.8	48	13.5	48.3	48	13.2	48.3	48	13.3	47.7	48	13.1
VI	48.6	48	13.1	44.3	45	12.5	48.2	49	13.4	47.6	48	13.3
VII	50.0	50	13.0	47.8	48	13.2	53.4	55	14.1	50.3	50	13.8
VIII	46.1	45	14.0	43.8	43.5	12.0	48.0	49	13.6	46.6	46	12.9
MN	44.3	43	13.0	43.9	42	13.1	44.7	44	13.1	43.8	42	13.5
IX	44.4	43	13.2	43.4	40	13.8	45.9	45	14.1	44.3	43	13.0
X	42.4	40	13.2	42.3	40.5	12.2	50.3	50	14.8	43.2	41	12.9
XI	46.5	47	13.1	47.0	45.5	11.2	44.3	42.5	13.8	46.0	45.5	12.1
XII	43.0	42	12.0	39.1	38	11.7	45.1	44	12.4	42.0	40	13.8
Total	47.0	47	13.4	45.0	44	13.3	48.0	48	13.8	46.7	46	13.4

Notes:

μ - Mean
δ - Median
σ - Standard Deviation

NL - Northern Luzon
SL - Southern Luzon
VS - Visayas

MN - Mindanao
CAR - Cordillera Autonomous Region

Table 4.3. Descriptive statistics on wife's age by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	46.7	44	17.1	46.0	43	17.0	45.5	43	16.8	47.0	44	17.3
CAR	43.6	40	16.1	40.6	39	17.2	-	-	-	42.6	40	16.5
I	48.7	45	17.8	46.5	44	14.9	-	-	-	48.1	45	17.0
II	44.6	42	16.5	-	-	-	-	-	-	44.6	42	16.5
III	50.9	48	17.5	51.1	48.5	18.7	53.2	42	19.4	51.0	48	17.8
SL	48.6	46	18.1	48.3	45	18.6	48.6	46	18.7	48.7	46	17.9
IV	48.5	45	19.1	46.4	43	17.9	50.6	49	19.4	48.3	45	18.9
V	49.1	47	16.1	48.0	44	16.9	50.5	47.5	17.7	49.2	46	16.6
VS	48.2	45	17.9	49.3	46	18.2	49.2	46	18.2	48.0	45	17.8
VI	49.9	46	18.8	45.6	41.5	18.9	48.1	45	17.7	49.0	46	18.7
VII	49.6	48	16.2	51.3	47	21.8	53.6	53	16.4	50.6	49	17.3
VIII	44.6	42.5	16.1	41.3	39	11.6	47.9	46	17.4	45.4	43	16.4
MN	44.5	40	17.8	44.3	40	18.1	45.2	41	18.2	43.9	40	17.8
IX	45.5	41	18.2	44.4	39.5	19.3	45.5	43	17.1	45.1	40	18.4
X	44.3	37	19.7	42.0	38	17.7	49.0	48	20.8	43.5	38	18.7
XI	49.3	46.5	19.5	43.6	42	12.3	44.8	40	18.0	46.6	43	17.7
XII	41.4	38	15.6	38.4	35	16.4	44.7	41	18.0	40.9	38	16.4
Total	47.3	45	17.6	44.7	41	17.8	48.4	46	18.1	46.9	44	17.8

Notes:
μ - Mean
δ - Median
σ - Standard Deviation

NL - Northern Luzon
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Table 4.4. Descriptive statistics on children's mean age by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	6.7	5.5	5.4	6.3	5	5.1	6.2	5.0	5.0	6.7	5.5	5.5
CAR	7.6	7	5.4	6.2	4	6.0	-	-	-	7.2	6	5.6
I	6.6	5.5	5.2	6.1	4.5	5.0	-	-	-	6.5	5.5	5.2
II	5.8	5	4.7	-	-	-	-	-	-	5.8	5	4.7
III	8.3	7	6.4	6.9	5.5	6.3	10.0	12.5	6.4	8.0	6.5	6.4
SL	6.6	5.5	5.5	6.3	5	5.5	6.4	5.5	5.5	6.7	5.5	5.5
IV	5.9	5.0	5.3	6.6	5.5	5.5	6.3	4.5	5.8	6.2	5	5.5
V	7.4	6.0	5.4	7.0	5.5	5.8	7.7	6.5	5.3	7.4	6	5.4
VS	6.2	5.0	5.5	6.7	5.5	5.7	6.5	5	5.6	6.1	5	5.3
VI	6.7	5.5	5.6	6.5	6	5.3	7.1	6	5.7	6.8	5.5	5.6
VII	7.0	5.5	5.9	5.9	4.5	6.1	6.9	5	7.1	6.8	5	6.2
VIII	4.7	3.5	4.2	3.4	3	2.7	5.1	4	4.4	4.8	4	4.2
MN	6.1	5	5.0	5.9	5	5.0	6.0	5	5.0	6.1	5	5.1
IX	6.3	5	5.3	5.8	4.5	5.2	7.3	5.5	6.5	6.3	5	5.5
X	5.6	4	4.8	5.4	4.5	4.5	5.1	3.5	5.4	5.4	4.5	4.7
XI	6.2	5.5	4.8	6.4	5.5	4.4	5.3	4.5	4.3	6.0	5.5	4.6
XII	6.9	6	5.2	5.3	4	4.8	7.0	6	5.7	6.3	5.5	5.2
Total	6.4	5	5.3	6.1	5	5.3	6.4	5	5.5	6.3	5	5.3

Notes:

μ - Mean
δ - Median
σ - Standard Deviation

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established households would have the higher tendency of moving to the uplands.

In terms of age distribution, the society is characterised by a relatively younger population. For the husbands, the modal age is about the 45 to 50 years while that of the wives is between 35 to 40 years. Children are still mostly dependents. The modal age at 12 to 15 year-old range is much younger than the legally defined minor age of 18 years old.

The pattern of household size (Table 4.5) ranges from as low as 4.8 in the upland areas of Region VII to 6.5 in the upland areas of Region III. On the average, the overall household size is about 5.7. However, it may be more appropriate to describe the central tendency in terms of the median owing to the nature of the variable being discreet. Across Regions, the median household size is 6, equivalent to the national average as per 1990 National Census of Statistics (NCSO, 1990). This considerably large household size has been one of the major concerns of development planners in the country on top of the concerns on very high population growth rate. The country's population is growing at 2.3 percent (NCSO, 1990), one of the highest in Asia. While high population growth rate is a common characteristic of less developed countries, the religious context for the Philippine case could not be overemphasised. Again, owing to its predominantly Roman Catholic religion, population policies and control programs, such as family planning and the use of contraceptives, despite the official endorsement, have not been very effective because of the opposition of the church to such measures.

Tables 4.6 and 4.7 show the pattern of educational attainment across respondents and Regions and ecological zone. A cursory scan at the statistics shows may not reveal an obvious pattern of variation across ecological zones and across regions. However, a formal analysis of variance (ANOVA) to test the differences in the mean level of education indicates statistically significant differences. For instance, an ANOVA of the mean educational level of husbands and wives across regions yields an F-ratio of 6.61 and 4.16, respectively, both highly significant (Appendix A). Across respondents, it is interesting to note that the average educational attainment of spouses is consistently higher than those of

Table 4.5. Descriptive statistics on household size by ecological zones by egion, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	5.8	6	2.2	6.1	6	2.3	6.1	6	2.2	5.8	6	2.2
CAR	5.7	6	2.5	6.0	6	2.7	-	-	-	5.7	6	2.4
I	5.6	6	2.3	5.4	5	2.3	-	-	-	5.6	6	2.3
II	5.6	5	2.0	-	-	-	-	-	-	5.6	5	2.0
III	6.2	6	2.4	6.5	6	2.4	5.4	6	1.8	6.3	6	2.4
SL	5.9	6	2.4	6.1	6	2.3	5.9	6	2.4	5.7	6	2.4
IV	5.5	5	2.4	5.7	6	2.2	5.3	5	2.3	5.5	5	2.3
V	5.9	6	2.5	6.1	6	2.5	6.4	6	2.6	6.1	6	2.5
VS	5.7	5	2.4	5.9	6	2.5	5.8	6	2.4	5.6	5	2.4
VI	5.8	6	2.4	6.4	6	2.5	6.2	6	2.6	6.0	6	2.4
VII	5.7	5	2.2	5.5	5	2.6	5.3	5	2.6	5.6	5	2.4
VIII	5.1	5	2.2	4.8	4	2.5	5.0	5	2.2	5.0	5	2.2
MN	5.8	6	2.4	5.8	6	2.4	5.6	6	2.2	5.8	6	2.4
IX	5.9	6	2.6	6.1	6	2.6	5.7	6	2.3	6.0	6	2.5
X	5.9	6	2.4	6.0	6	2.4	5.8	6	1.9	5.9	6	2.3
XI	5.3	5	2.2	6.1	6	2.3	5.4	5	2.4	5.5	5	2.3
XII	6.1	6	2.4	5.7	5	2.5	6.3	6	2.7	6.0	6	2.5
TOT	5.7	6	2.3	5.9	6	2.4	5.6	5	2.5	5.7	6	2.4

Notes:

μ - Mean
δ - Median
σ - Standard Deviation

NL - Northern Luzon
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CAR - Cordillera Autonomous Region

Table 4.6. Descriptive statistics on husband's education by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	6.7	6	3.3	6.7	6	3.3	6.7	6	3.4	6.6	6	3.3
CAR	6.6	6	3.9	5.9	6	4.4	-	-	-	6.3	6	4.1
I	7.0	6	3.1	7.0	6	3.0	-	-	-	7.0	6	3.1
II	6.6	6	3.3	-	-	-	-	-	-	6.6	6	3.3
III	6.6	6	3.9	6.3	6	3.2	6.4	6	3.1	6.5	6	3.3
SL	5.9	6	2.2	5.9	6	2.9	6.0	6	2.7	5.9	6	2.9
IV	6.0	6	3.7	5.8	6	2.9	5.9	6	2.8	5.9	6	2.9
V	5.9	6	2.8	6.0	6	2.7	6.2	6	2.9	6.0	6	2.8
VS	5.5	6	3.1	5.6	6	3.2	5.5	6	3.2	5.4	6	3.0
VI	6.0	6	3.4	4.6	5	2.7	5.5	6	3.0	5.7	6	3.3
VII	5.7	6	3.0	4.6	4	2.5	5.8	6	3.1	5.5	6	2.9
VIII	5.1	5	2.6	4.4	4	2.7	4.5	5	2.7	4.9	5	2.6
MN	5.5	6	3.3	5.4	6	3.2	5.5	6	3.2	5.6	6	3.3
IX	5.1	5	3.6	4.5	4	3.3	4.8	5	3.1	4.9	5	3.4
X	5.1	5.5	2.4	5.0	5	2.9	6.4	5	4.5	5.2	5	3.0
XI	6.3	6	2.7	6.0	6	2.8	5.9	6	3.2	6.1	6	2.9
XII	6.0	6	3.8	5.6	6	3.2	6.3	6	3.8	5.9	6	3.6
TOT	6.0	6	3.2	5.5	6	3.1	5.6	6	3.1	5.8	6	3.2

Notes:
μ - Mean
δ - Median
σ - Standard Deviation

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Table 4.7. Descriptive statistics on wife's education by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	6.2	6	3.7	6.2	6	3.6	6.2	6	3.6	6.2	6	3.7
CAR	7.6	6	3.5	6.7	6	2.8	-	-	-	7.3	6	3.6
I	7.2	6	2.8	7.1	6	3.0	-	-	-	7.2	6	2.9
II	7.0	6	2.9	-	-	-	-	-	-	7.0	6	2.9
III	7.0	6	3.1	6.8	6	3.0	6.8	6	3.5	6.9	6	3.2
SL	6.1	6	2.8	6.1	6	2.8	6.1	6	2.8	6.2	6	2.8
IV	6.1	6	2.8	6.2	6	2.9	5.9	6	2.8	6.1	6	2.9
V	6.2	6	2.6	6.3	6	2.8	6.3	6	2.6	6.3	6	2.6
VS	6.1	6	2.9	6.2	6	3.0	6.1	6	3.1	6.0	6	2.9
VI	6.7	6	3.2	5.3	6	2.7	6.3	6	3.0	6.5	6	3.2
VII	5.9	6	2.8	5.1	5	2.2	5.9	6	2.6	5.7	6	2.7
VIII	5.8	6	2.6	4.7	5	2.2	4.9	5	2.8	5.5	6	2.7
MN	5.8	6	3.3	5.8	6	3.2	5.8	6	3.2	5.8	6	3.3
IX	5.2	6	3.4	4.6	5	3.0	5.1	6	3.5	5.0	6	3.3
X	5.7	6	3.2	5.7	6	3.0	7.3	6	4.1	5.9	6	3.2
XI	7.0	6	2.7	6.0	6	2.9	6.3	6	2.9	6.5	6	2.9
XII	6.1	6	3.8	5.8	6	3.1	5.6	6	3.9	5.9	6	3.6
TOT	6.4	6	3.1	5.8	6	3.0	5.8	6	3.1	6.2	6	3.1

Notes:

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the husbands irrespective of the Region and ecological zone. This is important because it is indicative of the presence of equal opportunities for educational advancement for men and women in society. The lower average for men can be attributed to the fact that in the rural areas of the Philippines, sons are often viewed as additional hands or a potential source of additional income. Hence, young men are often drawn away from school to the farms to contribute to the family income either by choice or by the parents decision.

Dependency ratio is expressed as the quotient between the number of income earners in the family over the total number of members in the household. Table 4.8 indicates considerable variations across ecological zones and regions. The estimates indicate significant F-ratios for an ANOVA test of F_r by ecological zones and regions. By region, the F-ratio is 32.6 and by ecological zone, the F-ratio is 4.52. Both ratios are highly significant. This is expected considering that F_r is simply derived from the household size. The average dependency ratio of about 0.3 implies that given an average household size of 6, the average number of income earners would be 2 members.

4.7.2. Employment and Income

The overall average employment is about 12 days per month (Table 4.9) but, across ecological zones and regions, variations in the average employment is statistically significant. For both ecological zones and regions, the F-ratios are 4.39 and 189.3 respectively. However, the median employment is lower at ten days per month. This indicates that the median would be a better descriptive measure of employment pattern. Across regions the highest level of employment is in Region VII at 20 days. The lowest median employment of about 6 days characterises those respondents from Region XII. These extreme observations need to be qualified. On the one hand, while the level of employment in Region XII is very low, it does not necessarily mean that the people in the said region are worse off. Region XII is predominantly inhabited by Filipino Muslims. Generally, Muslims are better traders than they are farmers, hence, the very low level of farm work may be traded off with non-farm work. On the other hand, the

Table 4.8. Descriptive statistics on the ratio of income earners to household members by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	.29	.25	.19	.28	.22	.18	.27	.20	.17	.29	.25	.20
CAR	.26	.23	.17	.30	.20	.23	-	-	-	.28	.20	.19
I	.31	.25	.19	.30	.25	.16	-	-	-	.31	.25	.18
II	.25	.20	.15	-	-	-	-	-	-	.25	.20	.15
III	.36	.28	.24	.35	.29	.23	.40	.25	.33	.35	.29	.24
SL	.32	.25	.21	.33	.25	.21	.32	.25	.21	.31	.25	.21
IV	.33	.25	.22	.34	.29	.21	.34	.29	.21	.34	.27	.21
V	.29	.20	.21	.24	.17	.18	.22	.17	.18	.27	.20	.20
VS	.33	.25	.23	.34	.25	.24	.35	.25	.24	.34	.25	.23
VI	.35	.25	.24	.27	.20	.22	.33	.25	.24	.33	.25	.24
VII	.29	.25	.20	.32	.25	.20	.31	.25	.20	.30	.25	.20
VIII	.36	.33	.22	.40	.33	.25	.41	.33	.26	.37	.33	.24
MN	.27	.20	.19	.27	.20	.19	.27	.20	.19	.26	.20	.18
IX	.25	.20	.18	.22	.17	.14	.25	.20	.18	.24	.20	.17
X	.32	.25	.23	.33	.25	.23	.32	.27	.20	.32	.25	.23
XI	.29	.25	.18	.25	.20	.15	.30	.22	.22	.28	.23	.19
XII	.22	.20	.15	.25	.20	.17	.20	.20	.13	.23	.20	.15
TOT	.31	.25	.21	.22	.22	.20	.32	.25	.23	.30	.25	.21

Notes:

μ - Mean
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Table 4.9. Descriptive statistics on employment (days per month) by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	11.1	10	6.0	10.7	10	6.0	10.8	10	6.1	10.9	10	5.9
CAR	11.6	11	5.8	13.5	14.5	5.9	-	-	-	12.3	12	5.9
I	10.4	6.5	8.8	11.8	7	9.5	-	-	-	10.7	7	8.9
II	10.5	10	4.8	-	-	-	-	-	-	10.5	10	4.8
III	11.8	10	5.6	9.5	10	4.5	8.6	10	4.3	11.2	10	5.4
SL	14.1	14	6.9	14.2	14	6.8	14.1	14	6.9	14.1	14	7..0
IV	14.6	15	6.8	13.4	13	6.9	14.3	14	6.4	14.2	14	6.7
V	14.0	13	7.3	14.3	13	7.2	13.4	13	7.9	13.9	13	7.4
VS	12.1	11	8.1	11.9	10	8.3	12.1	11	8.2	12.4	11	8.0
VI	10.4	8	7.6	8.8	6	7.1	9.2	7	7.8	10.0	8	7.6
VII	19.2	20	6.9	19.1	21	7.0	19.6	22	6.7	19.2	20	6.9
VIII	13.1	12	7.5	14.7	13.5	7.3	14.0	14	7.0	13.5	12	7.3
MN	12.9	12	8.2	13.4	12	8.1	14.2	13	7.9	11.5	10	8.3
IX	15.1	16	8.4	15.5	15	7.9	18.4	20	6.1	15.7	16	8.0
X	13.5	13	7.0	12.2	12	6.5	13.0	13	6.3	12.6	12	6.6
XI	16.0	16	7.7	18.0	18	7.1	17.3	17	7.2	16.0	16	7.7
XII	8.5	6	5.7	8.8	6	6.3	8.3	6	5.9	8.5	6	5..9
TOT	13.8	11	8.8	12.9	10	7.7	13.2	13	7.8	12.2	10	7.5

Notes:

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very high level of employment for the respondents from Region VII does not imply that they are better off. This region was the entry point of the Spaniards on their effort to colonize the Philippine islands, consequently, the feudalistic system of landholdings still predominate the region. Most rural farm workers are employed as sugar *haciendas* (plantations) where they are paid very low wage rates. Anecdotal evidence suggested that in the mid 1980s, the sugar plantation workers in the region were paid as low as 30 pesos a day or roughly 1.5 Australian dollar.

The average annual income is about 25 thousand pesos (Table 4.10). An ANOVA to test the differences in mean income across ecological zones and regions shows that the differences are highly significant. By ecological zone and region, the F-ratios are 7.9 and 11.8, respectively. The mean income however, may not be a good reflection of the income distribution of rural workers. In most cases, the median income is lower than the mean. This pattern is indicative of inequality in income distribution. Therefore, it would be more meaningful to describe the income pattern in terms of the median. By region, the lowest median income (from 12.3 to 12.7) are exhibited in Regions IX and VII. This income range is less than half the highest income exhibited in Region III. Across ecological zones, while the variations are not as pronounced, it is interesting to note some semblance of a general pattern. The average lowland income is generally higher than both upland and coastal income. This pattern could be attributed to the way in which the pattern of economic progress has evolved. Early settlements usually are established in the fertile lowland areas. Hence, it is within these established lowlands where investments in land development and infrastructure are high. In contrast, upland settlements are relatively new and are often established in the marginal forest frontiers. Similarly, coastal settlements are usually situated in inaccessible mangroves where most communities rely heavily on subsistence catch fishery.

It is also interesting to note the levels of income relative to the regions with extremely low level of employment. Region XII which exhibited the lowest level of employment is actually ranked second highest in terms of the average level of

Table 4.10. Descriptive statistics on total farm income (000 pesos) by ecological zones by region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	28.0	26.0	25.6	20.8	23.8	25.0	24.9	23.1	24.5	23.7	27.0	25.8
CAR	28.7	23.0	22.9	22.6	18.4	17.8	-	-	-	23.0	28.2	22.6
I	25.5	16.5	23.9	21.8	14.0	21.6	-	-	-	24.5	16.0	23.4
II	28.5	23.7	21.0	-	-	-	-	-	-	28.5	23.7	21.0
III	48.5	46.2	25.1	41.7	42.9	27.7	24.0	14.5	7.2	46.5	45.8	26.0
SL	25.9	18.5	22.2	27.2	19.6	22.4	27.3	20.0	23.3	25.2	17.9	21.9
IV	28.3	21.8	22.2	27.5	19.0	22.8	28.3	20.0	23.0	28.1	20.5	22.5
V	20.8	14.5	20.5	19.1	10.7	19.5	21.2	16.2	19.1	20.6	14.1	20.7
VS	20.9	14.9	18.9	21.3	15.0	19.4	20.6	14.3	18.9	20.3	14.4	18.4
VI	25.6	19.3	21.0	16.5	10.8	16.6	26.0	19.7	20.7	25.1	18.3	20.7
VII	17.7	14.0	14.5	16.1	10.3	15.8	15.6	12.0	14.1	17.0	12.7	14.7
VIII	20.2	15.0	16.9	19.7	16.7	13.8	16.2	12.3	14.0	19.0	14.0	16.0
MN	25.2	18.2	21.2	23.7	17.2	19.9	23.4	16.8	20.0	25.9	19.0	21.4
IX	19.7	13.5	18.9	15.8	9.8	14.2	18.4	14.1	15.3	18.2	12.3	16.9
X	19.4	12.9	18.4	18.4	13.2	16.1	15.2	13.3	12.6	18.4	13.2	16.5
XI	35.7	30.3	21.4	30.8	26.0	22.0	22.7	17.1	19.3	30.7	24.6	21.6
XII	36.1	28.2	24.7	29.4	22.1	20.8	30.7	20.8	24.6	32.8	26.1	23.5
TOT	27.2	19.8	22.8	23.1	15.8	21.0	21.8	15.3	19.6	25.4	18.0	22.0

Notes:

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σ - Standard Deviation

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income. In contrast, Region VII which exhibited the highest level of employment, ranks second to the lowest.

Mean income, when taken into the context as an economic indicator, should be treated with caution because the issue of income distribution have to be taken into account. The average income is meaningless when the actual distribution indicated that roughly 55 percent (Table 4.11) of the income earners fall under the 20-thousand peso bracket. A closer look through the Lorenz Curve (Figure 4.1) reveals a distribution so skewed that roughly 70 percent of the income earners accounts only for about 30 percent of the total income earned. In a more quantitative measure, this distribution translates into a Gini Coefficient (Naygard and Sandstom, 1981) of about 0.46.

To put this coefficient in proper perspective, one has to refer back to the Lorenz Curve. The 45-degree line indicates perfect equality. The curve represents the loci of the percentage of income to the corresponding percentage of income earners. The Gini coefficient is simply the ratio of the area under the perfect equality line and above the Lorenz Curve to the total area under the 45-degree line. Therefore, at perfect equality, the Gini coefficient is 0. Conversely, at perfect inequality, the gini coefficient is 1.

4.7.3. Farming Profile

The average farm size of the rural farm workers is about 2.1 hectares (Table 4.12). This is not surprising considering the pressure that the Philippine population has forced upon the land resource of the country. The country as an archipelago, has about 30 million hectares of land, 63 percent of which is arable (NCSO, 1990). The 1980 Census of Agriculture has estimated that the total farm area is roughly 9.7 million hectares. Further, of the estimated 60.5 million, about 35 million are living in the rural area (NCSO). This puts great pressure on the 9.7 million farm lands, hence, it is not surprising to see the diminution in per capita size of landholding.

In most cases, the median size of landholdings is lower than the mean. This pattern could be attributed to the uneven distribution of land. Therefore, it is

Table 4.11. Total farm income distribution in rural Philippines, 1990.

INCOME	COASTAL		LOWLAND		UPLAND		TOTAL	
	f	%	f	%	f	%	f	%
< 5000	197	15.73	552	12.29	283	17.23	1032	13.99
5000 < 10000	234	19.40	644	14.37	307	18.69	1185	16.06
10000 < 15000	204	16.29	617	13.73	221	13.45	1042	14.12
15000 < 20000	150	11.98	493	10.97	159	9.68	802	10.87
20000 < 25000	96	7.66	381	8.48	142	8.64	619	8.39
25000 < 30000	74	5.91	286	6.36	96	5.84	456	6.18
30000 < 35000	67	5.35	256	5.70	80	4.87	403	5.46
35000 < 40000	38	3.03	211	4.69	55	3.34	304	4.12
40000 < 45000	39	.11	185	4.11	48	2.92	272	3.68
45000 < 50000	19	1.51	150	3.34	54	3.28	223	3.02
50000 < 55000	27	2.15	120	2.67	37	2.25	184	2.49
55000 < 60000	22	1.75	98	2.18	37	2.25	157	2.12
60000 < 65000	10	0.79	97	2.15	28	1.70	135	1.83
65000 < 70000	15	1.19	77	1.71	20	1.21	112	1.51
70000 < 75000	13	1.03	75	1.67	19	1.15	107	1.45
75000 < 80000	10	0.79	62	1.38	12	0.73	84	1.13
> = 80000	28	2.23	187	4.16	44	267	259	3.51
Total	1252	100	4491	100	1642	100	7376	100

Note: f - frequency

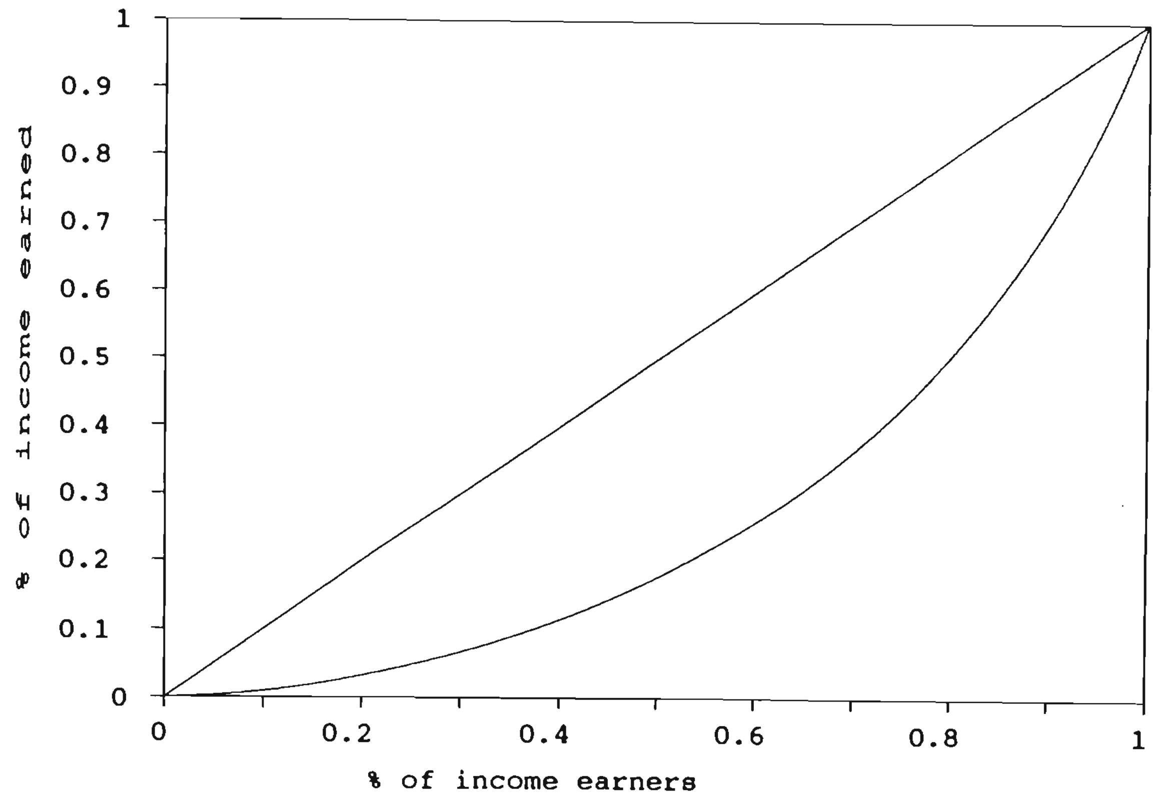

Figure 4.1. Income distribution in rural Philippines, 1990.

Table 4.12. Descriptive statistics of farm size (in hectares) by region and ecological zone in rural Philippines, 1990.

Reg.	Ecological Zones																			
	Lowland					Upland					Coastal					Total				
	μ	δ	σ	Min	Max	μ	δ	σ	Min	Max	μ	δ	σ	Min	Max	μ	δ	σ	Min	Max
NL	1.7	1.5	1.5	.02	15.1	1.6	1.2	1.3	.01	15.1	1.5	1.2	1.3	.02	15.0	1.8	1.5	1.5	.01	15.1
CAR	1.3	1.0	1.1	.25	8.5	.8	.6	.5	.12	3.0	-	-	-	-	-	1.2	1.0	1.0	.12	8.5
I	1.1	.9	1.0	.10	7.0	1.6	1.3	1.0	.25	6.0	-	-	-	-	-	1.2	1.0	1.0	.10	7.0
II	1.8	1.5	1.5	.02	15.1	-	-	-	-	-	-	-	-	-	-	1.8	1.5	1.5	.02	15.1
III	2.5	2.0	1.7	.18	10.0	2.1	2.0	1.5	.01	7.5	2.8	2.5	1.4	.75	6.0	2.4	2.0	1.7	.01	10.0
SL	2.5	1.5	2.8	.03	39.5	2.7	2.0	3.0	.03	39.5	2.7	2.0	2.9	.03	39.5	2.5	1.5	2.8	.03	39.5
IV	2.6	2.0	2.3	.20	16.0	2.8	2.0	3.7	.03	39.5	2.9	2.0	2.9	.25	23.0	2.7	2.0	2.9	.03	39.5
V	2.0	1.0	2.5	.10	20.0	2.6	1.3	3.8	.25	32.0	2.5	2.0	2.3	.25	11.5	2.2	1.2	2.7	.10	32.0
VS	1.6	1.0	1.8	.02	24.0	1.3	1.0	1.4	.02	24.0	1.4	1.0	1.7	.02	26.7	1.6	1.0	1.9	.02	26.7
VI	1.4	1.0	1.7	.02	24.0	1.4	1.0	1.1	.04	9.0	1.4	1.2	1.1	.05	8.0	1.4	1.0	1.6	.02	24.0
VII	1.1	.7	1.3	.02	14.0	1.0	.8	.9	.02	7.4	.9	.5	.99	.04	7.0	1.0	.75	1.1	.02	14.0
VIII	2.2	1.5	2.3	.13	20.0	2.0	1.8	1.5	.35	8.0	2.2	1.5	2.7	.10	26.7	2.2	1.5	2.4	.10	26.7
MN	2.7	2.0	3.2	.16	57.0	2.7	2.0	3.5	.16	57.0	2.8	2.0	3.9	.16	57.0	2.8	2.0	3.6	.16	57.0
IX	2.6	2.0	2.3	.20	18.0	3.4	2.0	3.5	.25	21.5	4.6	2.0	9.1	.16	57.0	3.2	2.0	4.6	.16	57.0
X	1.6	1.4	1.1	.25	6.0	2.6	2.0	2.3	.25	14.0	2.2	1.5	2.8	.20	15.5	2.3	1.7	2.1	.20	15.5
XI	1.7	1.5	1.4	.25	12.6	2.5	2.0	1.9	.25	10.0	3.6	2.0	5.7	.25	54.0	2.5	1.7	3.4	.25	54.0
XII	2.8	2.0	2.8	.27	30.0	2.9	2.0	2.4	.50	17.0	4.6	2.5	6.4	.75	42.0	3.1	2.0	3.6	.25	42.0
TOT	1.9	1.5	2.0	.02	57.0	2.3	1.7	2.6	.10	39.5	2.7	1.7	4.3	.40	57.0	2.1	1.5	2.6	.10	57.0

Notes:

μ - Mean
δ - Median
σ - Standard Deviation
Min - minimum

NL - Northern Luzon
SL - Southern Luzon
VS - Visayas
Max - maximum

MN - Mindanao
CAR - Cordillera Autonomous Region

more appropriate to describe the pattern of land distribution in terms of the median.

Across regions and ecological zones, the variations in the average farm size are quite pronounced as indicated by F-ratios from an ANOVA test of 32.04 and 44.58 for ecological zones and regions respectively. In terms of the median, the lowest is about 0.5 hectares in Region VII and the highest is roughly 2.5 from Regions III and IX. For the rest of the regions, the mean farm size cluster about the overall median of 1.5 hectares. It is also interesting to note the range of the sizes of landholdings. Overall, the minimum size is about 1/10 of a hectare to a maximum of about 57 hectares.

The median farm size of 1.5 hectares is made worse by the actual distribution of farm holdings. Table 4.13 indicates that about 50 percent of the respondents operate less than 1.5 hectares of land. Further, the Lorenz Curve (Figure 4.2) indicates that about 70 percent of the landholders accounts only for about 30 percent of the total land area. This skewed distribution translates to a Gini Coefficient of about 0.47.

In the 1960s, favourable government policies paved the way for the establishment of multinational agribusiness ventures which introduced the production of non traditional crops like banana, pineapple, palm kernel and rubber trees, among others. However, this has been limited to a few plantation type holdings concentrated mainly in the typhoon-free lands of southern Mindanao. Hence, the areas planted by most of the respondents are still devoted to the production of traditional crops, such as rice, corn, and coconut. The survey has indicated that these traditional crops account for about 70 percent of the crop planted: 40 percent for rice, 18 percent for corn, and 12 percent for coconut, respectively (Table 4.14). The remainder is distributed across a variety of crops including cacao, banana, coffee and sugar. Since the country is very small and comprised of thousands of islands, most of the traditional crops can be planted anywhere. Hence, the pattern of crop production is similar across regions dominated by the most traditional, and therefore, most familiar crops.

Table 4.13. Farm size distribution (in hectares) by ecological zones, Philippines, 1990.

AREA	COASTAL		LOWLAND		UPLAND		TOTAL	
	f	%	f	%	f	%	f	%
< .5	248	19.06	639	13.26	158	9.19	1045	13.19
.5 < 1.0	146	11.22	876	18.18	252	14.66	1274	16.08
1.0 < 1.5	215	16.52	1048	21.76	358	20.83	1621	20.46
1.5 < 2.0	141	10.83	573	11.89	171	9.95	885	11.17
2.0 < 2.5	168	12.91	553	11.48	248	14.43	969	12.23
2.5 < 3.0	50	3.84	244	5.06	84	4.88	378	4.77
3.0 < 3.5	92	7.07	310	6.43	140	8.14	542	6.84
3.5 < 4.0	27	2.07	115	2.38	41	2.38	183	2.31
4.0 < 4.5	45	3.45	126	2.61	77	4.48	248	3.13
4.5 < 5.0	18	1.38	60	1024	12	0.69	90	1.13
5.0 < 5.5	32	2.45	103	2.13	48	2.79	183	2.31
5.5 < 6.0	3	0.23	35	0.72	10	0.58	48	0.60
6.0 < 6.5	29	2.22	66	1.37	35	2.03	130	1.64
6.5 < 7.0	3	0.23	10	0.20	4	0.23	17	0.21
7.0 < 7.5	14	1.07	27	0.56	14	0.81	55	0.69
7.5 < 8.0	4	0.30	10	0.20	6	0.34	20	0.25
> = 8	66	5.07	105	2.18	60	3.49	231	2.91
Total	1301	100	4816	100	1718	100	7919	100

Notes: f - frequency

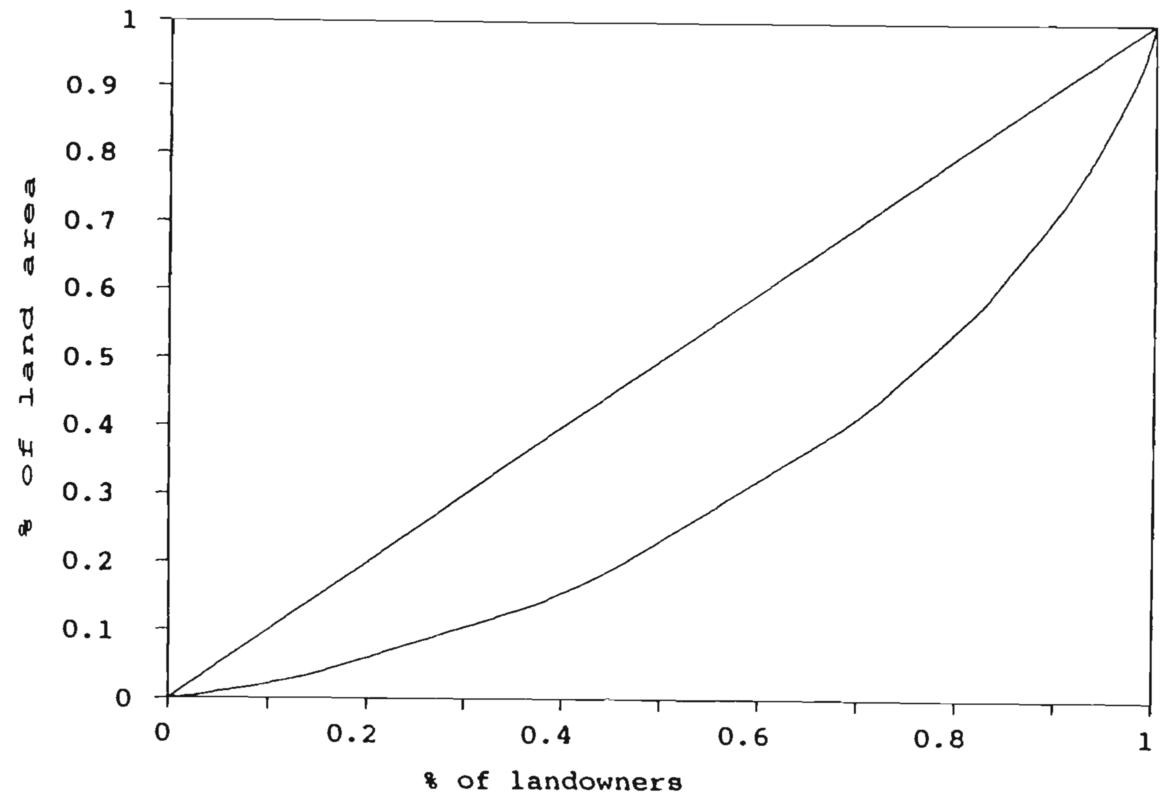

Figure 4.2. Land distribution in rural Philippines, 1990.

Table 4.14. Type of crops planted by farmers by region, Philippines, 1990.

Region	Rice		Corn		Coco		Banana		Coff		Sugar	
	f	%	f	%	f	%	f	%	f	%	f	%
NL	1453	28.33	203	26.00	-	-	7	1.33	9	2.39	77	35.00
CAR	134	2.61	33	4.21	-	-	3	0.57	9	2.12	-	-
I	378	7.37	25	3.19	-	-	-	-	-	-	5	2.27
II	565	11.02	108	13.81	-	-	-	-	-	-	-	-
III	376	7.33	37	4.73	-	-	4	0.76	-	-	72	32.72
SL	990	19.3	146	18.66	193	23.19	156	29.65	72	17.01	23	11.47
IV	565	11.02	80	10.23	142	17.06	48	9.12	58	13.71	23	10.45
V	425	8.28	66	8.43	51	6.12	108	20.53	14	3.30	-	-
VS	1786	35.99	246	31.45	271	32.60	225	42.77	32	7.56	78	35.45
VI	1014	20.94	70	8.95	7	0.84	38	7.22	20	4.72	60	27.27
VII	298	5.81	88	11.25	19	2.28	76	14.44	9	2.12	-	-
VIII	474	9.24	88	11.25	245	29.44	111	21.10	3	0.70	18	8.18
MN	898	16.38	187	23.89	368	44.21	138	26.25	309	73.04	40	18.18
IX	185	3.60	51	6.52	95	11.41	14	2.66	152	35.93	12	5.45
X	89	1.73	33	4.21	25	3.00	55	10.45	108	25.53	28	12.72
XI	253	4.93	31	3.96	121	14.54	61	11.59	13	3.07	-	-
XII	371	2.23	72	9.20	127	15.26	8	1.52	36	8.51	-	-
Total	5127	100	782	100	832	100	526	100	423	100	220	100

Note: f - frequency

In order to establish the tenurial profile into its proper perspective, it is necessary to characterise some of the tenurial classifications that may be peculiar to the Philippine setting. In the past, the Philippine government encouraged people to cultivate alienable and disposable lands of the public domain. People were allowed to occupy public lands and lay their claim by evidence of cultivation. To date, those claimants who are unable to have their claims titled are categorised as claimant cultivators. Those claimant cultivators who have allowed third parties to the use rights of their claims are classified as claimant non-cultivators.

Because of too much population pressure, people are forced to occupy and cultivate marginal lands under the public domain which are considered in-alienable. To respond to the needs of these people, the government has launched a program called Integrated Social Forestry (ISF). Those who qualify under this program are provided a certificate aptly named Integrated Social Forestry Certificate (ISFC). Finally, in the early 1970s, the government instituted a land reform program that covered tenanted rice and corn lands. The beneficiaries of the program who are still paying for the amortisation of the awarded lands are classified as amortising owner.

The tenurial pattern of rural Philippines is primarily characterised by three major tenurial forms (Table 4.15), namely: owner cultivatorship (29%), shareholder (23%), and leaseholder (18%). Across ecological zones, a similar pattern is indicated where owner cultivatorship, shareholder and leaseholder are the predominant forms of tenure. However, it is worth noting that the claimant cultivatorship and ISFC are higher in the upland zones. This is expected because both the alienable lands of the public domain offered for cultivatorship and the lands under the ISF would most likely be within an upland zone.

The more interesting statistic is the prevalence of sharehold tenurial arrangements. By law, as embodied in the previous agrarian reform program, sharehold is supposed to have been abolished. The rationale for the abolition of

Table 4.15. Distribution of farmers by tenure and ecological zone, Philippines, 1990.

TENURE	COASTAL		LOWLAND		UPLAND		TOTAL	
	f	%	f	%	f	%	f	%
Claimant Cult.	56	4.30	260	5.60	252	17.18	568	7.72
Claimant non Cult.	-	-	6	0.12	10	0.68	16	0.21
Shareholder	423	32.51	1018	21.93	288	19.64	1729	23.52
Leaseholder	146	11.22	1050	22.62	124	8.45	1320	17.95
Hired worker	142	10.91	281	6.05	85	5.79	508	6.91
ISFC holder	2	0.15	23	0.49	64	4.36	89	1.21
Amortizing owner	33	2.53	333	7.17	31	2.11	397	5.40
Owner cultivator	356	27.36	1240	26.72	564	3.84	2160	29.38
Owner non Cult.	14	1.07	39	0.84	13	0.88	66	0.89
Squatter	3	0.23	20	0.43	14	0.95	37	0.50
Free user	24	1.84	53	1.14	43	2.93	120	1.63
Mortgagee	4	0.30	24	0.51	6	0.40	34	0.46
Mixed tenure	98	7.53	553	11.91	224	15.27	875	11.90
Total	1301	100	4640	100	1466	100	7351	100

Note: f - frequency

sharehold as a form of tenure and at least be converted to leasehold is that it is perceived to be an arrangement exploitative of the tenants. However, sharehold still persists which imply the inefficacy of the legislation to abolish it.

Across regions, the same forms of tenurial arrangements predominate. However, it is worthy to note some peculiar patterns. Claimant cultivatorship is prevalent in the Cordillera Autonomous Region (Table 4.16). This could be attributed to the fact that the region is basically a mountain range. Another interesting statistic is the concentration of hired workers in Regions IV,V and VI. This does not imply that hiring farm workers is not practised elsewhere. This could be attributed to the proximity of these regions to the commercial centre of the country, hence, the higher degree of commercialisation of farming in the area. Further, the prevalence of ISFC holders in only a few of the regions indicate that the ISF program is not nationwide.

4.7.4. Household Amenities

The type of dwelling also indicates the level of well being of the rural workers. Table 4.17 shows that more than half of the respondents live in a type of dwelling made of light materials like wood, bamboo, *nipa* or *cogon* grass. The positive aspect pertains to the tenure of the house and the home lot. Most of the homes and home lots are owned.

The value of assets is derived from the current nominal value of the household assets ranging from a transistor radio to some motorised vehicle. On the average, the total value of assets owned is roughly 15 thousand pesos (Table 4.18). The range however starts from as low as 6 thousand in Region IX to as high as 42 thousand in Region III. Across regions, there is no distinct pattern as to the mean value of assets. In some regions like Region III, the value of assets owned by coastal respondents is considerably higher than those from the uplands. In some areas as Region XI, the value of assets of upland respondents is higher than those from the coastal areas. However, generally speaking, most of the mean value of assets for coastal respondents are higher than those from the uplands.

Table 4.16. Distribution of farmers and tenure by region, Philippines, 1990.

Tenure	Region																									
	NL								SL				VS						MN								Total	
	CAR		I		II		III		IV		V		VI		VII		VIII		IX		X		XI		XII			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1	83	46	2	.4	5	.7	12	2	16	2	29	4	45	4	57	11	93	9	29	6	32	9	57	12	108	17	568	7
2	1	.5	1	.2	-	-	1	.2	1	.1	5	.7	1	.08	1	.2	-	-	-	-	-	-	-	-	5	.8	16	.2
3	13	7	159	39	100	15	34	7	255	28	97	14	152	12	139	28	354	38	97	19	66	19	127	26	136	22	1729	22
4	8	4	82	20	169	25	198	40	134	15	138	21	304	25	57	11	69	7	43	8	19	5	61	13	38	6	1320	16
5	-	-	-	-	-	-	-	-	146	16	39	6	283	23	-	-	16	2	17	3	6	2	1	.2	-	-	508	6
6	-	-	-	-	-	-	13	3	1	.1	12	2	13	1	1	.2	1	.1	11	2	333	9	4	.8	-	-	89	1
7	-	-	4	.9	142	21	67	13	28	3	30	4	43	3	18	4	19	2	1	.2	6	2	33	7	6	.9	397	5
8	67	37	116	28	144	21	65	13	232	25	177	26	216	18	145	29	256	27	242	47	93	27	157	33	250	40	2160	27
9	2	1	3	.7	-	-	1	.2	8	.8	8	1	2	.1	13	2	3	.3	-	-	2	.6	1	.2	23	4	66	.8
10	-	-	-	-	-	-	-	-	7	.7	-	-	12	.9	13	2	1	.1	2	.3	-	-	1	.2	1	.1	37	.4
11	-	-	1	.2	6	.8	3	.6	5	.5	4	.5	26	2	-	-	13	1	21	4	25	7	8	2	8	1	120	1
12	-	-	-	-	17	2	-	-	3	.3	2	.2	4	.3	-	-	2	.2	3	.5	2	.6	1	.2	-	-	34	.4
13	6	4.5	40	10.6	90	14.5	97	21	82	8.5	126	20.6	109	10.6	46	12.6	113	13.3	43	10	54	18.8	29	5.4	41	8.2	875	13.2
T	180	100	408	100	673	100	491	100	917	100	667	100	1210	100	490	100	940	100	509	100	338	100	480	100	616	100	7919	100

Notes:

f - frequency
1 - claimant cultivator
2 - claimant non-cultivator
3 - shareholder
4 - leaseholder
5 - hired workers
6 - ISFC holder
7 - amortising owner
8 - owner-cultivator
9 - owner-noncultivator
10 - squatter
11 - free user
12 - mortgagee
13 - mixed tenure

Table 4.17. Type of house owned, home ownership and home lot tenure by region, Philippines, 1990.

REGION	TYPE OF HOUSE			HOME OWNERSHIP			HOME LOT OWNERSHIP			
	Concrete	Wooden	Temporary	Own	Rent	Free	Own	Rent	Free	Squatter
NL	363	293	618	1471	8	25	1660	9	74	-
CAR	20	50	36	170	2	1	170	2	5	-
I	76	84	190	382	2	6	382	2	23	-
II	78	95	320	648	2	-	648	2	22	-
III	189	64	72	271	2	18	460	3	24	-
SL	271	385	550	1517	5	57	1491	13	68	1
IV	125	200	360	870	3	39	864	6	41	1
V	146	185	190	647	2	15	627	7	27	-
VS	243	474	1543	2496	18	101	2494	16	115	2
VI	86	143	714	1126	3	70	1149	6	49	1
VII	68	78	275	474	-	16	459	4	23	-
VIII	89	253	554	896	15	29	886	6	43	1
MN	134	523	975	1842	8	74	1830	13	86	2
IX	18	103	327	477	2	16	482	1	25	-
X	4	67	124	313	1	24	319	4	12	-
XI	56	178	163	454	1	25	451	4	20	1
XII	56	175	298	598	4	9	578	4	29	1
TOTAL	1011	1675	3668	7326	39	268	7520	51	393	5

Note: Temporary house is mainly built of light materials like bamboo and grass.

Table 4.18. Descriptive statistics on the value of asset owned (in 000 pesos) by ecological zones and region, Philippines, 1990.

Region	Ecological Zones											
	Lowland			Upland			Coastal			Total		
	μ	δ	σ	μ	δ	σ	μ	δ	σ	μ	δ	σ
NL	25.0	16.9	25.6	20.1	13.2	21.7	19.4	12.4	27.1	27.3	19.8	26.2
CAR	16.2	11.2	16.3	5.6	2.8	5.4	-	-	-	14.1	8.7	15.3
I	23.5	15.9	22.4	15.7	9.1	18.2	-	-	-	21.4	14.3	21.6
II	21.2	14.7	21.1	-	-	-	-	-	-	21.2	14.7	21.1
III	44.6	40.3	29.8	32.2	24.5	27.2	70.5	64.8	44.1	42.2	37.5	30.3
SL	21.0	14.7	19.7	21.1	15.1	19.5	21.3	15.3	19.5	20.1	14.2	19.4
IV	22.7	16.3	19.4	19.8	14.0	18.7	23.0	17.2	21.6	21.9	15.5	19.7
V	18.2	12.5	19.5	14.7	10.4	16.8	16.4	12.6	16.6	17.4	12.0	18.5
VS	15.0	10.5	18.8	13.1	5.3	18.4	12.6	5.4	17.8	12.0	4.8	17.6
VI	16.5	10.5	21.1	9.5	5.8	12.6	15.4	8.5	18.4	16.8	10.9	20.4
VII	12.7	7.3	15.0	9.1	6.9	13.5	13.2	10.9	13.1	12.3	7.1	14.5
VIII	12.8	10.5	17.7	10.8	7.7	16.9	9.6	10.5	11.7	11.8	10.5	16.2
MN	16.3	12.0	17.7	14.7	11.5	15.1	15.7	12.0	16.2	16.1	12.0	17.4
IX	12.9	9.4	14.5	8.8	5.6	9.2	11.4	5.6	14.3	11.2	7.3	12.9
X	11.5	10.4	11.3	13.5	11.1	15.3	12.9	10.9	10.5	12.8	10.9	13.5
XI	20.5	15.5	18.6	20.2	13.7	19.7	14.2	13.3	10.2	18.7	14.3	17.3
XII	20.3	13.0	22.9	11.8	10.5	10.9	21.1	15.5	20.7	17.9	12.0	20.1
TOT	21.1	13.4	22.5	16.3	11.4	10.5	16.6	12.0	18.7	19.4	12.6	21.3

Notes:

μ - Mean
δ - Median
σ - Standard Deviation

NL - Northern Luzon
SL - Southern Luzon

MN - Mindanao
CAR - Cordillera Autonomous Region

The descriptive statistical analyses outlined in this section provide a clear picture of the existing social and economic conditions of rural households in the Philippines. This however only provides indicative relationships among the attributes of the households and their communities. To be able to generate more in-depth inferences on the relationships, it is necessary to estimate the parameters of the models outlined in the analytical tools.

4.8. Chapter Summary

This chapter comprises three distinct components. The first involves the identification of the relevant variables, the second pertains to the specific analytical tools and the third covers the description of the data set as well as the profile of the rural household in the Philippines. The variables identified concern the socio-economic attributes of the individual as well as the community. The analytical tools include some descriptive statistical technique and estimation procedure of models such as the system of simultaneous equations for the labour supply, the test for structural differences using binary variables and the logit model to assess the likelihood of access to gainful employment.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1. Introduction

This section starts with the estimation of the labour supply function both as a linear and quadratic function of the level of wage rate. The parameters of the structural equations were estimated to test the hypotheses based on the bounded rationality framework. Also, test for structural changes were done to establish the significant difference across the agrarian structure and the differences associated with the variation in ecological zones. Finally, the likelihood of access to employment across regions were estimated using the logit procedure.

5.2. The Labour Supply Model

The data set utilised in the parameter estimation of the labour supply models both for the neoclassical and the bounded rationality models, covers the entire Philippine archipelago. However, it is argued here that there is not much point in trying to estimate a single model for the entire country considering the very pronounced socio-economic and socio-cultural diversity across regions. Hence, in an effort to achieve some semblance of homogeneity, the data set and the subsequent analysis are clustered into four major groupings: Northern Luzon which covers the Cordillera Autonomous Region (CAR), Regions 1, 2, and 3; Southern Luzon which covers Regions 4, and 5; Visayas which covers the central Philippine Regions 6, 7, and 8 and Mindanao which covers Regions 9, 10, 11, and 12. Further, the analysis is structured to isolate individuals whose main source of income is farm work from those who have supplemental income from off-farm and/or non-farm work.

5.2.1. The Neoclassical Labour Supply Model

While the basic theoretical arguments of the hypotheses forwarded in these research are anchored on the bounded rationality framework, it is worthy to present an initial verification of the estimates of a model based on the conventional neoclassical economic framework. For this purpose, two distinct functional forms are being explored. One is the conventional linear form which supports the argument that work is a positive function of the wage rate - a strictly upward sloping labour supply curve. The other is a quadratic model which has been commonly used in past empirical work to verify the existence of the backward-sloping labour supply curve.

In these models, the level of work is hypothesised to be a function of the level of wage rate, the dependency ratio, the quality of work, the size of the farm, the labour force and the classification of the land.

Formally, the strictly linear model is expressed as:

$$W_i = f(S_i, F_{ri}, Q_{wi}, F_{zi}, A_{ni}, C_{li}),$$

where, the estimated function is,

$$W_i = \alpha_0 + \alpha_1 S_i + \alpha_2 F_{ri} + \alpha_3 Q_{wi} + \alpha_4 F_{zi} + \alpha_5 A_{ni} + \alpha_6 C_{li} + \epsilon_i.$$

The quadratic model is expressed as:

$$W_i = f(S_i, S^2_i, F_{ri}, Q_{wi}, F_{zi}, A_{ni}, C_{li}),$$

where, the estimated function is,

$$W_i = \alpha_0 + \alpha_1 S_i + \alpha_2 S^2 + \alpha_3 F_{ri} + \alpha_4 Q_{wi} + \alpha_5 F_{zi} + \alpha_6 A_{ni} + \alpha_7 C_{li} + \epsilon_i.$$

However, before any estimation can be done on the parameters of the models, it is a necessary condition to subject the data set into some test for statistical properties. Since the estimation of the labour supply models are based on the least squares technique, then it is appropriate to test whether or not the data set satisfies the basic assumptions of the ordinary least squares (OLS). These will include, among others, the test for multicollinearity and heteroscedasticity.

Also, it will be of great help if the model notation can be defined at this point. The estimates were done for models that refer to regional groupings and to whether or not farm employment is supplemented by off-farm and non-farm work.

The "*o*" refers to the estimates of the labour supply model with supplemental off-farm income, and the subscript "*on*" refers to the labour supply model with supplemental income from off-farm and non-farm work. Specifically:

NL - farm work supply for Northern Luzon;

SL - farm work supply for Southern Luzon;

VS - farmwork supply for Visayas;

MN - farm work supply for Mindanao;

NL_o - farm work supply with off-farm supplement for Northern Luzon;

SL_o - farm work supply with off-farm supplement for Southern Luzon;

VS_o - farm work supply with off-farm supplement for Visayas;

MN_o - farm work supply with off-farm supplement for Mindanao;

NL_{on} - farm work with off-farm and non-farm supplement for Northern Luzon;

SL_{on} - farm work with off-farm and non-farm supplement for Southern Luzon;

VS_{on} - farm work with off and non-farm supplement for Visayas; and

MN_{on} - farm work with off-farm and non-farm supplement for Mindanao.

Starting off with the test for multicollinearity, auxiliary regressions have indicated that across the independent variables included in the model, there is no major problem of multicollinearity. Table 5.1 indicated coefficient of correlations between each independent variable against the others ranging from naught to about fifteen percent. This characteristic is being consistently exhibited across the major source of employment and the four major regional groupings.

For the conventional upward sloping labour supply model, the parameter estimates across models by regions, in so far as the relationship between the level of work and the level of wage rate, have consistently been exhibited as negative and highly significant (Table 5.2). This implies an inverse relationship between the level of wage rate and the level of work. Hence, this empirical result is inconsistent with the proposition that if there is an increase in the level of wage rate, the level of work will also increase.

To cite a specific example, the estimated farm work supply model for Northern Luzon is as follows (NL):

$$W = 18.8 - .05S - .89F_r + .12Q_w + .06F_z - .0084A_n - 1.58C_l.$$

Again, focusing on the relationship between the level of work and the level of wage rate, the coefficient of S plainly implies that for a unit (one peso) increase in the level of wage rate, the level of work declines by about one half of one percent.

This empirical result, supports the argument earlier forwarded that the

Table 5.1. Estimated auxilliary R^2 across regional models by region, Philippines, 1990.

Model	R-squared with respect to all other variables					
	S	F_r	Q_w	F_z	A_n	C_l
NL	.0586	.0128	.0548	.0617	.1015	.1012
SL	.0092	.0270	.0091	.1549	.0117	.1597
VS	.0049	.0098	.0050	.1314	.0096	.1359
MN	.0303	.0119	.0191	.0203	.0325	.0214
NL_o	.0688	.0088	.0707	.0876	.0795	.1321
SL_o	.0234	.0196	.0100	.0292	.0019	.0268
VS_o	.0150	.0157	.0097	.0229	.0081	.0069
MN_o	.0315	.0160	.0232	.0426	.0214	.0183
NL_{on}	.0610	.0032	.0621	.0622	.0540	.0959
SL_{on}	.0156	.0156	.0153	.0275	.0074	.0261
VS_{on}	.0155	.0170	.0098	.0242	.0078	.0067
MN_{on}	.0282	.0152	.0306	.0443	.0234	.0219

Table 5.2. Estimated coeficient of the neoclassical linear labor supply model by region, Philippines, 1990.

Model	Variables							R^2
	S	F_r	Q_w	F_t	A_n	C_l	C_o	
NL	-.05	-.89	.12	.06	-.3E-3	-1.5	18.8	.197
(S.E)	(.005)***	(1.04)	(.04)***	(.13)	(.002)**	(.48)***	(.07)***	
SL	-.09	1.06	-.01	-.06	.6E-3	.028	20.72	.315
(S.E)	(.005)***	(1.11)	(.03)	(.10)	(.004)*	(.31)	(.88)***	
VS	-.10	1.18	.0001	-.09	-.1E-3	.13	20.87	.503
(S.E)	(.004)***	(.71)**	(.01)	(.13)	(.002)	(.22)	(.63)***	
MN	-.09	-3.3	.273	-.03	.4E-4	-.36	22.58	.354
(S.E)	(.007)***	(1.31)***	(.09)***	(.08)	(.003)	(.94)	(2.01)***	
NL_o	-.06	-2.2	.32	.064	-.3E-3	-1.0	18.15	.255
(S.E)	(.006)***	(1.36)**	(.08)***	(.17)	(.003)	(.55)**	(1.35)***	
SL_o	-.07	-.07	-.02	-.17	.7E-3	-.41	21.32	.253
(S.E)	(.008)***	(1.66)	(.04)	(.11)*	(.005)	(.68)	(1.51)***	
VS_o	-.09	1.44	.013	-.12	-.6E-4	.23	19.45	.426
(S.E)	(.005)***	(.96)*	(.02)	(.14)	(.002)	(.46)	(1.06)***	
MN_o	-.103	-3.48	.26	-.06	.3E-3	-.02	22.28	.391
(S.E)	(.008)***	(1.43)***	(.09)***	(.15)	(.0003)	(1.05)	(2.25)***	
NL_{on}	-.069	-2.48	.288	.122	-.3E-3	-1.30	18.70	.264
(S.E)	(.006)***	(1.27)**	(.08)***	(.16)	(.0003)	(.53)***	(1.29)***	
SL_{on}	-.07	.131	-.006	-.005	.001	-.62	21.39	.254
(S.E)	(.007)***	(1.65)	(.02)	(.12)	(.005)**	(.66)	(1.49)	
VS_{on}	-.096	1.52	.011	-.106	-.4E-4	.129	19.28	.409
(S.E)	(.005)***	(.97)**	(.02)	(.14)	(.0002)	(.47)	(1.08)	
MN_{on}	-.109	-3.47	.208	-.061	.6E-4	1.02	21.02	.417
(S.E)	(.008)***	(1.41)***	(.09)**	(.14)	(.0003)	(.98)	(2.10)	

Notes :

(S.E) - Standard Error
*** - significant at 1 %
** - significant at 5 %
* - significant at 10 %

conventional labour supply theory based on the neoclassical economic framework is unable to explain the relationship between work and wage rate for the case of rural agrarian communities in the Philippines.

As argued earlier, a labour supply curve showing an inverse relationship between the level of work and the level of wage rate can not be considered a labour supply curve in the conventional sense. Along a downward sloping labour supply curve, comparative statics will not be very meaningful because of the shaky theoretical foundation. When such a phenomenon has been observed in about the middle part of the 20th century, the conventional wisdom was wrapped around the *target income and limited aspiration hypothesis*. Back then, such argument would have attracted some attention because most were done on some purely subsistence and isolated societies where consumption is basically confined to the requirements for survival.

Hence, it has been widely accepted that in such societies, if wage rate falls, the individual will have to work more in order to maintain the subsistence level of income. Conversely, if the wage rate rises, the individual will have to reduce the level of work to maintain the same level of income because his aspiration is supposed to be limited.

Based on the current economic conditions, the world has drastically changed. No society that is in existence today can be considered isolated from the extended arms of the market institutions. The consumption structure even among those communities that were supposed to be isolated has expanded far beyond the basic needs for subsistence. Consumption has expanded to constitute some forms of amenities. In this context, the comparative statics of a wage rate increase in a downward sloping labour supply curve can no longer be strongly argued on the basis of the *target income and limited aspiration hypothesis*. At a certain wage rate, there corresponds a certain level of work. Suppose the wage rate increases, under the current consumption requirements, it is no longer plausible to argue that work will have to decline. Because of the expanded consumption requirements, even at subsistence level, individuals will have to increase the level of work for any increase in wage rate to achieve a higher level of consumption, if not exhaust the biologically feasible level of work for the given wage rate. Therefore there has to be an alternative theoretical formulation that could explain the existence of a downward sloping labour supply curve.

For the case of the quadratic model which is an attempt to verify the existence of a backward-bending labour supply curve, the parameter estimates have been exhibited as negative for the first degree of the wage rate variable (S) and positive for the second degree wage rate variable (S^2). These statistical attributes have been highly significant and consistent across the regional clusters and across type of employment (Table 5.3). The relationship described above is not a backward-bending labour supply curve. This is similar to that which was exhibited in the study done by Sharif (1990) for the case of Bangladesh. Borrowing from Sharif's words, such a behaviour between the level of work and the level of wage rate is referred to as "forward falling" labour supply curve.

For example, from the function

$$W_i = \alpha_0 + \alpha_1 S_i + \alpha_2 S^2 + \alpha_3 F_{ri} + \alpha_4 Q_{wi} + \alpha_5 F_{zi} + \alpha_6 A_{ni} + \alpha_7 C_{li} + \epsilon_i$$

in the case of farm plus off-farm work for the Southern Luzon, the estimated parameters are (See Table 5.3):

$$W = 27.81 - .21S + .0006S^2 - .63F_r - .02Q_w - .17F_z + .006A_n - .63C_l.$$

Again, giving more emphasis on the work and wage rate relationship, the estimated parameters of the quadratic functional form can be graphically represented as in Figure 5.1. This curve behaves in a manner similar to the estimated function in Sharif (1990) for Bangladesh. Hence, the same criticism applies as has been forwarded earlier. Such a curve may be treated as a supply function based on the framework of the neoclassical economic analysis. However, from a mathematical perspective, such a curve is ambiguous because at some points the correspondence

Table 5.3. Estimated coeficient of the neoclassical quadratic labor supply model by region, Philippines, 1990.

Model	Variables								R^2
	S	S2	Fr	Qw	Fz	An	Cl	Co	
NL	-.27	.9E-3	-1.25	.13	.053	-.3E-3	-1.1	28.56	.287
(S.E)	(.02)***	(.0001)***	(.98)*	(.04)***	(.12)	(.0003)	(.45)***	(1.59)***	
SL	-.27	.8E-3	.82	-.007	-.02	.5E-3	-.11	28.5	.378
(S.E)	(.02)***	(.0001)***	(1.06)	(.03)	(.10)	(.0004)*	(.30)	(1.34)***	
VS	-.19	.3E-3	1.39	-.001	-.06	-.1E-3	.16	24.44	.515
(S.E)	(.02)***	(.0009)***	(.71)**	(.01)	(.13)	(.0002)	(.22)	(1.04)***	
MN	-.25	.7E-3	-3.21	.28	-.02	.1E-3	-.45	28.76	.392
(S.E)	(.03)***	(.0001)***	(1.27)***	(.08)***	(.08)	(.0003)	(.92)	(2.41)***	
NL_o	-.24	.8E-3	-2.74	.33	-.04	-.1E-3	-.69	26.36	.312
(S.E)	(.03)***	(.0001)***	(1.31)**	(.08)***	(.16)	(.0003)	(.53)*	(1.96)***	
SL_o	-.21	.6E-3	-.63	-.01	-.17	.6E-3	-.63	27.81	.294
(S.E)	(.03)***	(.0001)***	(1.63)	(.03)	(.11)*	(.0005)*	(.67)	(2.14)***	
VS_o	-.18	.3E-3	1.81	.01	-.10	-.6E-4	.24	22.99	.439
(S.E)	(.02)***	(.0001)***	(.95)**	(.02)	(.14)	(.002)	(.45)	(1.48)	
MN_o	-.22	.6E-3	-3.32	.27	-.02	.3E-3	-.10	27.13	.416
(S.E)	(.03)***	(.0001)***	(1.41)***	(.09)***	(.15)	(.0003)*	(1.03)	(2.63)***	
NL_{on}	-.26	.9E-3	-3.02	.31	.005	-.2E-3	-.88	27.86	.341
(S.E)	(.03)***	(.0001)***	(1.21)***	(.07)***	(.15)	(.0003)	(.50)**	(1.84)***	
SL_{on}	-.22	.7E-3	-.33	-.005	.003	.9E-3	-.84	28.25	.300
(S.E)	(.03)***	(.0001)***	(1.60)	(.02)	(.11)	(.0005)**	(.64)*	(2.09)***	
VS_{on}	-.15	.2E-3	1.83	.01	-.08	-.4E-4	.15	21.78	.416
(S.E)	(.02)***	(.0001)***	(.97)**	(.02)	(.14)	(.0002)	(.47)	(1.48)***	
MN_{on}	-.22	.0005	-3.32	.21	-.02	.1E-3	.78	25.98	.438
(S.E)	(.03)***	(.0001)***	(1.39)***	(.09)***	(.14)	(.0003)	(.97)	(2.57)***	

Notes : (S.E) - Standard Error
*** - significant at 1 %
** - significant at 5 %
* - significant at 10 %

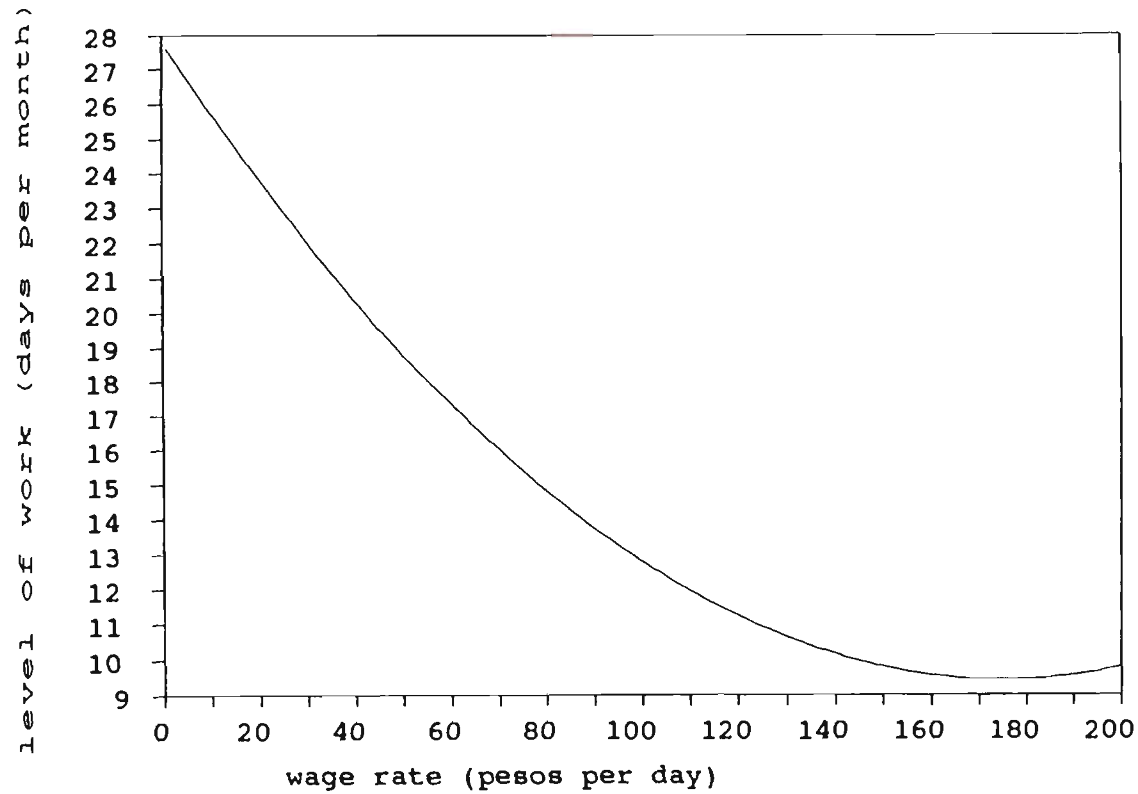

Figure 5.1. Estimated forward-falling labour supply for VSo.

between the work and wage rate coordinates are not unique. After the inflection point on the curve, which in this particular example is around the point where the wage rate is about 183 pesos, there are two solutions to the equation. For every point along the level of work axis beyond $S = 183$, there are two corresponding levels of wage rate.

Further, the criticisms earlier forwarded on the backward-bending labour supply curve of the neoclassical economic framework and of Sharif's "forward falling" labour supply curve, needs to be reiterated here. From a theoretical perspective, the backward-bending labour supply which has been the theoretical basis for a quadratic labour supply model, has a very serious limitation. In order to justify the backward-bending segment of the labour supply curve, it has been argued that the individual has to shift its preference to reduce or maintain the demand for income and increase the demand for leisure. This argument practically violates one of the basic axioms of the indifference curve analysis - the assumption of non-satiation. Geometrically, this implies that a backward-bending labour supply curve can only be derived from an indifference map where at the backward-bending portion, the individual indifference curves will have to intersect.

Furthermore, the estimated coefficients of the variables S and S^2 of the quadratic models implies that the inflection points tend to be situated at the higher end of the wage rate axis. Considering that the level of wage rate is distributed such that only few individuals are able to find employment with wages exceeding 150 pesos (from the sample it is estimated that only six percent of the respondents receive wages greater than 150 pesos), then for all practical purposes, the curve can be considered as a strictly downward sloping labour supply curve.

Both the linear and the quadratic estimation of the labour supply model exhibit an inverse relationship between the level of work and the level of wage rate. Again stressing the earlier argument that in such a relationship the neoclassical model is inadequate in explaining, it is now fitting to explore the alternative model derived from the bounded rationality framework.

5.2.2. Labour Supply in a Bounded Rationality Model

Considering the limitations of the conventional neoclassical framework in the analysis of labour supply, there is the need to explore alternative theoretical foundations. The bounded rationality framework which has been the central argument of this thesis is represented by an econometric model of a system of simultaneous equations relating the value of assets in relation to the absolute poverty threshold, aversion to work and the level of wage rate among others. Formally, the model includes the following structural equations:

Equation 1. $$A_w = \phi_1 + \phi_2 R_a + \phi_3 F_r + \phi_4 Q_w + \epsilon_1$$

Equation 2. $$R_a = \theta_1 + \theta_2 S + \theta_3 F_r + \theta_4 Q_w + \theta_5 F_z$$

Equation 3. $$W = \alpha_1 + \alpha_2 S + \alpha_3 A_n + \alpha_4 F_r + \alpha_5 C_l$$

Equation 4. $$S = \beta_1 + \beta_2 W + \beta_3 Q_w + \beta_4 A_n + \beta_5 F_r$$

However, before any estimation of the structural equations can be done, there is one critical problem that needs to be resolved. Consistently, across all regional groupings and type of employment, the data set shows the fact that the assumption of homoscedasticity is being violated (Table 5.4).

For instance, in the case of the neoclassical supply of farm work for Mindanao, both the Breusch-Pagan-Godfrey (B-P-G) (Breusch and Pagan, 1979) and the Glejser Tests (Glejser, 1969) have shown, based on the Chi-Square distribution that the hypothesis of homoscedasticity must be rejected. The Chi-Square values 41.5 and 42.3 for the B-P-G and Glejser tests, respectively, at 6 degrees of freedom, are well above the rejection region even at 0.05 percent level of significance.

Table 5.4. Test for heteroscedasticity on the linear model.

Models	Chi-Square*	
	B-P-G Test	Glejser Test
	41.8	59.5
SL	75.3	60.1
NL	10.5	54.0
MN	41.4	42.2
NLo	29.2	59.8
SLo	34.4	26.9
VSo	10.4	34.8
MNo	33.0	37.5
NLon	25.5	50.5
SLon	37.3	22.9
VSon	12.6	38.7
MNon	29.4	37.3

This type of statistical attribute renders the parameter estimates based on the ordinary least square technique dubious because the estimates are not the best linear unbiased estimates (BLUE) (Pindyck and Rubenfield, 1980). With the presence of heteroscedasticity, it is no longer possible to rely on the conventional t-test for confidence interval and the F-test for goodness-of-fit because the direction of the biased estimates of the variance of the parameters will actually depend upon how the variance (σ^2_i) is actually related to the observed values (X_i) (Gujarati, 1988).

Conceptually, in the data set used for the analyses, the statistical attribute is not unexpected. The behaviour of the variance of the level of work will have the tendency to be associated with the ratio of the value of asset to the absolute poverty threshold. This behaviour can be perceived as analogous to Valavanis' (1959) *discretionary income.* In this context, it has been argued that the variance of the saving behaviour tend to increase as income rises because individuals have more discretionary choices about savings if income is high. In analysing the level of work in the rural areas of the

Philippines, one may observe the tendency that the higher the value of non-work income, the more discriminating the individual in so far as the level of wage rate is concerned. The higher the ratio of non-work income to the absolute poverty threshold, the lower the amount of work offered and the higher the wage rate required to induce the individual to offer work given the value of non-work income.

Hence, the ordinary least square procedure is not appropriate in estimating the parameters of the function where the level of work is expressed as dependent upon the level of wage rate. It is necessary to incorporate in the analysis some form of remedial measures to avoid the consequences of estimating the parameters with the presence of heteroscedasticity.

In the ordinary least squares, each point receives equal weight in minimising the residual sum of squares (RSS) (Chow, 1983). In the case of heteroscedasticity, the observations with a higher variance will tend to dominate in the process of minimising the RSS. The remedial measure in the presence of heteroscedasticity provides more weight to those observations which have the tendency to cluster closely to their population mean. This procedure is commonly referred to as *the generalised least square* (GLS).

The generalised least square procedure can be formally illustrated using the two-variable model:

$$Y_i = \alpha_1 + \alpha_2 X_i + \mu_i$$

From the OLS procedure, the objective is to minimise

$$\sum \mu_i^2 = \sum (Y_i - \hat{\alpha}_1 - \hat{\alpha}_2 X_i)^2.$$

In the GLS procedure, the objective is to minimise

$$\sum g_i \mu_i^2 = \sum g_i (Y_i - \hat{\alpha}_1 - \hat{\alpha}_2 X_i)^2,$$

where $g_i = 1/\sigma_i^2$.

From the above exposition, it is apparent that the weight assigned to the terms in the equations is inversely proportional to the variance (σ^2). Consequently, the observation coming from a population with a relatively larger variance will have lesser weight. Conversely, observations coming from population with lower variances will have more weight. This procedure will result in a more efficient estimate making the parameters BLUE.

This leaves one more problem: the nature of the variance (σ^2) which serves as the weight. If the variance is known *a priori* then the construction of the weights becomes straight forward. However, in most empirical works, there is no *a priori* information on the variance of the parameters. Hence, there is the need to make some assumptions as to the nature of the relationship between the variance of the error term (μ_i) and the observed values of the explanatory variable (Gujarati) .

In conventional econometric procedure, Gujarati listed the most common assumptions about the variance include the following :

1. $E(\mu_i^2) = \sigma^2 X_i^2$

2. $E(\mu_i^2) = \sigma^2 X_i$

3. $E(\mu_i^2) = \sigma^2 [E(Y_i)]^2.$

The first assumption implies that the variance of μ_i is proportional to the square of the independent variable X. In this case, the model can be transformed by dividing the entire model with X_i. The second assumption indicates that the variance of μ_i is proportional to the actual value of the independent variable X. In this case, the model can be transformed by dividing the entire model with the square root of x_i. The third assumption relates the variance of μ_i to the square of the expected value of Y. In this case, the model is transformed by dividing the model by $[(Y_i)]$. Another common approach to reduce heteroscedasticity is to transform the data set into its logarithm. The logarithmic transformation reduces the scales in which the variables are quantified.

Finally, the estimation of the parameters of the structural equations is done with the Zellner estimation or Iterative Three-Stage Least Squares which follows the *generalised least square* procedure outlined by White, et. al. (1976). This procedure should be sufficient to remedy the problem of heteroscedasticity.

Before any attempts are done to interpret the estimates of the models, it would seem appropriate to reiterate the main argument of this thesis which lead to the construction of the systems of simultaneous equations. Based on the bounded rationality framework an individual who is looking for work, given a certain level of non-work income, will have a notion as to the level of work he is willing to offer and the level of an acceptable wage rate. This implies simultaneous determination of the level of non-work income, the level of wage rate and the level of work. This of course does not diminish the possible effects of other social and economic variables to the choice of the level of work and the level of wage rate. In the model, these include the following: the dependency ratio, the quality of work, farm size, the labour force and the land classification.

The discussion of the parameter estimates of the labour supply model based on the bounded rationality framework is structured in accordance to the presentation of the structural equations.

5.2.2.1. The Work Aversion Function

From equation (1) : $A_w = \phi_1 + \phi_2 R_a + \phi_3 F_r + \phi_4 Q_w + \epsilon_1$

it is hypothesised that,

$$\frac{\partial A_w}{\partial R_a}, \frac{\partial A_w}{\partial F_r}, \frac{\partial A_w}{\partial Q_w} > 0.$$

Tables 5.5 to 5.16 show the estimates of the simultaneous equation model of the labour supply based in bounded rationality. The results indicate that aversion to work (A_w) is directly related to the ratio of the non-work income (R_a). This relationship is exhibited consistently across all models by regional groupings.

Table 5.5. Estimates of farm work supply for Northern Luzon (NL), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.08	.017***						
W							-7.95	1.577***
S			.038	.015***	-.078	.023***		
F_r	.0001	.028	.615	.447*	-1.32	1.145	15.9	8.05**
Q_w	-.001	.0009	.004	.014			.675	.338**
F_z			.020	.063				
A_n					-.0001	.0001	-.0002	.001
C_l					-2.66	.420		
C_o	.443	.043***	-1.81	1.451	19.7	2.467***	188.03	17.14***
R^2	.4485		.1638		.1680		.1719	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.6. Estimates of farm work supply for Southern Luzon (SL), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.064	.024***						
W							-11.13	3.043***
S			-.008	.079	-.070	.052*		
F_r	-.018	.033	-.410	.761	1.22	1.173	12.64	9.869*
Q_w	.0007	.0007	-.001	.018			-.045	.039*
F_z			.080	.114				
A_n					.0002	.0003	.0043	.002**
C_l					.015	.016		
C_o	.433	.048***	2.44	6.661	19.10	4.561***	230.5	39.524***
R^2	.5907		.1590		.3140		.3117	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.7. Estimates of farm work supply for Visayas (VS), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.086	.028**						
W							-7.17	2.760***
S			.44	.805	-.13	.061**		
F_r	-.001	.198	-1.16	1.321	1.75	.784**	12.61	6.621**
Q_w	.0001	.0004	-.09	.089			.004	.025
F_z			-1.76	1.693				
A_n					.0003	.0001**	.002	.001**
C_l					-.001	.080		
C_o	.4515	.070***	-1.44	82.439	23.18	6.359***	168.86	25.590***
R^2	.69		.5700		.4682		.467	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.8. Estimates of farm work supply for Mindanao (MN), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.655	.514*						
W							-8.16	3.173***
S			.003	.010	.103	.154		
F_r	-.003	.151	.184	.292	-4.70	2.617**	-25.47	15.186**
Q_w	-.006	.007	-.00009	.019			2.38	.819***
F_z			-.002	.003				
A_n					-.0009	.0009	.001	.001
C_l					-1.01	1.361		
C_o	-.32	.679	.98	.782*	10.09	10.631	192.78	47.253
R^2	.6337		.3401		.2400		.3383	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.9. Estimates of farm work supply with off-farm supplement for Northern Luzon (NL_o), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.131	.029***						
W							-9.80	2.214***
S			.023	.008***	-.045	.031*		
F_r	-.025	.043	.756	.388**	-2.07	1.551*	-23.94	12.540***
Q_w	-.001	.002***	.056	.021***			2.32	.886***
F_z			-.005	.028				
A_n					.0001	.0002	-.001	.001
C_l					-.84	.586*		
C_o	.428	.550***	-.764	.814	17.30	3.041***	200.88	22.653***
R_2	.5208		.2338		.2218		.2236	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.10. Estimates of farm work supply with off-farm supplement for Southern Luzon (SL_o), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.148	.033***						
W							-5.037	2.191***
S			.039	.017**	-1.80	.071***		
F_r	.099	.054**	-.364	.536	-1.40	2.301	-7.75	11.609
Q_w	.001	.001	-.831	.007			-.0003	.022
F_z			.001	.014				
An					-.0000004	.0003	-.00003	.002
C_l					-.0002	.024		
C_o	.247	.066	-1.61	1.558	30.07	6.441***	166.48	29.575
R_2	.5419		.1872		.2400		.2421	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.11. Estimates of farm work supply with off-farm income supplement for Visayas (VS_o), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.123	.024***						
W							-8.21	2.915***
S			.058	.011***	-1.21	.046***		
F_r	-.005	.026	.113	.267	1.96	.987**	16.90	9.796**
Q_w	-.0005	.0006	.003	.005			.014	.075
F_z			-.040	.049				
A_n					.0002	.0002	.001	.001
C_l					.050	.431		
C_o	.357	.060***	-3.66	1.158***	21.51	4.276***	177.4	25.699***
R^2	.6476		.4970		.3823		.3787	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.12. Estimates of farm work supply with off-farm income supplement for Mindanao (LSFO4), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.178	.076**						
W							-10.87	3.615***
S			.007	.013	-.057	.066		
F_r	.099	.042***	.198	.322	-3.98	1.53***	-40.43	17.87**
Q_w	-.005	.002**	.030	.017**			1.38	1.003*
F_z			.008	.041				
A_n					.00007	.0004	.002	.002*
C_l					.023	.198		
C_o	.277	.104***	.528	1.018	20.03	5.22***	239.49	51.55***
R^2	.6805		.3539		.3638		.3717	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.13. Estimates of farm work supply with off-farm and non-farm income supplement for Northern Luzon (NL_{on}), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.105	.020***						
W							-8.11	1.698***
S			.036	.011***	-.048	.033*		
F_r	-.0007	.038	.899	.411**	-2.45	1.47**	-23.56	10.44**
Q_w	-.001	.002***	.054	.025**			2.19	.748***
F_z			-.005	.042				
A_n					.00007	.0003	-.001	.001
C_l					-1.11	.585**		
C_o	.473	.038***	-1.99	1.023**	18.14	3.300***	181.72	18.09***
R^2	.5060		.2178		.2382		.2295	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.14. Estimates of farm work supply with off-farm and non-farm income supplement for Southern Luzon (SL_{on}), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.148	.040***						
W							-5.80	3.608**
S			.052	.057	-.143	.044***		
F_r	.103	.054**	-.605	.815	-.110	1.628	-1.22	12.85
Q_w	.0007	.0007	-.004	.013			.004	.096
F_z			-.015	.088				
A_n					.0006	.0004*	.002	.004
C_l					-.112	.406		
C_o	.247	.074***	-2.64	4.79	26.40	4.21***	167.77	50.10***
R^2	.5527		.1791		.2495		.2441	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.15. Estimates of farm work supply with off-farm and non-farm income supplemenet for Visayas (VS_{on}), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.120	.024***						
W							-9.04	3.387***
S			.056	.012***	-.11	.047***		
F_r	.0001	.026	.049	.278	2.05	.996**	18.56	10.92**
Q_w	-.0005	.0006	.003	.005			.015	.076
F_z			-.029	.053				
A_n					.0002	.0002	.002	.002
C_l					.016	.413		
C_o	.362	.060***	-3.40	1.279***	20.2	4.319***	183.86	29.71***
R^2	.6502		.4985		.3688		.3654	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.16. Estimates of farm work supply with off-farm and non-farm income supplement for Mindanao (MN_{on}), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.174	.067***						
W							-6.64	3.202
S			.017	.014*	-.048	.075		
F_r	.103	.041***	.142	.352	-3.92	1.601***	-23.26	15.04
Q_w	-.007	.003**	.033	.022*			1.26	.654
F_z			-.011	.035				
A_n					-.0001	.0004	.002	.002
C_l					-.105	.430		
C_o	.287	.092***	-.148	1.103	19.39	5.76***	173.51	47.37
R^2	.6741		.4084		.3793		.4069	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Moreover, the estimates are highly significant. For instance, the aversion to work of workers from Southern Luzon based on farm work employment increases by about .08 for every unit increase in the ratio of non-work income to the relative poverty threshold. This is significantly different from zero at a significance level of at least one percent, that is, assuming all other factors being constant (Table 5.5). This direct relationship implies that those who have higher stock of asset from which current consumption requirements can be drawn from have the tendency to do lesser farm work relative to those whose current consumption requirements can only be met by having income from work.

The relationship between the aversion to work and the dependency index (F_r) has not been very consistent in the direction of the relationship is concerned across the regional groupings and source of employment. While it has been hypothesised that A_w is directly related to F_r, in some cases the relationship has been exhibited as inverse. This has been the case for those whose only source of income is farm work for Southern Luzon, Visayas and Mindanao. For those with supplemental income from off-farm work, the inverse relationship is shown for Northern Luzon and the Visayas. However, these negative parameter estimates of these cases have been consistently indicated as insignificant.

The rest of the estimates conforms to the hypothesis that A_w is directly related to F_r. This has been the case for the farm work labour supply model for Northern Luzon (*NL*), farm with off-farm supplemental work supply model for Southern Luzon (SL_o), farm with off-farm supplemental work supply for Mindanao and the rest of the regional groupings for the farm with supplemental off-farm and non-farm work supply models - NL_o to MN_{on}. Most of the positive parameter estimates has been indicated to be statistically significant. Furthermore, it is interesting to note that the significant parameter estimates come mainly from the models with supplemental income from off-farm and non-farm work. The case of the farm with off-farm supplemental work model for Southern Luzon (SL_o in Table 5.6), for instance, indicated that the tendency to do less farm work increases by about 0.1 for every unit increase in the dependency ratio. This estimate is statistically significant up to at least 3 percent level. This means that those who have lesser dependents tend to do less farm work, relatively speaking and assuming all other conditions being constant.

It must be noted that these results are less than the ideal relationship that is expected and desired. However some contributing factors can be presented to explain these patterns. One factor relates to the observation that the significant parameter estimates come mainly from the models with supplemental income from off-farm and non-farm work. This implies that relatively speaking, those whose employment come from both farm with off-farm supplemental and farm with off-farm and non-farm supplemental, who have lesser dependents, tend to have a higher aversion to work. For those whose main source of employment is own farm work there is not much room to vary the level of work in relation to the level of the dependency ratio because the level of work is constrained by work opportunities in the area. However, for those whose source of income is farm work with supplemental income from off-farm and non-farm work, there is room to vary the level of work in relation to the dependency index because the additional income from off-farm and non-farm work provides more leverage to reduce, if not avoid, farm work.

The quality of work (Q_w) measured by a proxy variable expressed in terms of the number of years spent in school is hypothesised to be directly related to the level of work aversion (A_w). The parameter estimates however, across models by regional grouping, do not show a consistent pattern to strongly support this hypothesis. For instance, across all models, among the parameter estimates, there are eight estimates that indicate an inverse relationship and four that are indicative of direct relationship. Further, among the significant parameter estimates, four are negative and two are positive. To cite a specific example, for NL_o model (Table 5.9), aversion to work declines by about 0.01 per unit increase in the number of years spent in school, all others being constant, and this relationship is significant at least at 1 percent. In another case, aversion to work increases by 0.001 per unit increase in the level of education for the case of the SL_o model. The logical implication of these results is that as far as the behaviour of aversion to work, the level of education may not be a critical influencing factor. This does not come as a surprise in this particular case because the level of education, on the average, across models by region, do not go beyond seven years (Table 4.6).

5.2.2.2. The Ratio of Non-work Income to Relative Poverty Threshold Function

From equation 2: $R_a = \theta_1 + \theta_2 S + \theta_3 F_r + \theta_4 Q_w + \theta_5 F_z + \epsilon_2$

it is hypothesised that:

$$\frac{\partial R_a}{\partial S}, \frac{\partial R_a}{\partial F_r}, \frac{\partial R_a}{\partial Q_w}, \frac{\partial R_a}{\partial F_z} > 0.$$

The estimates of the coefficient of the wage rate variable (S) are mostly positive. In the three models by regional groupings, eleven of the twelve estimates indicate direct relationship between the ratio of non-work income to the relative poverty threshold (R_a) and the wage rate variable (S) with the only negative estimate not statistically significant. Among the positive estimates, seven are shown to be highly significant. For instance in the case of the model VS_{on} (Table 5.15), the rest of the factors being held constant, the ratio of non-work income to the relative poverty threshold increases by about 0.05 for every Peso increase in the level of wage rate and this estimate is significant at least at 1 percent level. In practical terms, these measures indicate that the higher the earnings per unit of work the higher the tendency to accumulate assets from which the individual can draw from present consumption requirements.

Generally speaking, the estimated coefficient of the dependency ratio variable (F_r), in relation to the ratio of the non-work income to the relative poverty threshold, conforms to the expected direct relationship. Across the three models for the source of employment and by regional groupings, seven estimates are positive and five are negative. Among the positive estimates, 3 are statistically significant (this covers the models NL, NL_o and NL_{on}) and all of the negative estimates are insignificant. To cite a specific example, the case of the farm with supplemental off-farm and non-farm work supply model for Northern Luzon (NL_{on}) indicate that, assuming all other factors remaining constant, the ratio of non-work income to the relative poverty threshold increases by roughly 0.9 in response to a unit increase in the dependency ratio (Table

5.13). This estimate is statistically significant at one percent. This statistical relationship means that those who have lesser dependents tend to accumulate more assets where, from its current market value, the individual can draw current consumption requirements.

The fact that all the significant estimates come only from all the models for Northern Luzon needs to be properly noted. To explain this pattern however would mean some conjectures in a socio-cultural context. In the Philippine culture, it is common practice to typecast specific regional inhabitants with some cultural attributes. The inhabitants of Northern Luzon, called the *Ilocanos*, are generally associated with being frugal spenders. This is one among the many possible factors that could explain the pattern that only in this region the direct relationship between the dependency index and the ratio of non-work income to the relative poverty threshold is statistically significant.

Across all regions and by source of employment, the hypothesised relationship between the ratio of non-work income to the relative poverty threshold (R_a) and the level of education as a proxy to the quality of work (Q_w), has been, in a general sense supported by the estimated parameters. Of all the estimated coefficients, seven are positive conforming to the expected direct relationship. The rest are negative and insignificant. Among the seven positive estimates, four are significant to at least 6 percent level. The significant estimates include the models NL_o, MN_o, NL_{on} and MN_{on}. In the case of the farm with supplemental off-farm work supply model for Mindanao (MN_o) the ratio of non-work income to the relative poverty threshold increases by about 0.03 per unit increase in the level of education, assuming all other factors remaining constant. This estimate is significant to at least the level of 3 percent. In simpler terms, this relationship indicates that those with higher educational attainment tend to accumulate more assets where, from its current market value, the individual can draw current consumption requirements.

The estimated coefficients of the farm size (F_z) variable across the model, by source of employment and regional groupings, have been insignificant. This plainly indicates that the size of the farm that the individual is working on is not a critical determinant in the level of the stock of asset where the individual could possibly draw from present consumption requirements.

5.2.2.3. The Work Supply Function

From equation (3) $W = \alpha_1 + \alpha_2 S + \alpha_3 A_n + \alpha_4 F_r + \alpha_5 C_l$

it is hypothesised that

$$\frac{\partial W}{\partial S}, \frac{\partial W}{\partial F_r}, \frac{\partial W}{\partial A_n}, \frac{\partial W}{\partial C_l} < 0$$

With respect to the relationship between the level of work and the level of wage rate, most of the estimated parameters are negative which conforms to the expected relationship. Although this pattern excludes the positive estimated coefficient of the wage rate variable for the *MN* model, however, this estimate is insignificant. All the estimated negative coefficients are highly significant except for the coefficient for the MN_o model. For instance, in the SL_{on} model, the estimated coefficient of the wage rate variable indicates that for a unit (Peso) increase in the level of wage rate, the level of work declines by roughly 0.14 days given all other factors are constant. This estimate is significant at least at 1 percent level.

It has been the hypothesis that the higher the dependents of the individual (which means a lower F_r) the higher the work required to satisfy the consumption requirements, that is, the dependency ratio (F_r) is inversely related to the level of work (W). This hypothesis has been generally supported by the estimated parameters. Across the models by regional groupings, eight of the estimates conform to the hypothesis at least in its direction (negative) and four are inconsistent (positive). Among the eight negative estimates, six are statistically significant. To cite a specific example, the F_r coefficient of the farm work supply model for Mindanao (*MN*) indicates that the level of work declines by roughly 4.7 days for every unit increase in the dependency ratio. In this case, the estimate is significant to a level of at least 3 percent. As argued earlier, this means that as the number of dependents increase, more work is required to support the household's consumption requirement given all other factors are constant. Among the four positive estimates which are inconsistent with the hypothesis, three are highly significant. What makes these observations more worthy of noting is the fact that these significant positive estimates come from those models that cover the Visayas Region (VS, VS_o, and VS_{on}). For instance, in the VS model, the coefficient indicates that the level of work increases by 1.75 as the dependency ratio increases. This implies that the level of work increases as the number of dependents decline.

To provide some plausible arguments about these observations that at the outset seem to be inconsistent with the hypothesis, some facts need to be noted to put things in proper perspective. The Visayas Region was the entry point in the year 1521 of the Spaniards which made the Philippines its colony for more than three hundred years until the early part of the 20th century when the country was sold to the United States of America for US$ 20 million. The Spaniards established the friar lands which eventually became *haciendas* - an organisation of production in agriculture where the land size involves thousands of hectares. Consequently, a feudalistic land tenure system emanated from the structure of the *hacienda*. To date, the Region is still predominantly feudalistic and is one of the most economically depressed areas of the country. It has the highest incidence of share tenancy and leasehold and among the poorest in the country (Table 4.7). One of the factors that strengthened the people's anti-Marcos sentiment in the early 1980s is the fact that people (mostly children) in the region were dying for the simple reason that there was nothing to eat. Not that there was no food in the area but people simply did not have the money to buy food for the family.

This puts the people, in a general sense, homogeneously poor below the subsistence level of the country. In this case, it is possible that variations in the level of work could be attributed to work opportunities and the ability of the individuals to move to areas where there are farm, off-farm or non-farm work opportunities. Individuals with lesser dependents would have greater mobility and are therefore more likely to increase their opportunity to work more compared to those who would be burdened and constrained with larger family size.

It has been hypothesised that the level of work is inversely related to the labour force in the community, that is, the more the potential workers in the community, the lesser the likelihood for an individual to increase the level of work. In the various models estimated, the coefficients of the labour force variable do not support this hypothesis. Most of the coefficients are positive (for nine of the twelve models) and are insignificant except for the two cases for *VS* and SL_{on}. The rest of the estimates are negative but are all insignificant.

The reason for this apparent lack of relevance of the labour force variable in relation to the level of work can be attributed to the way the variable has been quantified. The labour force variable (A_n) was derived from the total population of the community based on the total number of persons including children. The population figure was only adjusted to measure the effective labour force based on the age distribution of the sample from each community of twenty respondents. To adjust the population to reflect the effective labour force based on such a minimal sample may not be sufficient to capture the real effective labour force. Hence, this limitation may be the primary reason why the A_n variable seemed unrelated to the level of work.

Land classification (C_l), a dummy variable designed to determine the relevance of whether or not the area of the community is irrigated, has been exhibited to be a less significant factor in determining the level of work. Out of the twelve specific models, four of the estimates do not conform to the hypothesis in terms of the direction of the relationship. Further, the estimates are not even statistically significant. The remaining eight estimates which conforms to the hypothesis are insignificant except for two models: NL_0 and NL_{on}. To illustrate this relationship, model NL_0 indicates that the coefficient of C_l is about -0.84 and significant at least at 7 percent level. This implies that the work intercept of the work wage rate line for farmers working on non-irrigated lands is less by 0.84 than those farmers working on irrigated lands. For practical purposes in this particular model, those who are engaged in rural employment in irrigated communities have greater opportunity to increase their work level relative to those working in non-irrigated areas.

5.2.2.4. The Wage Rate Function

From the equation 3:

$$S = \beta_1 + \beta_2 W + \beta_3 Q_w + \beta_4 A_n + \beta_5 F_r + \epsilon_4.$$

it has been hypothesised that

$$\frac{\partial S}{\partial W}, \frac{\partial S}{\partial A_n} < 0$$

$$\frac{\partial S}{\partial F_r}, \frac{\partial S}{\partial Q_w} > 0$$

The expected inverse relationship between the level of wage rate and the level of work has been generally supported by the parameter estimates. Across all models by regional groupings, the signs of the estimates are all negative and highly significant. For example, the coefficient of the wage rate variable (W) for the MN model is about -8.16 and significant at least to one percent level (Table 5.5). In the conventional framework, this result can be simply interpreted as a decline in the level of wage rate (S) by roughly 18 Pesos as W increases by one unit. However, one must be reminded that under the framework of *bounded rationality*, this relationship can not be interpreted in the conventional neoclassical economic sense. What this result implies is that given an increasing R_a, the individual tends to work less and is more discriminating in favour of much higher paying work.

The relationship between the level of wage rate (S) and the dependency ratio (F_r) is not very defined in this particular case. Among the twelve estimated parameters across models by regional groupings, five are positive which conform to the hypothesis. For instance in the VS_{on} model, the estimates indicate that the level of wage rate increases as the dependency ratio also increases. These estimates are significant up to at least four percent level. This plainly implies that those individuals with lesser dependents can afford to be more discriminating in their search for work in favour of higher paying work. On the other hand, the remaining estimates are negative which are inconsistent with the hypothesis. Among the negative estimates, six are significant. To cite a specific example, in the MN model the coefficient of the

F_r variable is about -25.47 and is significant at four percent level. It can be interpreted that those with higher number of dependents can also be discriminating in favour of higher wages.

At the outset, any statistical observation that would suggest that those with more dependents can be more discriminating in favour of higher wages than those who have lesser dependents would seem very odd. However, anyone familiar with the nature of rural Philippine conditions would readily find out that bearing more children is often a conscious decision by parents to generate more income earners for the family. Hence, if in a household, there are other family members who are contributing to the household income, then the household head can afford to be more discriminating in so far as the wage rate is concerned.

The hypothesis that the quality of work (Q_w) is directly related to the level of wage rate has been generally supported by the estimated parameters across the models by source of employment and regional groupings. Ten of the estimates across models by regional groupings are positive and six are significant. Meanwhile, the two negative estimates are insignificant. To cite a specific case, in the *NL* model, the coefficient of the Q_w variable indicates that the level of wage rate increases by about 0.67 as the level of education increases and is significant to at least 2 percent (Table 5.5). This relationship implies that those individuals with relatively higher education can be more discriminating in favour of higher paying farm work. As in the level of work function, the hypothesis that the level of wage rate is inversely related to the effective labour force has not been supported by the estimated parameters in the model. Among all the estimates, three are negative but are statistically insignificant. Most are positive and some are significant. The case of farm work supply model for Northern Luzon indicates that in areas where there are more prospective workers, the wage rate is higher (Table 5.5).

Again, this result which is not consistent with what has been expected could be attributed to the way the effective labour force variable was measured. The labour force variable (A_n) was derived from the total population of the community based on the total number of persons including children. The population figure was only adjusted to measure the effective labour force based on the age distribution of the sample from each community of about twenty respondents. To adjust the population to reflect the effective labour force based on such a minimal sample may not be sufficient to capture the real effective labour force. Hence, this limitation may be the primary reason why the A_n variable seemed unrelated to the level of work.

In the normal practice of econometric analysis, the intercept is often ignored because in most cases the concerns revolve around marginal analysis. However, in this model, the intercept is very significant. Specifically, from the equation

$$S = \beta_1 + \beta_2 W + \beta_3 Q_w + \beta_4 A_n + \beta_5 F_r + \epsilon_4$$

the intercept β_1 is very critical because this value will determine the level of the relative poverty threshold.

Across all models, β_1 has been consistently shown as positive and highly significant. Also, the magnitude falls within some reasonable range.

To illustrate the relevance of the vertical intercept of the wage rate model, consider the estimates of the intercept and the level of work variable for the work supply model with supplemental income from off-farm work for Southern Luzon (SL_o in Table 5.10). The estimated parameters yield $\beta_1 = 167.77$ and $\beta_2 = -5.03$. This implies that the wage rate line declines by 5.03 across the level of work axis. Considering that the assumed maximum level of work is about 26 days per month, the estimates indicate that implicitly, the level of wage rate required to achieve the relative poverty threshold is about 35 pesos per day which yields a relative poverty threshold income of about 982 Pesos per month equivalent, in 1990 prices, to roughly A$50 (Figure 5.2).

At this point it is appropriate to note some statistical attributes of the models, namely, the Durbin-Watson statistics for the test of serial correlation and the coefficient of determination (R^2).

As noted earlier, the system R-squared and the conventional coefficient of determination (R-squared) in a system of simultaneous equations are not very well defined. As noted by White et. al. (1990), the lower limit of both the system R-squared and the equation R-squared is negative infinity. Hence, the suggested statistic to assess how the independent variable is influenced by the regressors is the coefficient

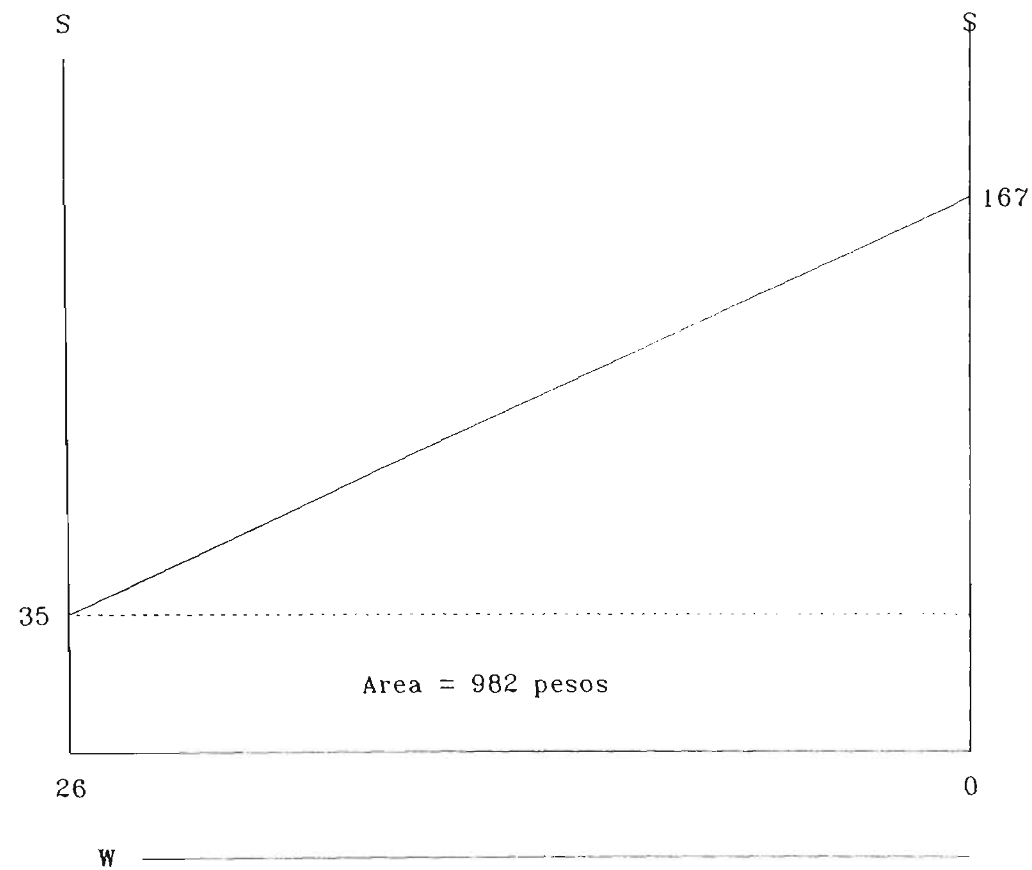

Figure 5.2. Estimated labour supply for SLo.

of determination between the observed and the predicted values. From now on, this statistic will be referred to as R^2_{op}.

The other critical statistic is the R^2_{op}. In a general sense, the coefficient of determination between the observed values and the predicted values are less than the ideal and desired degree of relationship (Tables 5.5 to 5.16). On the average, the coefficient of determination between the observed and the predicted values across equations by models are as follows:

Equation	Average R^2_{op}
1	0.5947
2	0.3173
3	0.3028
4	0.3125

Apparently, these values are less than ideal. However, one must be cautioned that in many empirical works, the objective of maximising the coefficient of determination may not always be necessary nor desirable.

5.2.3. Test for Structural Changes

As argued earlier, there are other variables which by nature are qualitative and relevant to the understanding of farm work behaviour in rural Philippines. These variables include the tenurial structure, the ecological zone and the cropping pattern.

The procedure outlined in the methodology of this research to assess the effects of the relevant qualitative variables involves the use of binary or dummy variables. Specifically, dummy variables are employed to estimate the intercept differential coefficient and the slope differential coefficient.

5.2.3.1. The Tenurial Structure

In the models developed earlier, the rest of the relations revolves around the wage rate function (Equation 4). Hence the test for structural changes are employed only in the wage rate function, that is, the intercept differential coefficients and the slope differential coefficients are estimated only through Equation 4.

The hypothesis that the wage rate function of those who are situated in the upper ladder of the tenurial structure would tend to be steeper has been, at the least, not contradicted by the estimated parameters and at most has been supported by some models. Specifically, the estimates for the intercept differential coefficients and the slope differential coefficients are shown to be consistent with the hypothesis for the following models: *TNL*; *TSL*; *TVS*; TVS_o; and TVS_{on} (where the letter *T* is added to normal model notation to indicate that the model is testing for structural changes with respect to the tenurial system).

To illustrate the effects of the intercept and slope differential coefficients, consider Figure 5.3 (based on the estimates from TVS_o in Table 5.17). This Figure illustrates that for landless workers (those which are at the bottom of the tenurial structure), the wage rate line declines by 2.75 from the vertical (wage rate) intercept $S = 129$ at T3 = 0. This implies that for the landless workers, the wage rate that is required to meet the relative poverty threshold is about 57 pesos, assuming all other factors constant. However, the slope of the wage rate line is flatter relative to those in other tenurial forms. For instance, for the shareholders (T3 = 1), the vertical (wage rate) intercept is about 156 pesos because the intercept differential coefficient is estimated at 27 pesos and the slope is about -5, given that the slope differential coefficient is about -2.05. The steeper slope for the shareholders wage rate line relative to the landless workers implies that shareholders can be more discriminating in favour of higher paying farm work.

5.2.3.2. The Ecological Zone

The Philippine arable lands are classified into three basic ecological zones, namely, upland, lowland and coastal. It has been one of the hypotheses in this research that the labour supply model will be different across these ecological zones. This hypothesis however, is not being strongly supported by the estimated parameters.

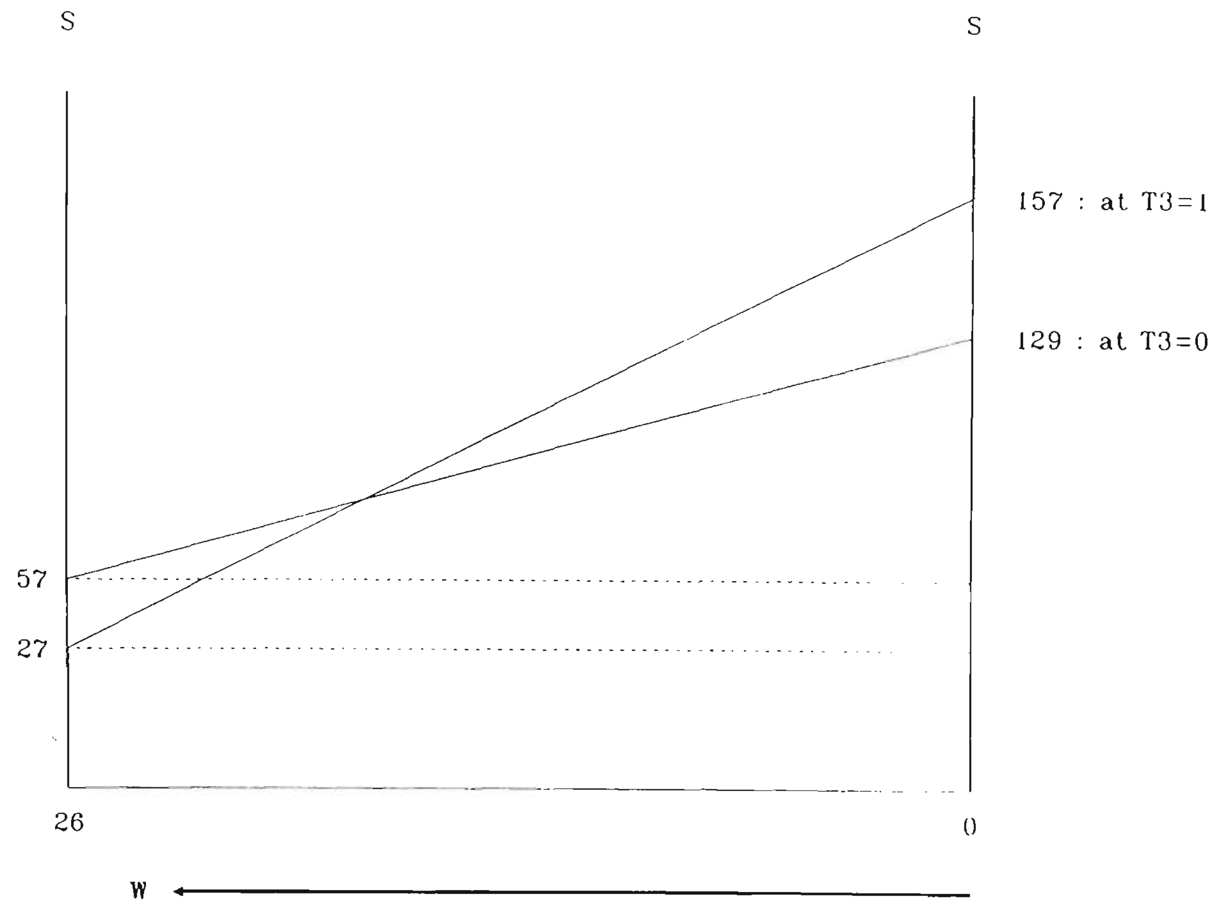

Figure 5.3. Slope and intercept differential: tenure in VSo.

Table 5.17. Estimated parameters of tenure dummy in farm work supply with off-farm supplement for Visayas (VS_o), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.140	.005***						
W							-2.75	1.29*
S			.046	.002***	-.177	.011***		
F_r	.032	.031	-2.00	.294	1.77	1.24*	3.50	7.49
Q_w	-.0003	.0006	.004	.004			-.009	.057
F_z			.004	.015				
A_n					.0002	.0001**	.001	.0009
T_1							27.86	10.60***
T_2							27.07	10.56***
T_3							27.46	11.87**
T_{1w}							-2.09	1.18***
T_{2w}							-2.07	1.14***
T_{3w}							-2.05	1.32**
C_t					.472	.169**		
C_o	.317	.020***	-2.50	.306***	26.80	1.32***	129.41	10.42***
R^2	.6558		.5805		.4610		.4417	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Almost all the estimates are insignificant (Appendix E), except for the estimates of the models *SL*, *VS*, and ZVS_{on}. To illustrate a specific example, the labour supply function of lowland workers whose sole income is derived from farm work for Southern Luzon (*ZSL*), is higher relative to all the others from other ecological zones in terms of intercept by about 53 Pesos and the slope of the function is declining faster by about 1.74 per unit increase in the level of work (Table 5.18). It is worth noting that two out of the four estimated models for workers, whose only source of income is farm work have been significant while for all the rest of the models where income is supplemented by off-farm and non-farm work, only the model ZVS_{on} is significant. This plainly implies that overall work behaviour of rural workers is not being affected by the geographic attributes of the community. Relatively speaking, however, work behaviour may be different across regions for those whose only source of income is farm work.

5.2.3.3. The Cropping Pattern

It has been argued earlier that cropping pattern may have critical relevance to farm work supply behaviour in rural Philippines. This argument is based on the notion that different crops have, to a certain extent, different labour requirements.

This hypothesis is supported by three of the estimated models, in particular *CSL*, *CVS*, and CSL_o (where the addition of letter *C* in the notation indicate the test for the type of crops). The rest of the estimates from the other models was insignificant. To illustrate the effects of the significant estimates for both intercept differential and slope differential coefficients, consider the estimated coefficients of the *CVS* model. All the intercept differential and slope differential coefficients are highly significant (Table 5.19). This relationship can best be presented by translating the estimates into graphical presentation.

Considering Equation 4 of *CVS*, the estimates indicate that the intercept of the wage rate line for rice farmers is higher than those engaged in other crops by 23.38. This is the coefficient of the intercept differential dummy C_1. Further, the slope differential coefficient (C_{1W}) for rice crop growers is also steeper than those engaged in other crops.

Table 5.18. Estimated parameters of zone dummy in farm work supply for Southern Luzon (TLSF2), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.206	.008***						
W							-1.74	1.21
S			.046	.004***	-.288	.023***		
F_r	.061	.045*	-.216	.447	1.23	2.41	-.25	.084
Q_w	.001	.001*	-.005	.006			.002	.001
F_z			.007	.008				
A_n					.0006	.0002**	.1E-3	8.99
Z_1							53.91	15.62***
Z_2							56.15	16.41***
Z_{1w}							-4.12	1.20***
Z_{2w}							-4.22	1.24***
C_t					1.38	.247***		
C_o	.177	.023***	-2.25	.409***	34.81	2.23***	76.49	15.25***
R_2	.5464		.2270		.2234		.1638	

Notes:

β_i = coefficients
S.E. = standard error
* = significant at 10%
** = significant at 5%
*** = significant at 1%

Table 5.19. Estimated parameters of Crop dummy in farm work supply for Visayas (VS), Philippines, 1990.

Variables	Equation 1		Equation 2		Equation 3		Equation 4	
	β_i	S.E.	β_i	S.E.	β_i	S.E.	β_i	S.E.
R_a	.189	.010***						
W							-2.91	.857***
S			.037	.002***	-.21	.016***		
F_r	.061	.033**	-.151	.244	.71	1.40	2.36	6.31
Q_w	.0008	.001	.007	.006*			.055	.038*
F_z			.022	.011**				
A_p					.0004	.0002**	.001	.001**
C_l					.25	.117**		
C_1							23.38	10.94**
C_2							23.17	10.57**
C_3							25.38	8.14***
C_4							20.24	6.40***
C_{1w}							-1.80	.840**
C_{2w}							-1.73	.794***
C_{3w}							-1.99	.645***
C_{4w}							-1.65	.522***
C_o	.242	.021***	1.24	.232***	27.52	1.371***	104.89	10.53***
R^2	.5713		.3992		.3424		.3355	

Notes:

β_i = coefficients   ** = significant at 5%
S.E. = standard error   *** = significant at 1%
* = significant at 10%

To examine further the implications of these statistical attributes, consider Figure 5.4. For crops other than rice, the wage rate line declines from the intercept $S = 104$ by 2.5 pesos per unit increase in the level of work. This decline levels off at the level of wage rate sufficient to achieve the relative poverty threshold which in this particular case is about 28 Pesos. For rice growing farmers, the slope is much steeper. Because the slope differential coefficient is about 23 Pesos, the vertical intercept shifts to $S = 127$ Pesos and declines by about 4.3 Pesos per unit increase in the level of work and levels off at $S = 23$. This is the level of wage rate required to achieve the relative poverty threshold for the rice growing farmers.

5.3. The Logit Model

The logistic probability function (Logit) is expressed as:

$$R_i = \alpha_1 + \alpha_2 R_a + \alpha_3 Q_w + \alpha_4 F_r + \alpha_5 L + \alpha_5 A_n + \alpha_6 C_{ll} + \alpha_7 Z_1 + \alpha_8 T_1 + \alpha_9 T_2 + \alpha_{10} T_3 + \epsilon,$$

where R_i is the logarithm of the odds of being gainfully employed to either being unemployed or underemployed. Formally R_i is expressed as:

$$R_i = \ln\left[\frac{P_i}{(1-P_i)}\right]$$

where P_i is the probability of access to gainful employment and implicitly (1-Li) is the probability of being unemployed or underemployed.

In this logit model the following relationships are hypothesised:

$$\frac{\partial R_i}{\partial Q_w}, \frac{\partial R_i}{\partial F_r}, \frac{\partial R_i}{\partial L}, \frac{\partial R_i}{\partial C_l}, \frac{\partial R_i}{\partial Z_1}, \frac{\partial R_i}{\partial T_1}, \frac{\partial R_i}{\partial T_2}, \frac{\partial R_i}{\partial T_3} > 0$$

$$\frac{\partial R_i}{\partial R_a}, \frac{\partial R_i}{\partial A_n} < 0$$

The estimated parameters of the logit models across regional groupings are presented in Tables 5.20 to 5.31. It must be noted however that these estimated

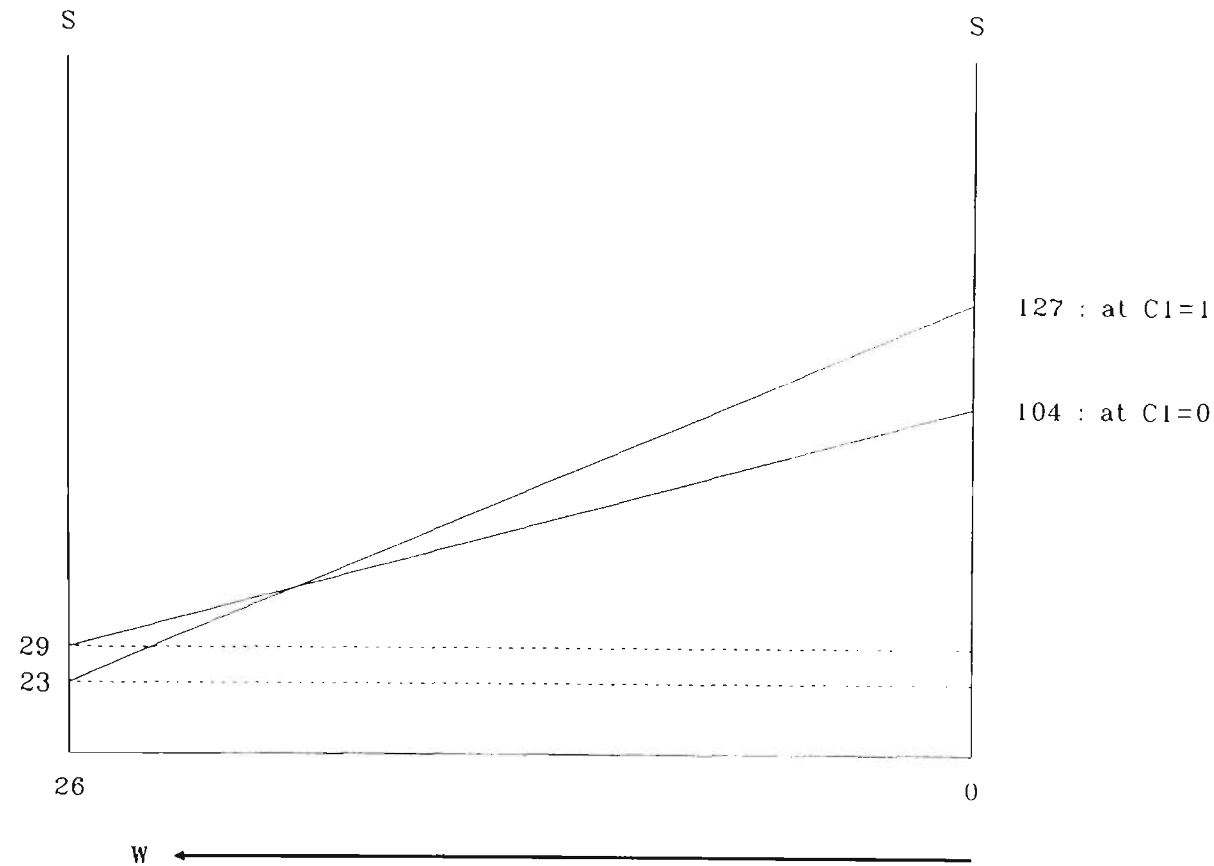

Figure 5.4. Slope and intercept differential: C1 in VS.

coefficients can not be interpreted in the conventional manner as in any other econometric models. What each of the coefficients indicates is a change in the logarithm of the dependent variable. In these particular models, the coefficient means a change in the logarithm of the odds of gainful employment over unemployment or underemployment. To make out the specific quantitative effects of the variables based on the estimated coefficients, some algebraic manipulations are required. However, the signs of the estimated coefficients provide the indicative direction of the relationship between the dependent and independent variables. A positive sign of the estimates indicate s direct relationship between the change in the logarithm of the odds of gainful employment over unemployment or under employment, otherwise, the relationship is inverse.

As noted earlier, the coefficient of the independent variable indicates the change in the logarithm of the odds of gainful employment per unit change in the explanatory variable. The marginal change however, must be interpreted differently because the change in the logarithm of the odds is not linear in the variables. To illustrate this argument, consider a simplified form of the logit model (for purposes of illustration) such that the logarithm of the odds is simply a function of R_a, hence

$$\ln\left(\frac{P}{1-P}\right) = \beta_1 + \beta_2 R_a + \mu$$

The expression above can be transformed as:

$$\ln P - \ln(1-P) = \beta_1 + \beta_2 R_a + \mu$$

Taking the total differential yields:

$$\left(\frac{1}{P}\right)\partial P - \left(\frac{1}{(1-P)}\right)*(-1)\partial P = \beta_2 \partial R_a$$

To express the partial derivative of P with respect to the partial derivative of R_a requires only simple algebraic manipulation, that is,

$$\left[\frac{1}{P} + \left(\frac{1}{1-P}\right)\right]\partial P = \beta_2 \partial R_a$$

$$\frac{\partial P}{\partial R_a} = \beta_2 P(1-P)$$

The exposition above shows that the change in the probability of employment (P) with respect to the change in R_a is not only determined by the coefficient (β_2) but also on the level of the probability at which the change is measured. Also, the level of probability depends upon the level of R_a where the probability is determined.

In the actual estimated logit model, the logarithm of the odds of employment is expressed as a function of several explanatory variables. In this case, the evaluation of the probability must be done by taking the values of all the explanatory variables simultaneously (Gujarati, 1988).

The estimated coefficients of the logit models across regions indicate that most of the expected relationships are supported, at least, in so far as the direction of the relationship is concerned (Table 5.20 to 5.31).

The relationship between the ratio of the value of assets to the absolute poverty threshold and the likelihood of gainful farm employment is expected to be inverse. Based on the conventional wisdom in labour supply analysis, this argument may seem surprising. However, based on the bounded rationality framework, where the relation between the level of work and the level of wage rate is strictly inverse, and where it is expected that the level of work can only decline, then the inverse relationship the logarithm of the odds of farm employment and the ratio of non-work income to the absolute poverty threshold becomes plausible. Work aversion is directly related to R_a. The estimated coefficients across models by region has consistently supported the proposition discussed above. For instance, in the estimates of the likelihood of farm employment for farmers whose only source of income is farm work in Northern Luzon, it is indicated that for a unit increase in R_a, the logarithm of the odds of farm

Table 5.20. Estimates of the logit model for farm workers in Northern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
Ra	-3.7834***	0.46595	-0.31217E-01
Qw	0.0068191	0.27574E-01	0.19197E-03
Fr	2.1954	1.2706	0.25251E-02
L	0.77058**	0.38236	0.45500E-02
An	-0.0001771	0.55626E-03	-0.60374E-03
Cl1	0.53670	0.46919	0.85817E-03
Z1	0.21427	0.74877	0.75526E-03
T1	1.1565*	0.69756	0.17323E-02
T2	0.56278	0.77433	0.42819E-03
T3	0.76417	0.72054	0.10493E-02
CONSTANT	10.228***	1.9375	0.42497E-01

LOG-LIKELIHOOD(0) = -397.67 LOG-LIKELIHOOD FUNCTION = -82.019
LIKELIHOOD RATIO TEST = 631.308 WITH 10 D.F.
MADDALA R-SQUARE 0.5947
CRAGG-UHLER R-SQUARE 0.87524
MCFADDEN R-SQUARE 0.79375
ADJUSTED FOR DEGREES OF FREEDOM 0.79076
APPROXIMATELY F-DISTRIBUTED 4.2334 WITH 10 AND 11 D.F.
CHOW R-SQUARE 0.83969

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
PREDICTED	0	171.	17.
PREDICTED	1	8.	503.

NUMBER OF RIGHT PREDICTIONS = 674.
PERCENTAGE OF RIGHT PREDICTIONS = 0.96423

EXPECTED OBSERVATIONS AT 0 = 179.0 OBSERVED = 179.0
EXPECTED OBSERVATIONS AT 1 = 520.0 OBSERVED = 520.0
SUM OF SQUARED "RESIDUALS" = 21.348
WEIGHTED SUM OF SQUARED "RESIDUALS" = 684.86

DURBIN-WATSON = 1.8535 VON NEUMANN RATIO = 1.8561 RHO = 0.07325
RESIDUAL SUM = 0.35980E-05 RESIDUAL VARIANCE = 0.30540E-01
SUM OF ABSOLUTE ERRORS= 46.468
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8399
LOG-LIKELIHOOD FUNCTION = -82.01858

Notes: *** - significant at 1%
** - significant at 5%
* - signifcant at 10%

Table 5.21. Estimates of the logit model for farm workers in Southern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-0.98292***	0.96318E-01	-0.69668
QW	-0.87153E-02	0.14595E-01	-0.18973E-01
FR	1.5760**	0.69330	0.18612
L	-0.55590***	0.17581	-0.38438
AN	0.56356E-03***	0.28451E-03	0.17840
CL	0.64073*	0.36375	0.81695E-01
Z1	-0.23374	0.38641	-0.39553E-01
Z2	0.32619	0.45643	0.20025E-01
T1	1.0612**	0.47447	0.13614
T2	2.0702***	0.56914	0.14501
T3	1.5679***	0.49648	0.15548
CONSTANT	1.4060**	0.70282	0.46810

LOG-LIKELIHOOD(0) = -279.52 LOG-LIKELIHOOD FUNCTION = -158.20
LIKELIHOOD RATIO TEST = 242.642 WITH 11 D.F.

MADDALA R-SQUARE 0.4365
CRAGG-UHLER R-SQUARE 0.59529
MCFADDEN R-SQUARE 0.43403
ADJUSTED FOR DEGREES OF FREEDOM 0.41889
APPROXIMATELY F-DISTRIBUTED 0.83661 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.51748

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	120.	22.
PREDICTED	1	38.	243.

NUMBER OF RIGHT PREDICTIONS = 363.
PERCENTAGE OF RIGHT PREDICTIONS = 0.85816

EXPECTED OBSERVATIONS AT 0 = 158.0 OBSERVED = 158.0
EXPECTED OBSERVATIONS AT 1 = 265.0 OBSERVED = 265.0
SUM OF SQUARED "RESIDUALS" = 47.762
WEIGHTED SUM OF SQUARED "RESIDUALS" = 457.45

DURBIN-WATSON = 1.0785 VON NEUMANN RATIO = 1.0810 RHO = 0.46045
RESIDUAL SUM = 0.29151E-06 RESIDUAL VARIANCE = 0.11291
SUM OF ABSOLUTE ERRORS= 96.751
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5176
LOG-LIKELIHOOD FUNCTION = -158.1990

Table 5.22. Estimates of the logit model for farm workers in Visayas, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-1.8922***	0.15001	-1.2279
QW	0.93525E-02	0.13335E-01	0.15172E-01
FR	1.3360**	0.67267	0.98683E-01
L	0.13760	0.29252	0.41376E-01
AN	0.82115E-04	0.16102E-03	0.22444E-01
CL	0.35422E-02	0.34044	0.24745E-03
Z1	0.50733	0.43683	0.77901E-01
Z2	0.17767	0.54884	0.73752E-02
T1	-0.43000	0.44546	-0.30329E-01
T2	0.10024	0.45990	0.83554E-02
T3	-0.71438	0.51695	-0.29413E-01
CONSTANT	5.5970***	0.85027	1.2939

LOG-LIKELIHOOD(0) = -461.01 LOG-LIKELIHOOD FUNCTION = -155.93
LIKELIHOOD RATIO TEST = 610.168 WITH 11 D.F.

MADDALA R-SQUARE 0.5897
CRAGG-UHLER R-SQUARE 0.79713
MCFADDEN R-SQUARE 0.66177
ADJUSTED FOR DEGREES OF FREEDOM 0.65624
APPROXIMATELY F-DISTRIBUTED 2.1344 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.79015

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	263.	22.
PREDICTED	1	11.	389.

NUMBER OF RIGHT PREDICTIONS = 652.
PERCENTAGE OF RIGHT PREDICTIONS = 0.95182

EXPECTED OBSERVATIONS AT 0 = 274.0 OBSERVED = 274.0
EXPECTED OBSERVATIONS AT 1 = 411.0 OBSERVED = 411.0
SUM OF SQUARED "RESIDUALS" = 34.499
WEIGHTED SUM OF SQUARED "RESIDUALS" = 13907.

DURBIN-WATSON = 1.9627 VON NEUMANN RATIO = 1.9656 RHO = 0.01748
RESIDUAL SUM = 0.11836E-03 RESIDUAL VARIANCE = 0.50364E-01
SUM OF ABSOLUTE ERRORS= 81.181
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7921
LOG-LIKELIHOOD FUNCTION = -155.9286

Table 5.23. Estimates of the logit model for farm workers in Mindanao, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-3.4830***	0.50331	-0.47259E-02
QW	0.26484***	0.10826	0.12765E-02
FR	0.92925	1.2042	0.24381E-03
L	0.89557**	0.29420	0.25971E-02
AN	-0.18960E-03	0.37089E-03	-0.18345E-03
CL	0.62406	0.86422	0.81341E-04
Z1	0.73354	0.73640	0.31976E-03
Z2	0.60067	1.9439	0.68722E-04
T1	-1.3548*	0.74684	-0.69455E-03
T2	-1.6598	1.2058	-0.13221E-03
T3	-1.4757	1.0962	-0.26500E-03
CONSTANT	8.3686***	1.8899	0.82051E-02

LOG-LIKELIHOOD(0) = -295.46 LOG-LIKELIHOOD FUNCTION = -39.909
LIKELIHOOD RATIO TEST = 511.099 WITH 11 D.F.

MADDALA R-SQUARE 0.5300
CRAGG-UHLER R-SQUARE 0.91022
MCFADDEN R-SQUARE 0.86493
ADJUSTED FOR DEGREES OF FREEDOM 0.86269
APPROXIMATELY F-DISTRIBUTED 6.9855 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.90920

PREDICTION SUCCESS TABLE

	ACTUAL 0	ACTUAL 1
PREDICTED 0	104.	7.
PREDICTED 1	3.	563.

NUMBER OF RIGHT PREDICTIONS = 667.
PERCENTAGE OF RIGHT PREDICTIONS = 0.98523

EXPECTED OBSERVATIONS AT 0 = 107.0 OBSERVED = 107.0
EXPECTED OBSERVATIONS AT 1 = 570.0 OBSERVED = 570.0
SUM OF SQUARED "RESIDUALS" = 8.1800
WEIGHTED SUM OF SQUARED "RESIDUALS" = 0.21485E+06

DURBIN-WATSON = 1.9332 VON NEUMANN RATIO = 1.9360 RHO = 0.03333
RESIDUAL SUM = 0.98398E-05 RESIDUAL VARIANCE = 0.12083E-01
SUM OF ABSOLUTE ERRORS= 19.777
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.9096
LOG-LIKELIHOOD FUNCTION = -39.90874

Table 5.24. Estimates of the logit model for farm workers with supplemental income in Northern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-3.7101***	0.46281	-0.41678E-01
QW	0.22258E-02	0.33550E-01	0.83696E-04
FR	1.7464	1.4284	0.27026E-02
L	0.40870	0.44128	0.31410E-02
AN	-0.63022E-04	0.56211E-03	-0.29328E-03
CL	0.41969	0.48308	0.87613E-03
Z1	0.40710E-01	0.75815	0.19182E-03
T1	1.3917*	0.74292	0.28222E-02
T2	0.64919	0.82695	0.66932E-03
T3	0.80132	0.76515	0.15158E-02
CONSTANT	10.514***	1.9803	0.59036E-01

LOG-LIKELIHOOD(0) = -384.44 LOG-LIKELIHOOD FUNCTION = -78.176
LIKELIHOOD RATIO TEST = 612.522 WITH 10 D.F.

MADDALA R-SQUARE 0.6052
CRAGG-UHLER R-SQUARE 0.87892
MCFADDEN R-SQUARE 0.79665
ADJUSTED FOR DEGREES OF FREEDOM 0.79351
APPROXIMATELY F-DISTRIBUTED 4.3093 WITH 10 AND 11 D.F.
CHOW R-SQUARE 0.84571

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	174.	16.
PREDICTED	1	4.	465.

NUMBER OF RIGHT PREDICTIONS = 639.
PERCENTAGE OF RIGHT PREDICTIONS = 0.96965

EXPECTED OBSERVATIONS AT 0 = 178.0 OBSERVED = 178.0
EXPECTED OBSERVATIONS AT 1 = 481.0 OBSERVED = 481.0
SUM OF SQUARED "RESIDUALS" = 20.046
WEIGHTED SUM OF SQUARED "RESIDUALS" = 693.14

DURBIN-WATSON = 1.8615 VON NEUMANN RATIO = 1.8643 RHO = 0.06924
RESIDUAL SUM = 0.32440E-05 RESIDUAL VARIANCE = 0.30419E-01
SUM OF ABSOLUTE ERRORS= 43.905
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8460
LOG-LIKELIHOOD FUNCTION = -78.17631

Table 5.25. Estimates of the logit model for farm workers with supplemental income in Southern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-1.1768***	0.12095	-0.52434E-01
QW	0.90009E-01	0.62581E-01	0.17926E-01
FR	-0.40541	0.80392	-0.38929E-02
L	0.14728	0.20259	0.10159E-01
AN	0.25947E-03	0.32182E-03	0.71410E-02
CL	0.57534	0.45335	0.71024E-02
Z1	0.17266	0.46246	0.22416E-02
Z2	0.54340	0.49744	0.39110E-02
T1	-0.25717	0.54589	-0.30459E-02
T2	0.87254	0.74343	0.51273E-02
T3	0.29795	0.60103	0.24566E-02
CONSTANT	3.6031***	0.87859	0.10652

LOG-LIKELIHOOD(0) = -211.20 LOG-LIKELIHOOD FUNCTION = -119.49
LIKELIHOOD RATIO TEST = 183.421 WITH 11 D.F.

MADDALA R-SQUARE 0.2462
CRAGG-UHLER R-SQUARE 0.51463
MCFADDEN R-SQUARE 0.43424
ADJUSTED FOR DEGREES OF FREEDOM 0.42447
APPROXIMATELY F-DISTRIBUTED 0.83731 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.47059

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	33.	9.
PREDICTED	1	32.	575.

NUMBER OF RIGHT PREDICTIONS = 608.
PERCENTAGE OF RIGHT PREDICTIONS = 0.93683

EXPECTED OBSERVATIONS AT 0 = 65.0 OBSERVED = 65.0
EXPECTED OBSERVATIONS AT 1 = 584.0 OBSERVED = 584.0
SUM OF SQUARED "RESIDUALS" = 30.965
WEIGHTED SUM OF SQUARED "RESIDUALS" = 951.20

DURBIN-WATSON = 1.8013 VON NEUMANN RATIO = 1.8041 RHO = 0.09727
RESIDUAL SUM = 0.27228E-07 RESIDUAL VARIANCE = 0.47712E-01
SUM OF ABSOLUTE ERRORS= 64.912
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4721
LOG-LIKELIHOOD FUNCTION = -119.4879

Table 5.26. Estimates of the logit model for farm workers with supplemental income in Visayas, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-1.9489***	0.16330	-1.0474
QW	0.11195E-01	0.13341E-01	0.15326E-01
FR	1.2273*	0.71713	0.77412E-01
L	0.81811E-01	0.31503	0.21025E-01
AN	0.53929E-04	0.16746E-03	0.13038E-01
CL	0.24467	0.35186	0.13676E-01
Z1	0.48661	0.44893	0.63566E-01
Z2	0.98972E-01	0.58263	0.31787E-02
T1	-0.61178	0.47055	-0.36275E-01
T2	0.77011E-01	0.48536	0.52798E-02
T3	-0.85676	0.53921	-0.31486E-01
CONSTANT	6.0230***	0.91283	1.1793

LOG-LIKELIHOOD(0) = -423.42 LOG-LIKELIHOOD FUNCTION = -141.46
LIKELIHOOD RATIO TEST = 563.917 WITH 11 D.F.

MADDALA R-SQUARE 0.5891
CRAGG-UHLER R-SQUARE 0.79932
MCFADDEN R-SQUARE 0.66591
ADJUSTED FOR DEGREES OF FREEDOM 0.66000
APPROXIMATELY F-DISTRIBUTED 2.1744 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.79174

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
PREDICTED	0	234.	22.
PREDICTED	1	12.	366.

NUMBER OF RIGHT PREDICTIONS = 600.
PERCENTAGE OF RIGHT PREDICTIONS = 0.94637

EXPECTED OBSERVATIONS AT 0 = 246.0 OBSERVED = 246.0
EXPECTED OBSERVATIONS AT 1 = 388.0 OBSERVED = 388.0
SUM OF SQUARED "RESIDUALS" = 31.353
WEIGHTED SUM OF SQUARED "RESIDUALS" = 16053.

DURBIN-WATSON = 1.9385 VON NEUMANN RATIO = 1.9415 RHO = 0.03076
RESIDUAL SUM = 0.51790E-04 RESIDUAL VARIANCE = 0.49452E-01
SUM OF ABSOLUTE ERRORS= 73.823
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7936
LOG-LIKELIHOOD FUNCTION = -141.4587

Table 5.427 Estimates of the logit model for farm workers with supplemental income in Mindanao, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-3.4736***	0.50332	-0.47381E-02
QW	0.26204***	0.10877	0.12740E-02
FR	0.92773	1.2029	0.24506E-03
L	0.88999***	0.29436	0.26028E-02
AN	-0.18935E-03	0.37014E-03	-0.18486E-03
CL	0.61409	0.86363	0.81010E-04
Z1	0.74005	0.73650	0.32217E-03
Z2	0.60580	1.9371	0.70148E-04
T1	-1.3513*	0.74611	-0.70118E-03
T2	-1.6581	1.2045	-0.13367E-03
T3	-1.4460	1.1029	-0.25858E-03
CONSTANT	8.3611***	1.8883	0.82479E-02

LOG-LIKELIHOOD(0) = -293.10 LOG-LIKELIHOOD FUNCTION = -39.865
LIKELIHOOD RATIO TEST = 506.463 WITH 11 D.F.

MADDALA R-SQUARE 0.5288
CRAGG-UHLER R-SQUARE 0.90947
MCFADDEN R-SQUARE 0.86399
ADJUSTED FOR DEGREES OF FREEDOM 0.86172
APPROXIMATELY F-DISTRIBUTED 6.9297 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.90830

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	103.	7.
PREDICTED	1	3.	560.

NUMBER OF RIGHT PREDICTIONS = 663.
PERCENTAGE OF RIGHT PREDICTIONS = 0.98514

EXPECTED OBSERVATIONS AT 0 = 106.0 OBSERVED = 106.0
EXPECTED OBSERVATIONS AT 1 = 567.0 OBSERVED = 567.0
SUM OF SQUARED "RESIDUALS" = 8.1891
WEIGHTED SUM OF SQUARED "RESIDUALS" = 0.20428E+06

DURBIN-WATSON = 1.9332 VON NEUMANN RATIO = 1.9360 RHO = 0.03342
RESIDUAL SUM = 0.91487E-05 RESIDUAL VARIANCE = 0.12168E-01
SUM OF ABSOLUTE ERRORS= 19.789
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.9087
LOG-LIKELIHOOD FUNCTION = -39.86490

Table 5.28. Estimates of the logit model for farm workers with supplemental off-farm and non-farm income in Northern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-3.5825***	0.45519	-0.51461E-01
QW	0.25933E-02	0.32474E-01	0.12562E-03
FR	1.8202	1.4142	0.36407E-02
L	0.40975	0.43629	0.39990E-02
AN	-0.42183E-04	0.56424E-03	-0.25550E-03
CL	0.40318	0.49009	0.10476E-02
Z1	0.29499E-01	0.74850	0.17491E-03
T1	1.2639*	0.74173	0.33563E-02
T2	0.59262	0.83884	0.75297E-03
T3	0.74464	0.76195	0.17814E-02
CONSTANT	10.092***	1.9549	0.72083E-01

LOG-LIKELIHOOD(0) = -369.32 LOG-LIKELIHOOD FUNCTION = -76.639
LIKELIHOOD RATIO TEST = 585.364 WITH 10 D.F.

MADDALA R-SQUARE 0.6086
CRAGG-UHLER R-SQUARE 0.87715
MCFADDEN R-SQUARE 0.79249
ADJUSTED FOR DEGREES OF FREEDOM 0.78910
APPROXIMATELY F-DISTRIBUTED 4.2009 WITH 10 AND 11 D.F.
CHOW R-SQUARE 0.84231

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
PREDICTED	0	170.	17.
PREDICTED	1	4.	433.

NUMBER OF RIGHT PREDICTIONS = 603.
PERCENTAGE OF RIGHT PREDICTIONS = 0.96635

EXPECTED OBSERVATIONS AT 0 = 174.0 OBSERVED = 174.0
EXPECTED OBSERVATIONS AT 1 = 450.0 OBSERVED = 450.0
SUM OF SQUARED "RESIDUALS" = 19.786
WEIGHTED SUM OF SQUARED "RESIDUALS" = 616.32

DURBIN-WATSON = 1.8502 VON NEUMANN RATIO = 1.8531 RHO = 0.07473
RESIDUAL SUM = 0.22013E-05 RESIDUAL VARIANCE = 0.31709E-01
SUM OF ABSOLUTE ERRORS= 43.198
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8426
LOG-LIKELIHOOD FUNCTION = -76.63858

Table 5.29. Estimates of the logit model for farm workers with supplemental off-farm and non-farm income in Southern Luzon, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-1.1921***	0.12723	-0.39106
QW	0.72770E-01	0.57891E-01	0.78369E-01
FR	0.35613	0.79837	0.22314E-01
L	-0.74344**	0.22059	-0.25423
AN	0.68329E-03*	0.34368E-03	0.10934
CL	-0.83255*	0.44386	-0.22566
Z1	-0.31404	0.45526	-0.26191E-01
Z2	0.43279	0.56535	0.13143E-01
T1	1.1657*	0.59316	0.73445E-01
T2	2.4843***	0.76650	0.90081E-01
T3	1.4397***	0.62115	0.77655E-01
CONSTANT	4.1724***	1.2397	0.70163

LOG-LIKELIHOOD(0) = -221.96 LOG-LIKELIHOOD FUNCTION = -109.47
LIKELIHOOD RATIO TEST = 224.983 WITH 11 D.F.

MADDALA R-SQUARE 0.4547
CRAGG-UHLER R-SQUARE 0.65166
MCFADDEN R-SQUARE 0.50681
ADJUSTED FOR DEGREES OF FREEDOM 0.49170
APPROXIMATELY F-DISTRIBUTED 1.1211 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.57226

PREDICTION SUCCESS TABLE

	ACTUAL 0	ACTUAL 1
PREDICTED 0	79.	16.
PREDICTED 1	27.	249.

NUMBER OF RIGHT PREDICTIONS = 328.
PERCENTAGE OF RIGHT PREDICTIONS = 0.88410

EXPECTED OBSERVATIONS AT 0 = 106.0 OBSERVED = 106.0
EXPECTED OBSERVATIONS AT 1 = 265.0 OBSERVED = 265.0
SUM OF SQUARED "RESIDUALS" = 32.386
WEIGHTED SUM OF SQUARED "RESIDUALS" = 394.97

DURBIN-WATSON = 1.2336 VON NEUMANN RATIO = 1.2369 RHO = 0.38237
RESIDUAL SUM = 0.14531E-07 RESIDUAL VARIANCE = 0.87294E-01
SUM OF ABSOLUTE ERRORS= 65.475
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5723
LOG-LIKELIHOOD FUNCTION = -109.4664

Table 5.30. Estimates of the logit model for farm workers with supplemental off-farm and non-farm income in Visayas, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-1.8971***	0.15010	-1.2256
QW	0.93485E-02	0.13364E-01	0.15116E-01
FR	1.3305*	0.67256	0.97841E-01
L	0.14697	0.29221	0.44101E-01
AN	0.81569E-04	0.16120E-03	0.22136E-01
CL	-0.13095E-01	0.33981	-0.91604E-03
Z1	0.51661	0.43721	0.79194E-01
Z2	0.18896	0.54960	0.77791E-02
T1	-0.44117	0.44475	-0.30862E-01
T2	0.87275E-01	0.45875	0.72152E-02
T3	-0.74198*	0.51564	-0.30547E-01
CONSTANT	5.6126***	0.85052	1.2925

LOG-LIKELIHOOD(0) = -462.95 LOG-LIKELIHOOD FUNCTION = -156.19
LIKELIHOOD RATIO TEST = 613.520 WITH 11 D.F.

MADDALA R-SQUARE 0.5901
CRAGG-UHLER R-SQUARE 0.79774
MCFADDEN R-SQUARE 0.66262
ADJUSTED FOR DEGREES OF FREEDOM 0.65713
APPROXIMATELY F-DISTRIBUTED 2.1426 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.79093

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
PREDICTED	0	263.	22.
PREDICTED	1	12.	391.

NUMBER OF RIGHT PREDICTIONS = 654.
PERCENTAGE OF RIGHT PREDICTIONS = 0.95058

EXPECTED OBSERVATIONS AT 0 = 275.0 OBSERVED = 275.0
EXPECTED OBSERVATIONS AT 1 = 413.0 OBSERVED = 413.0
SUM OF SQUARED "RESIDUALS" = 34.514
WEIGHTED SUM OF SQUARED "RESIDUALS" = 14177.

DURBIN-WATSON = 1.9647 VON NEUMANN RATIO = 1.9676 RHO = 0.01732
RESIDUAL SUM = 0.12249E-03 RESIDUAL VARIANCE = 0.50166E-01
SUM OF ABSOLUTE ERRORS= 81.246
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.7928
LOG-LIKELIHOOD FUNCTION = -156.1906

Table 5.31. Estimates of the logit model for farm workers with supplemental off-farm and non-farm income in Mindanao, Philippines, 1990.

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ELASTICITY AT MEANS
RA	-3.4714***	0.50861	-0.45923E-02
QW	0.26693***	0.10988	0.12557E-02
FR	0.92563	1.2394	0.23406E-03
L	0.86784***	0.30573	0.24796E-02
AN	-0.22215E-03	0.36747E-03	-0.21259E-03
CL	0.43393	0.87135	0.55935E-04
Z1	0.90362	0.75637	0.37038E-03
Z2	0.54309	1.9113	0.62140E-04
T1	-1.2628*	0.74790	-0.63102E-03
T2	-1.7050	1.2098	-0.13582E-03
T3	-1.4933	1.1081	-0.26170E-03
CONSTANT	8.3947***	1.9301	0.80125E-02

LOG-LIKELIHOOD(0) = -287.34 LOG-LIKELIHOOD FUNCTION = -38.922
LIKELIHOOD RATIO TEST = 496.841 WITH 11 D.F.

MADDALA R-SQUARE 0.5295
CRAGG-UHLER R-SQUARE 0.90991
MCFADDEN R-SQUARE 0.86454
ADJUSTED FOR DEGREES OF FREEDOM 0.86224
APPROXIMATELY F-DISTRIBUTED 6.9627 WITH 11 AND 12 D.F.
CHOW R-SQUARE 0.90934

PREDICTION SUCCESS TABLE

		ACTUAL 0	ACTUAL 1
	0	102.	6.
PREDICTED	1	2.	549.

NUMBER OF RIGHT PREDICTIONS = 651.
PERCENTAGE OF RIGHT PREDICTIONS = 0.98786

EXPECTED OBSERVATIONS AT 0 = 104.0 OBSERVED = 104.0
EXPECTED OBSERVATIONS AT 1 = 555.0 OBSERVED = 555.0
SUM OF SQUARED "RESIDUALS" = 7.9405
WEIGHTED SUM OF SQUARED "RESIDUALS" = 0.17511E+06

DURBIN-WATSON = 1.9212 VON NEUMANN RATIO = 1.9241 RHO = 0.03941
RESIDUAL SUM = 0.99072E-05 RESIDUAL VARIANCE = 0.12049E-01
SUM OF ABSOLUTE ERRORS= 19.246
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.9098
LOG-LIKELIHOOD FUNCTION = -38.92215

employment decreases by about 3.78, *ceteris paribus*.

The level of education has a direct relationship with the odds of farm employment. This means that the more years the individual spent in school, the greater is the likelihood of farm employment, be it solely in farm work or with supplemental income from off-farm and non-farm employment. Eleven of the twelve estimated coefficients of Q_w across all regions conform to this hypothesis and five are statistically significant. To cite a specific example, the farm workers in Mindanao (*LMN*) increase their likelihood of farm employment, *ceteris paribus*, by about 0.26 per unit increase in the level of education.

The estimated coefficients of the dependency ratio (F_r) variable conform to the hypothesis forwarded earlier that R is positively related to F_r except for the estimated F_r coefficient in the LSL_o model which is insignificant anyway. However, for the positive coefficients, the significant estimates come only from seven models. Nevertheless, this implies that in a general sense, the higher the dependency ratio (lower dependents), the higher the likelihood of gainful farm employment. As a specific example, the logarithm of the odds of farm employment for farm workers with supplemental off-farm income from Visayas increases by about 1.22 per unit increase in the dependency ratio, *ceteris paribus*. With respect to the average size of landholdings, it should not be very difficult to embrace the idea that the higher the average size of landholdings in the area the higher is the likelihood of gainful farm employment. At least in direction, this hypothesis is being supported by ten of the twelve models. Four of the positive estimates are statistically significant. For those farm workers in Northern Luzon whose income comes only from farm work (*LNL*), the logarithm of the odds of gainful farm employment increases by 0.77, *ceteris paribus*, per unit increase in the average hectarage of landholdings in the area. Among the negative estimates, one is statistically significant. It is interesting to note that this significant but negative estimate refers to the LSL_{on} model which applies to farm workers from Southern Luzon with supplemental income from both off-farm and non-farm work. These two factors associated with income and geographic location could have, in combination, contributed to the inverse relationship. The fact that farm work is being supplemented by off-farm and non-farm income can easily account for the lower likelihood of farm work. Moreover, the proximity of Southern Luzon to the National Capital Region, the centre for government and trade can possibly account for the greater non-farm work opportunities and thus reducing the likelihood of farm employment.

Based on the idea of competition, it is argued that the higher the number of potential workers, the lesser the likelihood of farm employment. This proposition, however, is not being supported by the estimated parameters. Among the twelve models, six have shown positive results and the remaining six showed negative estimates. All these estimated parameters are statistically insignificant. The plausible explanation to this result, as argued in the labour supply model, pertains to the measurement of the effective labour force (A_n). The value of A_n is derived from the total population of the Barangay including the elders and children, adjusted for effective labour force by the actual age distribution of household members from the sample of 20 households per Barangay. This sample size may not be a sufficient source of an adjustment factor to capture the effective labour force.

Whether or not the land is irrigated is expected to bear a significant relationship with the likelihood of farm employment. This relationship is being measured by the dummy variable C_l. Irrigated lands are associated with higher cropping intensity, hence, greater employment opportunities. At least in direction, this hypothesis is being supported by most of the estimated coefficients of C_l across the models. However, the significant estimates only come from three models (*LNL*, *LSL*, and *LVS*). For instance, the likelihood of farm employment is higher in irrigated lands relative to non-irrigated lands in the case of farm workers in Northern Luzon.

Geographically, it has been argued that employment opportunities vary with respect to the ecological zones, that is, whether the area is within a lowland, coastal or upland zones. This argument is being captured by two dummy variables (Z_1 and Z_2) to capture the three zones. However, for Northern Luzon where there are no coastal areas, as far as the sample is concerned, the variable only involves Z_1 to evaluate the difference between lowland and upland. Across all models, only the difference in the odds of farm employment between lowland and those otherwise is being supported by the estimates. Eleven of the estimates of Z_1 are positive which conform to the hypothesis. Among these positive coefficients, five are statistically significant. The logarithm of the odds of farm employment, assuming all other factors constant, is higher for those living in the lowland than for those who are in the upland or coastal areas.

However, the coefficient for Z_2 has been indicated as statistically insignificant either way. This implies that the odds of farm employment between coastal and upland zones are not different.

Consistent with the concept of farm work aversion, tenure dummy is expected to be inversely related to the logarithm of the odds of farm work employment. This implies that those who belong to the lowest strata in the tenurial structure will have lesser aversion to do farm work - they are more willing and therefore have the higher likelihood to be in farm work employment.

The estimated coefficients provide a mixture of results. Across all models, the estimates for T_1 (T_1 = 1 if owner operator, 0 otherwise) yield seven negative results which conform to the hypothesis and five positive results which are otherwise contrary. Four of the negative estimates are statistically significant and five of the positive estimates are significant.

For the T_2 tenure dummy (T_2 = 1 if leaseholder, 0 otherwise), nine of the estimates are inconsistent in sign but all are not significant. The remaining three estimates are negative and are all statistically significant.

The estimated parameters for T_3 (T_3 = 1 if shareholder; 0 otherwise) are equally distributed in terms of sign: six are positive and six are negative. It is interesting to note that all the six positive estimates except one (LSL_{on}), are insignificant and all the consistent negative estimates are statistically significant.

At the outset, the results outlined above would seem meaningless but a closer examination can provide some sort of plausible pattern. The dummy variable T_1 attempts to capture the difference between those who are at the highest ladder of the tenurial structure and those who are not. The dummy variable series extends to capture the differences at the lower level of the tenurial structure until the lowest group - the landless workers.

The estimated coefficient of T_1 does not provide for a tentative interpretation of the results either way. However, going down to the estimates of the coefficients of T_2 and T_3, a pattern can be seen considering that most of the significant negative estimates are those that pertains to the tenure dummy pertaining to the lower tenurial forms.

This implies that at the upper end of the tenurial structure, tenure is not a relevant factor to differentiate the likelihood of farm work employment. However, at the lower end of the tenurial structure, it can be argued that landless workers (when $T_3 = 0$) would have lesser aversion to do farm work and are therefore more likely to get farm work employment. For instance, the logarithm of the odds of farm work employment for landless farm workers with off-farm supplement for Southern Luzon (LSL_o) is higher than those who otherwise have greater security of access to and use of land.

As pointed out earlier, the change in the probability with respect to a change in any particular variable depends not only on the variable but also on the value of the probability itself at which the change is being evaluated. Moreover, the probability depends upon the values of the explanatory variables in the model. This leads to the problem of choice as to which values should be used to establish the probability and evaluate the marginal probability changes with respect to the independent variables. Pindyck and Rubinfeld (1981) suggested that the probability value be evaluated at the mean values of the independent variables.

The estimated changes in the probability are presented in Table 5.32 for the models across regions. To cite a specific case, consider the estimated probability change for the model *LSL*. At their mean values, the change in the probability of the likelihood of farm employment is dominated by the ratio of the non-work asset to the absolute poverty threshold, the dependency ratio, the average size of landholdings and the binary variables capturing the qualitative attributes of land tenure. For instance, as the ratio of non-work income to the poverty threshold increases by one unit, the likelihood of farm work employment declines by about 4 percent. A unit increase in

Table 5.32. Change in probability evaluated at the mean values of the variables.

Variable	MODELS											
	NL	SL	VS	MN	NL_o	SL_o	VS_o	MN_o	NL_{on}	SL_{on}	VS_{on}	MN_{on}
R_a	-.038	-.066	-.268	-.001	-.053	-.077	-.234	-.006	-.064	-.132	-.269	-.047
Q_w	.00007	-.0002	.001	.0001	.00003	.005	.001	.0005	.00004	.008	.001	.003
F_r	.022	.052	.189	.0005	.025	-.026	.147	.001	.032	.039	.188	.012
L	.007	-.018	.019	.0005	.005	.009	.009	.001	.007	-.082	.020	.011
A_n	-.18E-5	.00001	.00001	-.11E-6	-.91E-6	.00001	.65E-5	-.37E-6	-.76E-6	.00007	.00001	-.31E-5
C_l	.005	.021	.0005	.0003	.006	.037	.029	.001	.007	-.092	-.001	.005
Z_1	.002	-.007	.072	.0004	.0005	.011	.058	.001	.0005	-.034	.073	.012
Z_2		.010	.025	.0003		.035	.011	.001		.047	.026	.007
T_1	.012	.035	-.061	-.0007	.020	-.016	-.073	-.002	.022	.129	-.062	-.017
T_2	.005	.068	.014	-.0009	.009	.057	.009	-.003	.010	.275	.012	-.023
T_3	.007	.052	-.101	-.0008	.011	.019	-.103	-.002	.013	.159	-.105	-.020

the average size of farm holdings in the community increases the odds of farm work employment by about one percent. At the lower end of the tenurial structure, the likelihood of farm work employment is higher by 2 percent for the landless worker than those with more secure tenure. Aside from using the logit models to evaluate the impact of the variables to the probability of farm work employment, the model can readily lend itself to predictive purposes. Suppose an individual farmer in Southern Luzon possesses the following attributes:

1. value of asset is about 36,000 (R_a=4);
2. completed grade 5 (Q_w=5);
3. only worker with 5 children (F_r=.25);
4. the average land size is 3.5 (l=3.5);
5. the adjusted population (A_n=1000);
6. the farm is irrigated lowland (Z_1=1 and C_1=1);
7. only source of income is farm work; and
8. landless (T_1, T_2, and T_3 = 0)

Using the *LSL* model, the probability that such an individual will be in farm work employment is about 70 percent.

Across all the logit models, the likelihood ratio has been consistently shown to be highly significant (at least up to 0.1 percent level) based on a Chi Square test. This plainly implies that the models across regional groupings predicts the likelihood of farm employment a lot better than simply a random chance such as flipping a coin. The goodness of fit based on the McFaddens R^2 is about 0.70 on the average across all models. This indicates that about 70 percent of the variation in the samples likelihood of farm employment is explained by the variables considered in the estimated logit function. Because by definition of the logit model the R^2 is normally low, then the 70 percent average R^2 can be considered as an adequate indicator that the model fits the data quite well.

Finally, except for the case of *LSL* and LSL_{on} with a prediction rate of about 85 percent, all the other models indicate a higher percentage of prediction rate which on the average exceeding 95 percent on the average.

CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS

6.1. Summary of the Methodology

The interest in this research was drawn from the glaring facts of massive poverty and income inequality in the rural areas of the Philippines. As pointed out earlier, the inefficacy of development strategies, policies and programs relates to the failure of policy makers to acquire appropriate information about rural workers. The set of information is categorised into two analytical sub-groups. The first refers to those set of information that lends itself to situational or descriptive analysis. The analytical requirements of this first data set can be readily achieved by basic measures of central tendencies, distribution and dispersion.

The second relates to the relationships of some attributes of the farmers as well as the communities in the context of work allocation behaviour. Specifically, the methods include the estimation of a labour supply model, test for structural changes and an estimation of a probability model of farm work employment.

The latter involves three major methodological approaches. The estimation of the labour supply was done with the comparison of the neoclassical model, both the conventional linear and quadratic models, with that of a labour supply model in a bounded rationality framework expressed in a system of simultaneous equations. The test for structural changes involves the estimation of the effects of some categorical variables by using dummy variables to determine differentials in both intercept and slope coefficients. Finally, the probability of farm work employment was estimated using the logistic probability distribution (logit) model.

6.2. Summary of Findings

6.2.1. The Socio-Economic Profile

Statistics derived from the Benchmark Survey simply confirms, at least in a descriptive context, the depressed state of Philippine rural communities. An average family size of six is too large for a population of which about 40 percent live below the absolute poverty threshold. One of the main factors that fuel social discontent is the state of social inequity. This is being indicated by a Gini Ratio of about 46 for both income and landholdings. Further, the agrarian structure is such that about half of the sample is characterised by an unsecured access to the use of lands. Other attributes such as very low level of education and the type of dwelling mainly made of light materials like bamboo, nipa and cogon grass compound the bleak picture of the existing socio-economic conditions of the rural areas in the Philippines.

6.2.2. The Labour Supply

The main argument in this research pertains to the relationship between the level of work and the level of wage rate. This, however, does not necessarily ignore the effects of the other variables such as the dependency ratio, non-work income, land size and tenure among others.

Based on the neoclassical economic framework, the relationship between work and wage rate is inverse. This is exhibited in both the strictly linear and quadratic models. In the quadratic model, the inflection point at which the labour supply curves bends upward is at the higher end of the wage rate axis where relatively few cases are being observed, hence, for all practical purposes, the curve is strictly inverse.

This results facilitated the estimation of the labour supply model in a bounded rationality framework in a system of simultaneous equations. Similarly, the relationship between work and wage rate is established as inverse. The level of work is also influenced by other socio-economic attributes, in particular, by the attributes outlined above. The variable on the effective labour force which has consistently been exhibited as having an insignificant relationship with the level of work is an exception. With respect to the qualitative variables, it has been indicated that across tenurial groups, ecological zones and even across some cropping patterns, the labour supply behaviour tends to indicate significant variations. It is worth noting that the overall goodness of fit of the models is far from the ideal that is expected and desired as indicated by the low coefficient of determination across all models. This however, does not necessarily mean that the results are meaningless and insignificant.

6.2.2. The Logit Model

The estimates of the logistic probability models for the odds of farm employment indicated that the likelihood of farm employment is mainly influenced by the ratio of non-work income to the absolute poverty threshold, the dependency ratio, the average size of land holdings and the tenurial dummy variables.

6.3. Conclusions

The inverse relationship between the level of wage rate and the level of work, both in the conventional linear and quadratic models, is not a surprising result. This simply conforms to the established pattern that in poor agrarian communities, the estimate of the wage rate parameter in a model relating work to the level of wage rate tends to be negative (Pencavel, 1986). This relationship paves the way for the argument that the neoclassical economic framework is not adequate, conceptually, to explain the labour supply behaviour in poor agrarian communities.

One of the limitations of the neoclassical economic analysis of the labour supply is the treatment of non-work income. In conventional theory, non-work income is an exogenous variable that affects the labour supply only as a parameter that shifts the labour supply function. In the bounded rationality framework, farm work behaviour is simultaneously determined with the level of wage rate, the level of non-work income and the inherent tendency to avoid farm work.

The results, in general, conform to the proposition that farm work behaviour is more appropriately represented by a simultaneous system. It has been indicated that work aversion is directly associated with non-work income relative to the poverty threshold. The level of dependency is also a critical factor in the model, that is, the more dependents there are in the family, the lesser is the tendency to avoid farm work.

The results also indicated that the higher the level of non-work income the higher is the level of wage rate, the lower is the number of dependents and the higher is the level of education.

Simultaneously, the lower level of work is associated with higher wage rate and unirrigated farm lands. Meanwhile, a higher level of wage rate is associated with a lower level of farm work and lower level of education. Further, within the bounded rationality framework, the farm work behaviour is significantly different across the tenurial structure, ecological zone and cropping patterns.

Because of the very different methodological approaches that were adopted between the estimation of the labour supply model in the neoclassical economic framework vis-a-vis the labour supply model in a bounded rationality framework there is no direct statistical measure to assess whether one analytical framework, is better than the other. However, it is argued that the bounded rationality framework provides a more plausible conceptual basis for an inverse relationship between the level of wage rate and the level of farm work. The conceptual framework based on the bounded rationality theory yields a strictly downward sloping labour supply curve. In the neoclassical framework, the empirical evidence suggesting inverse relationship between the level of work and the level of wage rate is often, after the fact, justified by some ad hoc arguments, such as the *limited aspiration and target income* hypothesis.

Consistent with the idea of work aversion, the probability of gainful farm employment is lower for those with higher non-work income in relation to the absolute poverty threshold. Also, the higher the likelihood of access to gainful employment, the higher is the level of education, the lower is the number of dependents, the higher is the average size of landholdings, the higher is the cropping intensity (associated with irrigated lands) and the lower is the status of the individual in terms of the tenurial structure.

6.4. Implications for Policy

6.4.1. Implications of the Labour Supply Model

The main arguments of this research are anchored on the proposition that the neoclassical economic framework of analysis has been inadequate in providing explanations to the empirical evidence established earlier in past labour supply studies. The result in this research conforms to what has been established in past empirical works, that is, the level of work in depressed agrarian societies is inversely related to the level of wage rate. What is interesting to note is that such a behaviour lends itself to the analytical framework based on the theory of *bounded rationality*. Hence, the results provide critical relevance to rural development efforts by the Philippine government both in terms of the theoretical foundations and in specific strategies, policies and programs. The attempts of the government to mitigate the problems of massive rural poverty and income inequality are still anchored on the neoclassical paradigm that labour supply is a direct function of the level of wage rate. For instance, it has been argued that growth leads to wage increases because an increase in labour demand also raises the level of wage rate (Adelman, 1986) and that rural labour supply is highly elastic because of a large pool of idle and extremely low productive labour (Mellor, 1986). The empirical evidence that in depressed agrarian societies the level of work is inversely related to the level of wage rate poses a question to such neoclassical economic wisdom. Further, in consideration of the proposition that there is an inherent tendency to avoid farm work and that given a certain level of non-work income, work is pegged at a certain level and the search is focused on a satisfactory level of wage rate, then the existing economic framework for rural development strategies needs to be reexamined.

In the late 1960s, the Philippine economy was an envy of neighbouring Southeast Asian nations. However, the legacy of the corrupt dictatorial administration of Mr.Marcos from 1965 to 1986 has caused a set back in Philippine economy so drastic that the country now is at the bottom end in terms of economic well being relative to its Southeast Asian neighbours.

Since the end of the Marcos dictatorship, the goal of subsequent government administrations is to catch up with the economic performance of the so called *Asian Tiger Economies*. The economic battle cry is "Philippines: Newly Industrialised Economy (NIC) by the year 2000". This is believed to result into cutting short the normal path towards industrialisation. This concept has put the focus on growth oriented strategies which are biased against a major sector in the economy - the agriculture sector. Immediately after the ouster of Mr. Marcos, the strategy was more oriented towards growth and equity via a comprehensive agrarian reform program. However, the program has been put into the sideline because of the desire to cut short the development process in order to fast track the industrialisation strategies. Instead of pursuing vigorously with the agrarian reform program, the resources are now concentrated into the development of industrial enclaves, often referred to as Export Processing Zones and Industrial Zones, relying on the notion that growth will eventually trickle down.

At this point in its development stage, agriculture is still a very dominant sector of the Philippines. Therefore policies should focus on the agriculture sector and implicitly the rural workers.

Based on the notion that rural workers have the tendency to avoid farm work not only because it is back breaking but also perceived to be demeaning, there are specific policies that can be adopted and existing policies reformed. For instance, the legislated minimum agricultural wage needs to be reviewed because it is ineffective. The policy is only implemented in corporate and commercial farms affecting a negligible proportion of the rural workers. This is also redundant because corporate and commercial agricultural farm workers are already unionised and can therefore exercise their bargaining power which in some cases may allow them greater benefits than what is being structured under the legislation. Further, the economic framework from which the wisdom of legislated minimum wages has been derived is not realistic.

If agriculture is a significant sector in the economy and that if rural work behaviour is tied up with the characteristic of farm work, then policies can also be tailored to accommodate such peculiarities. At present, policies are biased against the agricultural sector. Agricultural products are subjected to price ceilings to protect the politically relevant and powerful urban consumers.

In this context there are a couple of policies that can be adopted to correct and at the same time reduce the stigma attached to farm work. Agriculture can be made more profitable. This can be achieved provided the existing marketing structure is also made more efficient by eliminating price ceiling policies. Similarly, growth in agriculture can be increased by providing appropriate support and subsidies. Also, labour-neutral technological innovations can be developed and tailored to the existing land holding structure not only to improve productivity but also to reduce the irksomeness of farm work.

While it is true that in the long run as the society transforms itself from agrarian based to industrial based and eventually to service and information based societies, the share of agriculture will decline in absolute terms, it is still very necessary to sustain growth in agriculture. Hence, constant monitoring of rural work behaviour is still of paramount significance and implicitly, the appropriate analytical framework is *sine qua non*.

It has been established that the more dependents there are in the household the higher is the pressure to do more farm work to support the household's consumption requirements. The policy implications of this relationship touches into the very core of Philippine culture. To date the population growth rate of the Philippines ranks one of the highest in Asia. Concerns have been raised that this state of rapidly expanding population and subsequently relatively larger family size undermine the development efforts of government. It has been argued that it is not reasonable to be raising larger families amidst poverty.

While these arguments make practical sense, it is very difficult to inculcate these into a population that is devoutly catholic. Hence, any population policy measures aimed at mitigating the population problem must also incorporate measures to break down the religious barriers or at least not inconsistent with the doctrine of the catholic church.

Finally, any policy measure or program that bear direct relevance to farm work behaviour should account for the established differences across some community attributes. In particular, the farm work behaviour varies across the tenurial structure and across cropping patterns. This implies that the present classification of rural workers, for instance, for purposes of the legislated minimum wage as "agricultural workers", need to be revised to account for the variation.

6.4.2. Implications of the Logit Model

The results of the logit model which estimate the relationship between the likelihood of farm employment and some socio-economic attributes, may provide some indicative directions for policy in so far as providing greater employment opportunities in the rural areas.

First of all, it must be noted that there is an inherent tendency to avoid farm work assuming that the decision maker has some form of economic leverage or source of non-work income. Also, while it has been indicated that the more dependents there are in the household, the greater is the pressure to do more farm work, the logit model has indicated that the likelihood of farm employment is lesser as the number of dependents increases. This too implies some policy measures that may help mitigate the problem of over population and a very high rate of population growth in the Philippines.

In the rural areas, irrigated lands provide more farm employment opportunities. Obviously, this indicates that irrigation projects are significant avenues to provide more employment opportunities in the rural areas.

Finally, those who belong to the lower stratum in the tenurial structure has the higher tendency to do farm work. This relationship bears significant implications to policies aimed at providing a more equitable distribution of land and income. In the long run, programs like agrarian reform can shift the benefits of the use of land to the actual tillers of the land. However, programs and policies can be formulated to make farming more profitable and some technological innovations may be developed to make farm work less back-breaking and demeaning.

6.5. Implications for Further Research

The estimated models in this study have been limited in terms of the overall reliability of each individual models particularly the labour supply models because of the less than satisfactory level of the coefficient of determination. Ideally, estimation of labour supply can best be estimated from a data set derived through a diary type survey. However, because of time and financial constraints, such an ideal condition could not be achieved. Hence, the study had to make use of an existing data set drawn from a survey using the recall method.

Further, since total work is often a combination of farm work, off-farm work and non-farm work, it would be more appropriate if a study on labour supply can be done where the three types of employment can be isolated with their respective quantities and corresponding levels of wage rate.

Furthermore, non-work income has been established as a critical factor in the labour supply behaviour. A study that covers a wider range of non-work income could provide a better account of the relationship. Hence, studies that addresses the concerns presented above could provide more accurate estimates.

Also, the *bounded rationality* framework, particularly in relation to the inherent aversion to farm work as employed in this research, can be used to dispel the myth that rural-urban migration is basically determined by greater employment opportunities in the urban areas. One may be able to establish that those rural folks who migrated to the metropolitan areas more often than not ended up being sucked into the urban slams and be worse off in terms of well being compared to doing farm work in the rural areas.

Finally, the analysis of labour supply in rural Philippines is only one of the direct applications of the conceptual framework on consumer behaviour based on the theory of *bounded rationality* and of Maslow's theory of the hierarchy of needs. A closer examination of the framework and additional assumptions and modifications of the theory on hierarchy of needs, updated to the consumption patterns of a more commercialised society, can lead to an analytical framework that can be used for an empirical work on consumer behaviour, in general and demand estimation, in particular.

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Annex A

The Neoclassical Labour Supply Function

Formally, suppose that the level of satisfaction or the level of utility is derived from combining the consumption of goods and leisure. Thus the choice is a combination that is optimal subject to the time, price and income constraints.

Further, suppose that the total number of hours available for work and leisure is H, the number of hours spent for work is W and the wage rate is S, then the utility function can be expressed as:

$$U = f(E,Y) \tag{A.1}$$

and the time and budget constraints are

$$H = (E + W) \tag{A.2}$$

$$Y = (WS) \tag{A.3}$$

where

U	-	total utility
E	-	leisure time
Y	-	income
H	-	total time available
W	-	time of work
S	-	wage rate

Taking the total differential of the utility function yields

$$dU = \left(\frac{\partial U}{\partial Y}\right) dY + \left(\frac{\partial U}{\partial E}\right) dE$$

Since along an indifference curve dU = 0, then:

$$\frac{dY}{dE} = -\left(\frac{\partial U/\partial E}{\partial U/\partial Y}\right)$$

The above expression is referred to, in indifference curve analysis, as the marginal rate of substitution between leisure and income. Since the marginal utility of both income and leisure are assumed to be positive, then the marginal rate of substitution is strictly negative. The indifference curve slopes downward.

Equations (A.2) and (A.3) representing the time and income constraints, can be combined to form a single constraint. Thus,

$$Y = (H - E)S \qquad \text{(A.4)}$$

To search for optimal solutions, the Lagrangean function (Henderson and Quandt, 1971) can be formed and the first derivative of U can be evaluated at zero, which yields:

$$L = U(E,Y) + \lambda[S(H-E) - Y] \qquad \text{(2.5)}$$

$$\frac{\partial L}{\partial E} = \frac{\partial U}{\partial E} - \lambda S = 0 \qquad \text{(A.6)}$$

$$\frac{\partial L}{\partial Y} = \frac{\partial U}{\partial Y} - \lambda = 0 \qquad \text{(A.7)}$$

Therefore,

$$\frac{\partial U/\partial E}{\partial U/\partial Y} = S \qquad \text{(A.8)}$$

From equations (A.2) and (A.3), it is apparent that if the individual does not work then $W = 0$ and $E = H$. Conversely, if all of H is used for work then $Y = SH$. Hence, the income-leisure line rises to SH with S as the slope.

Thus, equation (A.8) simply indicates that, at equilibrium conditions, the marginal rate of substitution between leisure and income should be equal to the wage rate S. Implicitly, expression (A.8) indicates the relationship between work (W) and wage rate (S) because both leisure and income are functions of W. In other words, given the wage rate, the individual allocates between income and leisure and by residual, allocates time for work.

Suppose that wage rate increases. This will cause an increase in the slope of the income-leisure line equivalent to the change in S. Consequently, the allocation of the total number of hours available between work and leisure changes as the individual is raised to a higher level of utility $\{U=f(E,Y)\}$. This movement, however, is dependent upon two distinct economic adjustments: the income effect and the substitution effect. The income effect is a direct consequence of the rise in S given $Y=SW$. However, a rise in wage rate also means an increase in the opportunity cost of leisure. Thus, leisure becomes relatively expensive and, as a consequence, the individual substitutes leisure for work.

To illustrate this, consider Figure A.1. Line segment HF is the income leisure line (analogous to the budget line with slope equal to S). Relating this line to the indifference curve $IC1$, then the optimal combination of leisure and work is at point A corresponding to a level of leisure E_1 and by residual, a level of work at W_1. Suppose S increases from S_1 to S_2, then the income leisure line rotates clockwise to a new line HG. The new relevant indifference curve would now be IC_2. Hence the optimal allocation of work and leisure changes.

Obviously, the new equilibrium is at point B where the marginal rate of substitution (MRS_{EY}) between leisure and income is equal to the new wage rate S2. In standard economic terminology, the movement from point A to point B is referred to as the gross substitution effect. The gross substitution effect is further referred to as the sum of the compensated substitution effect and the pure income effect. The movement from point A to point C is called the compensated substitution effect and the movement from point C to point B is the pure income effect.

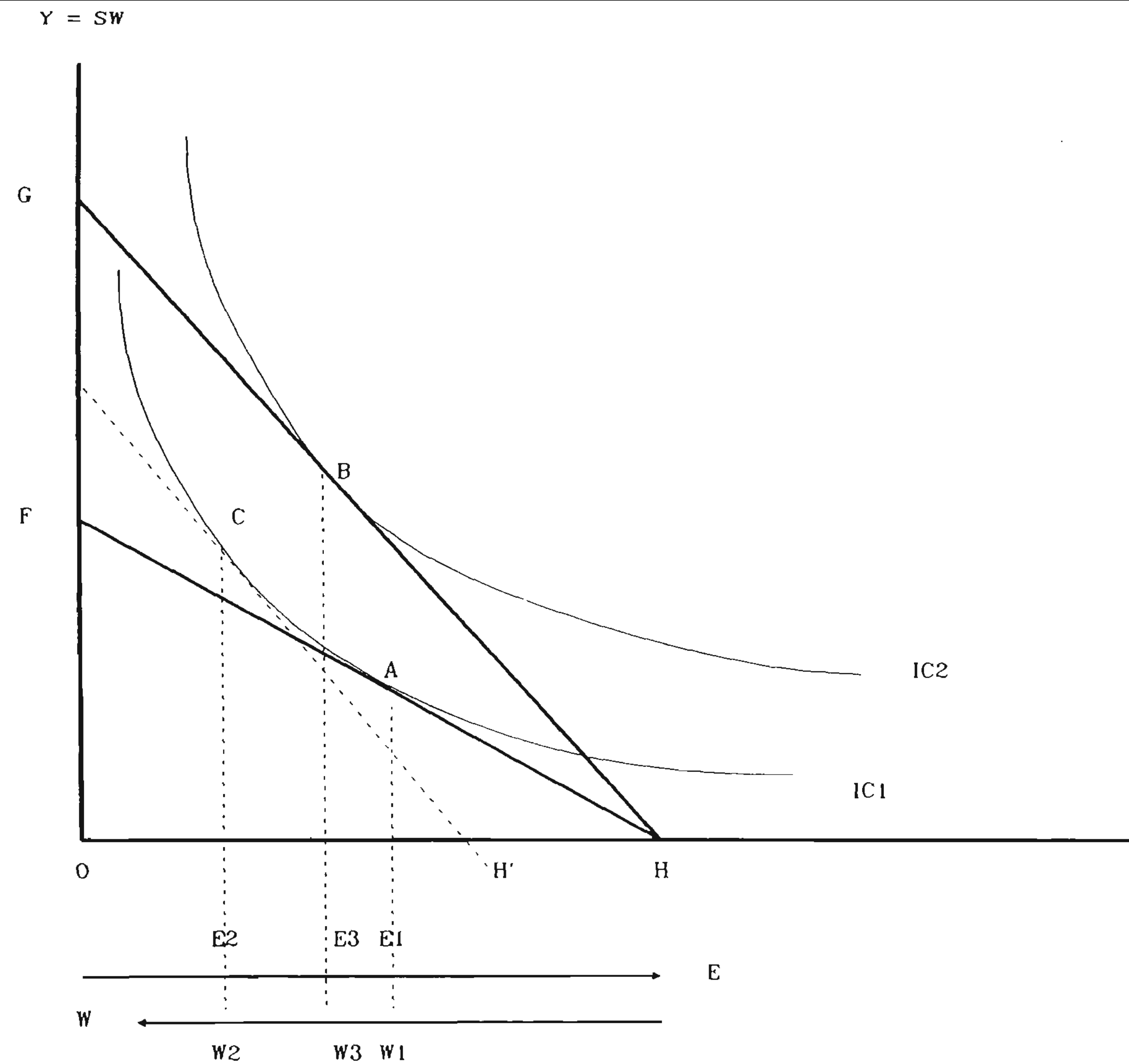

Figure A.1. Utility maximisation where U=f(E,Y).

Considering Figure A.1, suppose that the individual is forced back to his original level of satisfaction at the original indifference curve (IC_1). This can be illustrated by notionally reducing the individual's level of income which can be represented by an imaginary line tangent to the original indifference curve. Hence, the relevant budget constraint is the dotted line *H"H'* which is parallel to the new budget line *HG*. Given these conditions, the equilibrium point is at *C*. This implies that if forced to be back on the original level of utility ($dU=0$), the individual will substitute leisure, which has become relatively expensive, in exchange for income. The substitution effect which is negative dominates the positive income effect. Consequently, the increase in wage rate results in a decrease in the level of leisure and by residual, an increase in the level of work. Once the compensated substitution effect is determined, the pure income effect is simply the residual movement from point *C* to point *B*. The income effect implies an increase in the consumption of leisure time from E_2 to E_3. Assuming that leisure is a normal good, then the increase in the consumption of leisure time as a result of an increase in the individual's real income is expected in economic theory. Apparently, the reduction in the consumption of leisure time due to substitution is greater than the increase due to the income effect; thus, the gross substitution effect is a reduction in the consumption of leisure time from E_1 to E_3. Again, by residual, the reduction in the consumption of leisure time implies an increase in the level of work from W_1 to W_3. Figure A.2 translates the movement in the amount of work in response to a change in the level of wage rate into a labour supply curve. In this illustration, the dominance of the substitution effect *vis-a-vis* the income effect is attributed mainly to the way the preference function (the indifference curves) is drawn in Figure A.1. Geometrically, an indifference map with a different shape may otherwise yield an opposite result.

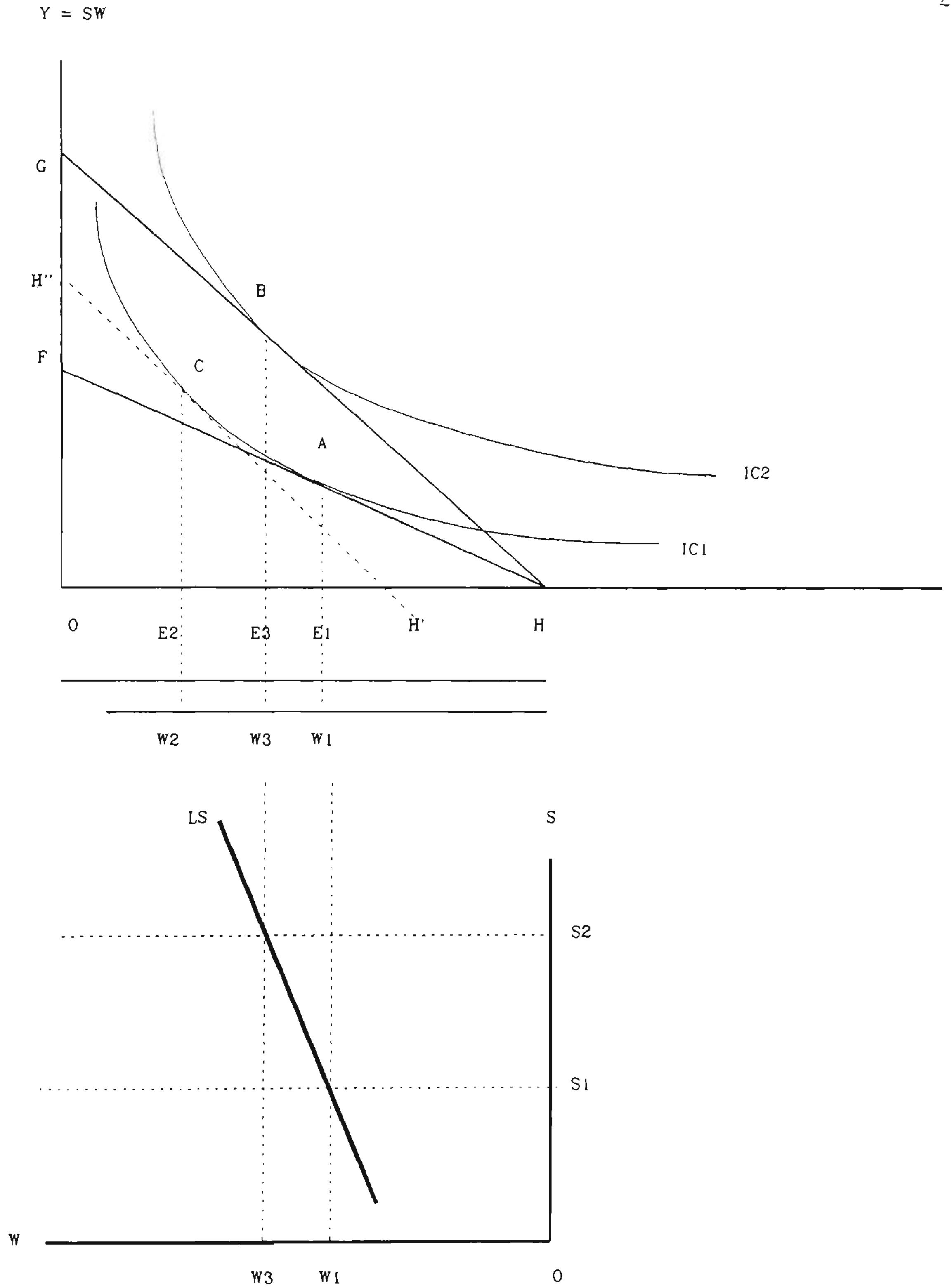

Figure A.2. Labour supply in a neoclassical model.

Annex B

The Test for the Rank and Order Conditions of the Structural Equations

To address the problem of the identification of each of the structural equations in the model, it is necessary to satisfy two conditions: the order condition of identifiability which is a necessary but not sufficient condition and the rank condition of identifiability which is a necessary and sufficient condition (Chow, 1983).

For purposes of illustration in the identification of the structural equations, the following notations will be used:

N = the number of endogenous variables in the model;

n = the number of endogenous variables in the equation;

X = the number of exogenous variables in the model; and

x = the number of exogenous variables in the equation.

According to Chow, in a simultaneous model of N structural equations, the equation is properly identified if and only if the number of exogenous variables excluded from the equation is greater than or equal to the number of endogenous variables included in that equation less one. This condition can be formally expressed as

$$(X - x) \geq (n - 1)$$

In case $(X\text{-}x) = (n\text{-}1)$, the equation is exactly or just identified and if $(X\text{-}x) > (n\text{-}1)$, the equation is overidentified.

Table B.1 indicates the order conditions of identifiability of the structural equations. First, recall that in the simultaneous equation model, there are seven exogenous variables and four endogenous variables. The first column in Table B.1 indicates the structural equation and the corresponding number of exogenous variables (x) and endogenous variables (n). The order condition as defined earlier is indicated in the fourth column of Table B.1.

Table B.1 The order conditions of the structural equations.

Structural Equations	Variables	X-x	n-1	Status
4.5	x=2;n=2	3	1	Overidentified
4.6	x=3;n=2	2	1	Overidentified
4.7	x=3; n=2	2	1	Overidentified
4.8	x=3; n=2	2	1	Overidentified

The next concern is the rank condition which establishes the necessary and sufficient condition of identifiability.

As defined by Chow, in a model of N simultaneous equations, any particular equation is identified if and only if at least one non-zero determinant of a matrix of order (N-1) can be constructed from the coefficients of the variables (both exogenous and endogenous) excluded from the particular equation but included in the other equations in the model.

From the structural equations of the labor supply model, the evaluation of the appropriate determinants of order (N-1) can be facilitated by constructing a table of the relevant parameters included in each structural equation.

To determine the rank condition of each of the structural equations, the procedure outlined by Gujarati (1988, p. 589) may be applied:

1. Write down the structural coefficients of the corresponding structural equations;
2. Strike out the coefficients of the row in which the equation under consideration appears;
3. Strike out the columns corresponding to the equation under consideration in which the entries to the table are non-zero; and
4. The entries left in the table will then give only the coefficients of the variables included in the simultaneous equation system but not in the structural equation under consideration.

Based on the procedure outlined above, if at least one non-zero determinant of order (N-1) exists, the equation is exactly or over identified and the rank of such matrix is exactly equal to (N-1). Otherwise the rank of the matrix is less than (N-1).

Hence, the order and rank condition of identifiability can be combined to form the following general rules (Gujarati, p. 590):

1. If $(X - x) > (n - 1)$ and the rank of the relevant matrix is (N-1), the equation is overidentified;
2. If $(X - x) = (n - 1)$ and the rank of the relevant matrix is (N-1), the equation is exactly identified;
3. If $(X - x) \geq (n - 1)$ and the rank of the relevant matrix is less than (N - 1), the equation is underidentified; and
4. If $(X - x) < (n - 1)$ the structural equation is unidentified and the rank of the relevant matrix is less than (N - 1).

Table B.2. provides the matrix of parameters from each of the four structural equations.

Table B.2. Matrix of parameters in the labor supply model.

Eq	I	W	S	R_a	A_w	F_r	Q_w	An	F_2	C_1
1)	α_1	0	0	α2	1	α3	α4	0	0	0
2)	β_1	0	β_2	1	0	β_3	β_4	0	β_5	0
3)	Θ_1	1	Θ_2	0	0	Θ_4	0	Θ_3	0	Θ_5
4)	ϕ_1	ϕ_2	1	0	0	ϕ_5	ϕ_3	ϕ_4	0	0

Following the above procedure, the relevant matrices for each of the structural equations can be generated. From the first structural equation referring to the function:

$$A_w = f(R_a, F_r, Q_w),$$

the relevant matrix can be represented as:

$$A = \begin{bmatrix} 0 & \beta_2 & 0 & \beta_5 & 0 \\ 1 & \theta_2 & \theta_3 & 0 & \theta_5 \\ \phi_2 & 1 & \phi_4 & 0 & 0 \end{bmatrix}$$

From matrix A, a matrix such as A_1 of order (N-1) can be generated such as:

$$A_1 \quad = \quad \begin{vmatrix} \beta_2 & 0 & \beta_5 \\ \theta_2 & \theta_3 & 0 \\ 1 & \phi_4 & 0 \end{vmatrix}$$

Evaluating the determinant of A_1 yields,

$$|A_1| \quad = \quad \beta_5\phi_4\theta_2 \; - \; \theta_3\beta_5$$

From the second structural equation:

$$R_a \quad = \quad f(S, F_r, Q_w, F_z),$$

the matrix is:

$$B \quad = \quad \begin{bmatrix} 0 & 1 & 0 & 0 \\ 1 & 0 & \theta_3 & \theta_5 \\ \phi_2 & 0 & \phi_4 & 0 \end{bmatrix}$$

From matrix B, an (N-1) matrix B1 can be generated.

$$B_1 \quad = \quad \begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & \theta_3 \\ \phi_2 & 0 & \phi_4 \end{bmatrix}$$

Evaluating B_1 yields:

$$|B_1| = \theta_3\phi_2 - \phi_4.$$

Similarly, for the third structural equation,

$$W = f(S, A_n, F_r, C_l),$$

the relevant matrix is:

$$C = \begin{bmatrix} \alpha_2 & 1 & \alpha_4 & 0 \\ 1 & 0 & \beta_4 & \beta_5 \\ 0 & 0 & \phi_3 & 0 \end{bmatrix}$$

From matrix C a matrix of order (N-1) can be derived such as:

$$C_1 = \begin{bmatrix} \alpha_2 & 1 & \alpha_4 \\ 1 & 0 & \beta_4 \\ 0 & 0 & \phi_3 \end{bmatrix}$$

Therefore,

$$|C| = -\phi_3.$$

Finally, from the functional relationship

$$S = f(W, Q_w, A_n, F_f),$$

The relevant matrix is:

$$D = \begin{bmatrix} \alpha_2 & 1 & 0 & 0 \\ 1 & 0 & \beta_5 & 0 \\ 0 & 0 & 0 & \theta_5 \end{bmatrix}$$

om matrix D, a matrix such as D_1 of order (N-1) can be derived where:

$$D_1 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \beta_5 & 0 \\ 0 & 0 & \theta_5 \end{bmatrix}$$

and:

$$|D_1| = \beta_5\theta_5.$$

Since the determinants of all the relevant matrices A_1, B_1, C and D_1 are not equal to zero, then the rank of the matrices is greater than (N-1). Therefore, the rank condition is satisfied. Consequently, all the structural equations satisfy the rank and order conditions of identifiability.

Annex C

The 2SLS Procedure

To formally outline the estimation procedure using 2SLS, the structural equations of the labor supply model will have to be examined:

$$A_w = \alpha_1 + \alpha_2 R_a + \alpha_3 F_r + \alpha_4 Q_w + \epsilon_1 \qquad \text{(C.1)}$$

$$R_a = \beta_1 + \beta_2 S + \beta_3 F_r + \beta_4 Q_w + \beta_5 F_z + \epsilon_2 \qquad \text{(C.2)}$$

$$W = \theta_1 + \theta_2 S + \theta_3 A_n + \theta_4 F_r + \theta_5 C_l + + \epsilon_3 \qquad \text{(C.3)}$$

$$S = \phi_1 + \phi_2 W + \phi_3 Q_w + \phi_4 A_n + \phi_5 F_r + \epsilon_4 \qquad \text{(C.4)}$$

Technically, these structural equations can be readily estimated using the ordinary least square method (OLS). However, the parameter estimates will be biased and inconsistent. This is attributed to the OLS assumption that the independent variables are either nonstochastic or independent of the random error term (ϵ_i).

In the system of simultaneous equations such as the labor supply model developed previously, the condition of independence between the independent variables and the random error terms is not satisfied. For illustration, consider the last two of the four structural equations (W and S). In the first equation, W is the dependent variable. In the second equation, however, W is an explanatory variable of the dependent variable S. Now, suppose ϵ_3 (due to some other circumstances) changes, as a consequence, W also changes. Since W is an explanatory variable of S, in effect, the change in S is related to the change ϵ_3. Therefore, S, which is also an explanatory variable, is not really independent of the random error term ϵ_3. Likewise, W is not independent of the random error term ϵ_4. This is clearly a violation of the basic assumption of the OLS technique. Specifically:

$$A_w = f(\epsilon_3);$$

$$S = f(\epsilon_1, \epsilon_4);$$

$R_a = f(\epsilon_4)$; and

$S_w = f(\epsilon_3)$

The way out of this predicament is to find a substitute or "proxy" variable that is highly correlated to the variable under consideration but is not in any way correlated to the random error term. In conventional econometric notation, said proxy variables are referred to as the "instrumental variables".

The 2SLS procedure was developed to provide the "instrumental variables". As the term two-stage least square or 2SLS suggests, the technique applies the ordinary least square (OLS) procedure in two stages. The first step is to generate the "instrumental variables", that is, to eliminate the influence of the random error term to the explanatory variables. The second step is to apply the OLS to the structural equations. However, instead of using the original values of the endogenous variables, the estimated values are used. These estimated values are, in effect, isolated from the influence of the random error terms. Thus, the OLS assumption is no longer violated at the second stage.

For the labor supply model, the first stage involves the generation of the "instrumental variables" by applying the OLS technique to each of the endogenous variables as a function of all the exogenous variables included in the whole system of equations. Thus

$$A_w = \pi_1 + \pi_2 F_r + \pi_3 Q_w + \pi_4 A_n + \pi_5 F_z + \pi_6 C_l + \mu_1 \qquad \text{(C.5)}$$

$$R_a = \delta_1 + \delta_2 F_r + \delta_3 Q_w + \delta_4 A_n + \delta_5 F_z + \delta_6 C_l + \mu_2 \qquad \text{(C.6)}$$

$$W = \tau_1 + \tau_2 F_r + \tau_3 Q_w + \tau_4 A_n + \tau_5 F_z + \tau_6 C_l + \mu_3 \qquad \text{(C.7)}$$

$$S = \sigma_1 + \sigma_2 F_r + \sigma_3 Q_w + \sigma_4 A_n + \sigma_5 F_z + \sigma_6 C_l + \mu_4 \qquad \text{(C.8)}$$

where π_i, τ_i, δ_i, and σ_i are the parameters and μ_i are the random error terms. From the four equations above, the estimated values of W, R_a, S, and A_w can be expressed as:

$$\hat{A}_w = \pi_1 + \pi_2 F_r + \pi_3 Q_w + \pi_4 A_n + \pi_5 F_z + \pi_6 C_l, \qquad \text{(C.9)}$$

$$\hat{R}_a = \delta_1 + \delta_2 F_r + \delta_3 Q_w + \delta_4 A_n + \delta_5 F_z + \delta_6 C_l, \tag{C.10}$$

$$\hat{W} = \tau_1 + \tau_2 F_r + \tau_3 Q_w + \tau_4 A_n + \tau_5 F_z + \tau_6 C_l, \tag{C.11}$$

$$\hat{S} = \sigma_1 + \sigma_2 F_r + \sigma_3 Q_w + \sigma_4 A_n + \sigma_5 F_z + \sigma_6 C_l. \tag{C.12}$$

Thus, C.5, C.6, C.7, C.8 can be expressed as:

$$A_w = \hat{A}_w + \mu_1, \tag{C.13}$$

$$R_a = \hat{R}_a + \mu_2, \tag{C.14}$$

$$W = \hat{W} + \mu_3, \tag{C.15}$$

$$S = \hat{S} + \mu_4. \tag{C.16}$$

The above equations which express the endogenous variables in terms of their respective estimated values from the stage 1 OLS estimation,can be used to transform the original structural equations. Consequently, each of the structural equations can now be expressed in terms of explanatory variables which are independent of the random error term.

Thus:

$$A_w = \alpha_1 + \alpha_2(\hat{R}_a + \mu_3) + \alpha_3 F_r + \alpha_4 Q_w + \epsilon_1, \tag{C.17}$$

$$R_a = \beta_1 + \beta_2(\hat{S} + \mu_4) + \beta_3 F_r + \beta_4 Q_w + \beta_5 F_z + \epsilon_2 \tag{C.18}$$

$$W = \theta_1 + \theta_2(\hat{S} + \mu_4) + \theta_3 A_n + \theta_4 F_r + \theta_5 C_l + \epsilon_3, \tag{C.19}$$

$$S = \phi_1 + \phi_2(\hat{W} + \mu_3) + \phi_3 Q_w + \phi_4 A_n + \phi_5 F_r + \epsilon_4. \tag{C.20}$$

Finally,

$$A_w = \alpha_1 + \alpha_2 \hat{R}_a + \alpha_3 F_r + \alpha_4 Q_w + \epsilon_1^*, \tag{C.21}$$

$$R_a = \beta_1 + \beta_2 \hat{S} + \beta_3 F_r + \beta_4 Q_w + \beta_5 F_z + \epsilon_2^*, \tag{C.22}$$

$$W = \theta_1 + \theta_2 \hat{S} + \theta_3 A_n + \theta_4 F_r + \theta_5 C_l + \epsilon_3^*, \tag{C.23}$$

$$S = \phi_1 + \phi_2 \hat{W} + \phi_3 Q_w + \phi_4 A_n + \phi_5 F_r + \epsilon_4^*. \tag{C.24}$$

were:

$$\begin{aligned} \epsilon_1^* &= \epsilon_1 + \alpha_2 \mu_3, \\ \epsilon_2^* &= \epsilon_2 + \beta_2 \mu_4, \\ \epsilon_3^* &= \epsilon_3 + \theta_2 \mu_4, \\ \epsilon_4^* &= \epsilon_4 + \phi_2 \mu_3. \end{aligned}$$

The parameters of the preceding four structural equations can now be estimated using the OLS technique. The use of the instrumental variables (the estimated values of the endogenous variables) has eliminated the problem of dependence between the corresponding explanatory variables and the respective random error terms.

Appendix D. Analyses of Variance (ANOVA) for selected socio-economic attributes by Ecological Zones and Region.

Dependent Variable	Group	Source of Variation						F Stat.	P Value
		Between Groups			Within Group				
		D.F.	SSB	MSB	D.F.	SSW	MSW		
Husband's Age	Zone	2	7652	3826	7916	1435088	181.2	21.1	.000
	Region	12	49204	3683	7906	1398536	176.8	20.8	.000
Wife's Age	Zone	2	11453	5726	7916	2506315	316.6	18.0	.000
	Region	12	63001	5250	7906	2456747	310.4	16.9	.000
Children's Mean Age	Zone	2	144.2	73.13	7916	229993	29.0	2.4	.083
	Region	12	5345	445	7906	224792	28.4	15.6	.000
Household Size	Zone	2	56.5	28.29	7916	46184	5.83	4.84	.007
	Region	12	935.5	77.95	7906	45305	5.73	13.6	.000
Husband's Education	Zone	2	364.3	182.16	7907	525564	66.46	2.74	.006
	Region	12	5237.6	436.4	7897	520690	65.93	6.61	.000
Wife's Education	Zone	2	1871.2	935.6	7907	5003581	642.8	1.47	.220
	Region	12	31443.3	2620.2	7897	4974009	629.8	4.16	.000
F_r Ratio	Zone	2	.422	.211	7916	368.9	.0466	4.52	.010
	Region	12	17.45	1.45	7906	351.9	.0445	32.67	.000
Level of Work	Zone	2	719.66	359.83	7916	648233	81.88	4.39	.012
	Region	12	144873	12072	7906	504709	63.25	189.3	.000
Farm Income	Zone	2	2.03777E+11	1.01888E+11	7916	1.01577E+14	1.2831E+10	7.94	.000
	Region	12	1.79935E+12	1.49946E+11	7906	9.99819E+13	1.2646E+10	11.85	.000
Farm Size	Zone	2	443.8	221.9	7916	54811.1	6.92	32.04	.000
	Region	12	3502.3	291.86	7906	51752.5	6.54	44.58	.000

APPENDIX E

Estimates for the structural equations with the tenure dummy.

1.NL

I.DEPENDENT VARIABLE = AW   511 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.14600	0.70837E-02	20.611	0.6752	1.3650	0.53456	0.0000
FR	0.44952E-01	0.41107E-01	1.0936	0.0485	0.48687E-01	0.22806E-01	0.1371
QW	-0.15520E-02	0.17022E-02	-0.91178	-0.0405	-0.40557E-01	-0.16523E-01	0.1809
CONSTANT	0.28359	0.24748E-01	11.459	0.4536	0.00000E+00	0.45916	0.0000

DURBIN-WATSON = 1.7046   VON NEUMANN RATIO = 1.7079   RHO = 0.14357
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4267

II.DEPENDENT VARIABLE = RA   511 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.50262E-01	0.59154E-02	8.4968	0.3534	1.0977	2.1588	0.0000
FR	0.45805	0.50813	0.90144	0.0400	0.53063E-01	0.63470E-01	0.1837
QW	0.29797E-01	0.13573E-01	2.1953	0.0971	0.83283E-01	0.86642E-01	0.0141
FZ	0.62365E-01	0.28838E-01	2.1625	0.0957	0.56126E-01	0.52801E-01	0.0153
CONSTANT	-3.0792	0.59615	-5.1652	-0.2238	0.00000E+00	-1.3617	0.0000

DURBIN-WATSON = 1.9277   VON NEUMANN RATIO = 1.9315   RHO = 0.03311
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1806

III.DEPENDENT VARIABLE = W   511 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.21713	0.21197E-01	-10.243	-0.4144	-1.5675	-1.9250	0.0000
AN	0.74750E-03	0.20084E-03	3.7219	0.1632	0.12055	0.76916E-01	0.0001
FR	-0.36530	1.8460	-0.19789	-0.0088	-0.13988E-01	-0.10449E-01	0.4216
CL	1.8551	0.37278	4.9763	0.2160	0.17266	0.22103	0.0000
CONSTANT	28.894	2.1957	13.159	0.5050	0.00000E+00	2.6375	0.0000

DURBIN-WATSON = 1.7713   VON NEUMANN RATIO = 1.7748   RHO = 0.10384
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0839

IV.DEPENDENT VARIABLE = S   511 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	6.8692	2.6579	2.5845	0.1148	0.95150	0.77480	0.0049
QW	-0.33325	0.42647	-0.78141	-0.0349	-0.42647E-01	-0.22561E-01	0.2173
AN	-0.16850E-02	0.19359E-02	-0.87038	-0.0389	-0.37640E-01	-0.19556E-01	0.1920
FR	-20.393	10.654	-1.9141	-0.0853	-0.10816	-0.65791E-01	0.0278
T1	102.51	23.217	4.4155	0.1937	1.2085	0.36560	0.0000
T2	110.32	25.811	4.2744	0.1878	1.2610	0.34899	0.0000
T3	101.06	26.040	3.8810	0.1710	0.90983	0.16290	0.0001
T1W	-9.9067	2.4481	-4.0467	-0.1781	-1.6093	-0.41658	0.0000
T2W	-10.525	2.6358	-3.9933	-0.1758	-1.5575	-0.37770	0.0000
T3W	-10.244	2.7003	-3.7937	-0.1673	-1.0938	-0.16987	0.0001
CONSTANT	40.770	22.371	1.8225	0.0812	0.00000E+00	0.41977	0.0342

DURBIN-WATSON = 1.9808   VON NEUMANN RATIO = 1.9847   RHO = 0.00956
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1226

2. SL

I. DEPENDENT VARIABLE = AW 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18059	0.69628E-02	25.937	0.7793	1.2658	0.53964	0.0000
FR	0.40279E-01	0.43752E-01	0.92063	0.0441	0.37675E-01	0.23483E-01	0.1786
QW	0.15953E-02	0.10879E-02	1.4665	0.0701	0.59320E-01	0.19638E-01	0.0713
CONSTANT	0.22414	0.21944E-01	10.214	0.4398	0.00000E+00	0.41724	0.0000

DURBIN-WATSON = 1.7158 VON NEUMANN RATIO = 1.7198 RHO = 0.13553
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5526

II. DEPENDENT VARIABLE = RA 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.52605E-01	0.46046E-02	11.425	0.4808	1.4329	2.7701	0.0000
FR	-0.12589	0.46553	-0.27042	-0.0130	-0.16800E-01	-0.24562E-01	0.3934
QW	-0.68154E-02	0.63101E-02	-1.0801	-0.0518	-0.36156E-01	-0.28076E-01	0.1401
FZ	0.59486E-03	0.79513E-02	0.74814E-01	0.0036	0.96036E-03	0.82049E-03	0.4702
CONSTANT	-2.7582	0.43588	-6.3280	-0.2906	0.00000E+00	-1.7183	0.0000

DURBIN-WATSON = 1.8632 VON NEUMANN RATIO = 1.8674 RHO = 0.06636
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2259

III. DEPENDENT VARIABLE = W 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.27074	0.24075E-01	-11.246	-0.4750	-1.7358	-1.6736	0.0000
AN	0.35075E-03	0.22023E-03	1.5926	0.0762	0.30072E-01	0.21991E-01	0.0556
FR	0.72874	2.3976	0.30394	0.0146	0.22889E-01	0.16691E-01	0.3806
CL	1.0176	0.24996	4.0711	0.1918	0.76421E-01	0.12375	0.0000
CONSTANT	34.338	2.2944	14.966	0.5834	0.00000E+00	2.5112	0.0000

DURBIN-WATSON = 1.7205 VON NEUMANN RATIO = 1.7244 RHO = 0.13968
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2220

IV. DEPENDENT VARIABLE = S 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-0.40880E-01	1.4690	-0.27829E-01	-0.0013	-0.63763E-02	-0.66132E-02	0.4889
QW	-0.36461E-01	0.11760	-0.31004	-0.0150	-0.71011E-02	-0.28524E-02	0.3783
AN	0.48671E-03	0.15302E-02	0.31808	0.0154	0.65089E-02	0.49366E-02	0.3752
FR	-0.82996	9.1997	-0.90215E-01	-0.0044	-0.40661E-02	-0.30751E-02	0.4641
T1	47.792	18.879	2.5315	0.1215	0.55558	0.20091	0.0057
T2	47.854	19.910	2.4035	0.1154	0.43746	0.96719E-01	0.0081
T3	46.797	18.999	2.4632	0.1182	0.52973	0.17655	0.0069
T1W	-3.4794	1.4408	-2.4150	-0.1159	-0.63421	-0.19972	0.0079
T2W	-3.4510	1.5241	-2.2643	-0.1088	-0.50814	-0.10230	0.0118
T3W	-3.4243	1.4630	-2.3407	-0.1124	-0.60977	-0.17644	0.0096
CONSTANT	85.532	18.523	4.6176	0.2178	0.00000E+00	1.0119	0.0000

DURBIN-WATSON = 1.7157 VON NEUMANN RATIO = 1.7196 RHO = 0.14213
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2144

3. VS

I. DEPENDENT VARIABLE = AW 377 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.13556	0.49576E-02	27.344	0.8168	1.1267	0.51033	0.0000
FR	0.24321E-01	0.31155E-01	0.78065	0.0404	0.25982E-01	0.12124E-01	0.2175
QW	-0.50409E-03	0.65605E-03	-0.76837	-0.0398	-0.25127E-01	-0.53009E-02	0.2211
CONSTANT	0.32836	0.18623E-01	17.632	0.6742	0.00000E+00	0.48285	0.0000

DURBIN-WATSON = 1.8139 VON NEUMANN RATIO = 1.8188 RHO = 0.09157
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6787

II. DEPENDENT VARIABLE = RA 377 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.47582E-01	0.26178E-02	18.176	0.6858	1.1595	1.9915	0.0000
FR	-0.69122E-02	0.32564	-0.21227E-01	-0.0011	-0.88847E-03	-0.91534E-03	0.4915
QW	0.60180E-02	0.47608E-02	1.2641	0.0654	0.36092E-01	0.16810E-01	0.1031
FZ	0.19196E-01	0.16266E-01	1.1801	0.0611	0.18463E-01	0.10949E-01	0.1190
CONSTANT	-2.6069	0.31453	-8.2883	-0.3948	0.00000E+00	-1.0183	0.0000

DURBIN-WATSON = 2.0868 VON NEUMANN RATIO = 2.0924 RHO = -0.04424
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5249

III. DEPENDENT VARIABLE = W 377 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.18000	0.10998E-01	-16.367	-0.6470	-1.2666	-2.0793	0.0000
AN	0.25853E-03	0.16047E-03	1.6110	0.0832	0.35730E-01	0.31758E-01	0.0536
FR	1.1005	1.3577	0.81057	0.0420	0.40845E-01	0.40221E-01	0.2088
CL	1.6295	0.27006	6.0338	0.2986	0.13488	0.29356	0.0000
CONSTANT	25.172	1.3756	18.300	0.6883	0.00000E+00	2.7137	0.0000

DURBIN-WATSON = 1.6869 VON NEUMANN RATIO = 1.6914 RHO = 0.15518
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4330

IV. DEPENDENT VARIABLE = S 377 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	1.8355	2.0613	0.89048	0.0465	0.26087	0.15890	0.1866
QW	0.56910E-01	0.13679	0.41605	0.0217	0.14006E-01	0.37982E-02	0.3387
AN	-0.94122E-03	0.17601E-02	-0.53474	-0.0279	-0.18487E-01	-0.10009E-01	0.2964
FR	-1.4849	8.8916	-0.16700	-0.0087	-0.78323E-02	-0.46982E-02	0.4337
T1	66.000	18.690	3.5313	0.1815	0.65641	0.17482	0.0002
T2	65.328	17.692	3.6925	0.1895	0.68498	0.21024	0.0001
T3	64.742	17.809	3.6353	0.1867	0.56139	0.11540	0.0001
T1W	-6.9903	2.1171	-3.3019	-0.1701	-0.79888	-0.16336	0.0005
T2W	-6.9990	1.9967	-3.5053	-0.1802	-0.89162	-0.22074	0.0002
T3W	-6.8583	2.0098	-3.4124	-0.1756	-0.73522	-0.12004	0.0003
CONSTANT	91.685	16.762	5.4699	0.2749	0.00000E+00	0.85568	0.0000

DURBIN-WATSON = 1.9136 VON NEUMANN RATIO = 1.9187 RHO = 0.04210
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3305

4. MN

I. DEPENDENT VARIABLE = AW 335 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.20378	0.91119E-02	22.364	0.7757	1.1681	0.51844	0.0000
FR	0.93140E-01	0.37787E-01	2.4649	0.1343	0.95078E-01	0.60070E-01	0.0069
QW	-0.31943E-02	0.24833E-02	-1.2863	-0.0705	-0.47154E-01	-0.34351E-01	0.0992
CONSTANT	0.23573	0.23750E-01	9.9257	0.4789	0.00000E+00	0.45584	0.0000

DURBIN-WATSON = 1.7076 VON NEUMANN RATIO = 1.7127 RHO = 0.13730
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6425

II. DEPENDENT VARIABLE = RA 335 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.42001E-01	0.37936E-02	11.071	0.5204	1.2438	2.6286	0.0000
FR	-0.31734E-01	0.32539	-0.97528E-01	-0.0054	-0.56512E-02	-0.80447E-02	0.4612
QW	0.13544E-01	0.13195E-01	1.0265	0.0564	0.34880E-01	0.57250E-01	0.1523
FZ	0.41730E-03	0.42528E-02	0.98125E-01	0.0054	0.11686E-02	0.74099E-03	0.4609
CONSTANT	-2.2084	0.33139	-6.6641	-0.3444	0.00000E+00	-1.6785	0.0000

DURBIN-WATSON = 1.7367 VON NEUMANN RATIO = 1.7419 RHO = 0.12533
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3513

III. DEPENDENT VARIABLE = W 335 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.25636	0.23876E-01	-10.737	-0.5088	-1.4522	-1.4562	0.0000
AN	0.12263E-04	0.12761E-03	0.96099E-01	0.0053	0.17513E-02	0.84933E-03	0.4617
FR	-2.5954	2.0410	-1.2716	-0.0698	-0.88406E-01	-0.59717E-01	0.1017
CL	-0.94039E-02	0.18972	-0.49567E-01	-0.0027	-0.77120E-03	-0.11426E-02	0.4802
CONSTANT	36.474	2.0886	17.463	0.6930	0.00000E+00	2.5162	0.0000

DURBIN-WATSON = 1.7442 VON NEUMANN RATIO = 1.7494 RHO = 0.12728
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3074

IV. DEPENDENT VARIABLE = S 335 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.7324	0.36178	-10.317	-0.4973	-0.65891	-0.65707	0.0000
QW	0.15048	0.19165	0.78516	0.0436	0.13086E-01	0.10163E-01	0.2162
AN	0.34745E-03	0.62994E-03	0.55156	0.0306	0.87601E-02	0.42364E-02	0.2906
FR	-9.7457	7.5123	-1.2973	-0.0719	-0.58604E-01	-0.39475E-01	0.0973
T1	1.5647	4.4695	0.35008	0.0194	0.20159E-01	0.79413E-02	0.3631
T2	1.0548	4.8430	0.21780	0.0121	0.79846E-02	0.11854E-02	0.4138
T3	1.5894	5.4627	0.29095	0.0162	0.16880E-01	0.40334E-02	0.3855
T1W	-0.10350	0.29850	-0.34673	-0.0193	-0.22540E-01	-0.72905E-02	0.3644
T2W	-0.15410	0.35956	-0.42858	-0.0238	-0.14178E-01	-0.18156E-02	0.3341
T3W	-0.14355	0.36133	-0.39727	-0.0221	-0.25834E-01	-0.56463E-02	0.3456
CONSTANT	138.64	6.2126	22.316	0.7784	0.00000E+00	1.6837	0.0000

DURBIN-WATSON = 1.7510 VON NEUMANN RATIO = 1.7563 RHO = 0.12384
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3078

5. NL_O

I. DEPENDENT VARIABLE = AW 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.15682	0.77359E-02	20.272	0.7213	1.3407	0.54144	0.0000
FR	-0.42013E-01	0.49237E-01	-0.85328	-0.0438	-0.41362E-01	-0.19981E-01	0.1968
QW	-0.12745E-01	0.28699E-02	-4.4410	-0.2224	-0.20939	-0.13334	0.0000
CONSTANT	0.38436	0.28883E-01	13.308	0.5643	0.00000E+00	0.61188	0.0000

DURBIN-WATSON = 1.7710 VON NEUMANN RATIO = 1.7757 RHO = 0.11211
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5183

II. DEPENDENT VARIABLE = RA 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.51735E-01	0.46480E-02	11.131	0.4968	1.2066	2.3428	0.0000
FR	0.88066	0.53322	1.6516	0.0846	0.10142	0.12131	0.0493
QW	0.84042E-01	0.19736E-01	4.2583	0.2139	0.16150	0.25466	0.0000
FZ	0.89235E-02	0.19215E-01	0.46441	0.0239	0.83292E-02	0.68976E-02	0.3212
CONSTANT	-3.7427	0.49117	-7.6199	-0.3649	0.00000E+00	-1.7257	0.0000

DURBIN-WATSON = 2.0021 VON NEUMANN RATIO = 2.0074 RHO = -0.00231
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2339

III. DEPENDENT VARIABLE = W 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24526	0.18462E-01	-13.285	-0.5642	-1.6293	-2.1566	0.0000
AN	-0.65673E-04	0.16453E-03	-0.39916	-0.0205	-0.87363E-02	-0.56855E-02	0.3449
FR	-2.9086	2.2876	-1.2714	-0.0653	-0.95406E-01	-0.77793E-01	0.1018
CL	0.56453E-01	0.26043	0.21677	0.0111	0.48356E-02	0.70996E-02	0.4142
CONSTANT	36.111	2.0234	17.846	0.6762	0.00000E+00	3.2330	0.0000

DURBIN-WATSON = 1.9252 VON NEUMANN RATIO = 1.9303 RHO = 0.03632
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2089

IV. DEPENDENT VARIABLE = S 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.6533	2.3023	-2.0212	-0.1042	-0.70048	-0.52922	0.0216
QW	0.13493	0.33544	0.40224	0.0209	0.11117E-01	0.90284E-02	0.3438
AN	-0.39861E-03	0.10325E-02	-0.38608	-0.0200	-0.79822E-02	-0.39247E-02	0.3497
FR	-11.685	9.6835	-1.2067	-0.0624	-0.57697E-01	-0.35543E-01	0.1138
T1	-6.6490	23.821	-0.27913	-0.0145	-0.84117E-01	-0.24746E-01	0.3901
T2	-7.0382	23.982	-0.29348	-0.0152	-0.83428E-01	-0.20395E-01	0.3846
T3	-6.7442	23.936	-0.28175	-0.0146	-0.68849E-01	-0.12730E-01	0.3891
T1W	0.60187	2.2414	0.26853	0.0139	0.10513	0.25872E-01	0.3941
T2W	0.64688	2.2534	0.28706	0.0149	0.10331	0.22046E-01	0.3870
T3W	0.57562	2.2616	0.25452	0.0132	0.69344E-01	0.10895E-01	0.3995
CONSTANT	153.09	23.270	6.5787	0.3228	0.00000E+00	1.5587	0.0000

DURBIN-WATSON = 1.9208 VON NEUMANN RATIO = 1.9259 RHO = 0.03857
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2110

6. SL_o

I. DEPENDENT VARIABLE = AW 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.17832	0.32880E-02	54.234	0.9520	1.3105	0.54245	0.0000
FR	0.12672	0.55518E-01	2.2825	0.1298	0.11438	0.79557E-01	0.0112
QW	0.13172E-02	0.13383E-02	0.98425	0.0564	0.48909E-01	0.16887E-01	0.1625
CONSTANT	0.19048	0.24411E-01	7.8033	0.4085	0.00000E+00	0.36111	0.0000

DURBIN-WATSON = 1.6897 VON NEUMANN RATIO = 1.6952 RHO = 0.14631
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5416

II. DEPENDENT VARIABLE = RA 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.55724E-01	0.59481E-02	9.3684	0.4739	1.4287	2.9685	0.0000
FR	-0.13758	0.63401	-0.21701	-0.0125	-0.16898E-01	-0.28395E-01	0.4141
QW	-0.74709E-02	0.76658E-02	-0.97458	-0.0559	-0.37748E-01	-0.31487E-01	0.1649
FZ	-0.56600E-03	0.28558E-02	-0.19819	-0.0114	-0.10210E-02	-0.87344E-03	0.4214
CONSTANT	-3.0612	0.58947	-5.1931	-0.2859	0.00000E+00	-1.9077	0.0000

DURBIN-WATSON = 1.9064 VON NEUMANN RATIO = 1.9126 RHO = 0.04442
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1852

III. DEPENDENT VARIABLE = W 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.29769	0.31537E-01	-9.4392	-0.4767	-1.8719	-1.7959	0.0000
AN	0.48395E-05	0.76504E-04	0.63258E-01	0.0036	0.42981E-03	0.28949E-03	0.4748
FR	-3.0463	3.1472	-0.96794	-0.0555	-0.91763E-01	-0.71202E-01	0.1665
CL	-0.15682E-01	0.88701E-01	-0.17680	-0.0102	-0.11521E-02	-0.18543E-02	0.4298
CONSTANT	40.646	3.0833	13.183	0.6037	0.00000E+00	2.8687	0.0000

DURBIN-WATSON = 1.9323 VON NEUMANN RATIO = 1.9386 RHO = 0.03360
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2398

IV. DEPENDENT VARIABLE = S 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.9230	58.447	-0.67121E-01	-0.0039	-0.62387	-0.65026	0.4732
QW	-0.34660E-02	0.49414	-0.70142E-02	-0.0004	-0.68304E-03	-0.27422E-03	0.4972
AN	0.70435E-03	0.96648E-02	0.72878E-01	0.0042	0.99480E-02	0.69838E-02	0.4710
FR	-10.070	37.177	-0.27086	-0.0157	-0.48238E-01	-0.39013E-01	0.3932
T1	-6.6348	870.92	-0.76181E-02	-0.0004	-0.79317E-01	-0.27720E-01	0.4970
T2	-9.7153	865.29	-0.11228E-01	-0.0007	-0.83183E-01	-0.15498E-01	0.4955
T3	-8.2792	868.64	-0.95313E-02	-0.0006	-0.10026	-0.36792E-01	0.4962
T1W	0.59029	58.640	0.10066E-01	0.0006	0.11263	0.34169E-01	0.4960
T2W	0.77168	58.452	0.13202E-01	0.0008	0.10428	0.17967E-01	0.4947
T3W	0.54909	58.355	0.94095E-02	0.0005	0.10904	0.34391E-01	0.4962
CONSTANT	143.27	863.01	0.16601	0.0096	0.00000E+00	1.6760	0.4341

DURBIN-WATSON = 1.9260 VON NEUMANN RATIO = 1.9323 RHO = 0.03682
RESIDUAL SUM = 0.42419E-11 RESIDUAL VARIANCE = 1209.6

7. VS_o

I. DEPENDENT VARIABLE = AW 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.14028	0.57554E-02	24.374	0.7746	1.1787	0.52363	0.0000
FR	0.32078E-01	0.31780E-01	1.0094	0.0507	0.34774E-01	0.15904E-01	0.1564
QW	-0.37239E-03	0.63306E-03	-0.58823	-0.0295	-0.19789E-01	-0.38757E-02	0.2782
CONSTANT	0.31721	0.20206E-01	15.699	0.6194	0.00000E+00	0.46434	0.0000

DURBIN-WATSON = 1.8777 VON NEUMANN RATIO = 1.8824 RHO = 0.05409
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6558

II. DEPENDENT VARIABLE = RA 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.46896E-01	0.26044E-02	18.007	0.6714	1.1524	1.9942	0.0000
FR	-0.20067	0.29491	-0.68044	-0.0342	-0.25888E-01	-0.26653E-01	0.2481
QW	0.41364E-02	0.42922E-02	0.96370	0.0484	0.26159E-01	0.11533E-01	0.1676
FZ	0.45907E-02	0.15749E-01	0.29149	0.0147	0.44617E-02	0.21601E-02	0.3853
CONSTANT	-2.5021	0.30686	-8.1539	-0.3796	0.00000E+00	-0.98120	0.0000

DURBIN-WATSON = 2.1076 VON NEUMANN RATIO = 2.1129 RHO = -0.06480
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5805
RUNS TEST: 218 RUNS, 195 POSITIVE, 205 NEGATIVE, NORMAL STATISTIC = 1.7157

III. DEPENDENT VARIABLE = W 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.17711	0.11005E-01	-16.094	-0.6293	-1.2856	-2.0955	0.0000
AN	0.26847E-03	0.15543E-03	1.7273	0.0866	0.38622E-01	0.36104E-01	0.0421
FR	1.7756	1.2480	1.4228	0.0714	0.67666E-01	0.65619E-01	0.0774
CL	0.47231	0.16980	2.7816	0.1386	0.62199E-01	0.69055E-01	0.0027
CONSTANT	26.805	1.3252	20.228	0.7133	0.00000E+00	2.9247	0.0000

DURBIN-WATSON = 1.5494 VON NEUMANN RATIO = 1.5533 RHO = 0.22367
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4610

IV. DEPENDENT VARIABLE = S 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-2.5542	1.2934	-1.9747	-0.0996	-0.35188	-0.21588	0.0241
QW	-0.94057E-02	0.57716E-01	-0.16297	-0.0083	-0.24207E-02	-0.61673E-03	0.4353
AN	0.10618E-02	0.90301E-03	1.1759	0.0595	0.21044E-01	0.12069E-01	0.1198
FR	3.5043	7.4913	0.46778	0.0237	0.18397E-01	0.10946E-01	0.3200
T1	27.866	10.609	2.6268	0.1320	0.25519	0.57822E-01	0.0043
T2	27.074	10.563	2.5632	0.1289	0.26586	0.69286E-01	0.0052
T3	27.467	11.877	2.3126	0.1165	0.22082	0.40528E-01	0.0104
T1W	-2.8971	1.1822	-2.4506	-0.1233	-0.30647	-0.54638E-01	0.0071
T2W	-2.7724	1.1485	-2.4140	-0.1215	-0.32586	-0.70183E-01	0.0079
T3W	-2.8570	1.3241	-2.1576	-0.1087	-0.27777	-0.40246E-01	0.0155
CONSTANT	129.14	10.482	12.320	0.5298	0.00000E+00	1.1909	0.0000

DURBIN-WATSON = 1.7506 VON NEUMANN RATIO = 1.7550 RHO = 0.12302
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4417

8. MN_o

I. DEPENDENT VARIABLE = AW 293 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.19937	0.87553E-02	22.772	0.8013	1.1298	0.51697	0.0000
FR	0.99748E-01	0.39429E-01	2.5298	0.1472	0.96933E-01	0.61852E-01	0.0057
QW	-0.44011E-02	0.25139E-02	-1.7507	-0.1024	-0.63094E-01	-0.45652E-01	0.0400
CONSTANT	0.24269	0.23738E-01	10.224	0.5154	0.00000E+00	0.46683	0.0000

DURBIN-WATSON = 1.7339 VON NEUMANN RATIO = 1.7398 RHO = 0.12353
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6736

II. DEPENDENT VARIABLE = RA 293 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.40892E-01	0.34260E-02	11.936	0.5753	1.2267	2.5127	0.0000
FR	0.13758	0.34053	0.40400	0.0238	0.23593E-01	0.32900E-01	0.3431
QW	0.21428E-01	0.13577E-01	1.5782	0.0926	0.54210E-01	0.85720E-01	0.0573
FZ	0.10764E-02	0.82620E-02	0.13029	0.0077	0.17807E-02	0.16915E-02	0.4482
CONSTANT	-2.2012	0.31276	-7.0382	-0.3831	0.00000E+00	-1.6330	0.0000

DURBIN-WATSON = 1.6887 VON NEUMANN RATIO = 1.6945 RHO = 0.13402
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3982

III. DEPENDENT VARIABLE = W 293 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24494	0.20936E-01	-11.700	-0.5676	-1.3889	-1.4080	0.0000
AN	0.34659E-04	0.11761E-03	0.29469	0.0174	0.50106E-02	0.23663E-02	0.3841
FR	-3.8033	2.0872	-1.8222	-0.1068	-0.12328	-0.85084E-01	0.0342
CL	-0.35587E-01	0.19368	-0.18374	-0.0108	-0.28972E-02	-0.43493E-02	0.4271
CONSTANT	35.953	1.9232	18.694	0.7404	0.00000E+00	2.4951	0.0000

DURBIN-WATSON = 1.7070 VON NEUMANN RATIO = 1.7128 RHO = 0.13498
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3455

IV. DEPENDENT VARIABLE = S 293 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.6894	0.99333	-3.7142	-0.2160	-0.65066	-0.64183	0.0001
QW	0.13818	0.26746	0.51665	0.0308	0.11653E-01	0.89963E-02	0.3027
AN	0.47191E-03	0.87645E-03	0.53843	0.0320	0.12032E-01	0.56049E-02	0.2951
FR	-14.643	8.4641	-1.7300	-0.1025	-0.83706E-01	-0.56987E-01	0.0418
T1	5.3126	15.435	0.34418	0.0205	0.65912E-01	0.24955E-01	0.3654
T2	4.8118	16.264	0.29585	0.0176	0.35998E-01	0.55515E-02	0.3837
T3	5.5316	15.763	0.35093	0.0209	0.56449E-01	0.13448E-01	0.3628
T1W	-0.34026	1.0101	-0.33685	-0.0201	-0.70654E-01	-0.22475E-01	0.3681
T2W	-0.48379	1.1135	-0.43447	-0.0259	-0.44301E-01	-0.59205E-02	0.3320
T3W	-0.38360	1.0300	-0.37242	-0.0222	-0.67769E-01	-0.14589E-01	0.3548
CONSTANT	139.42	15.712	8.8735	0.4672	0.00000E+00	1.6832	0.0000

DURBIN-WATSON = 1.7167 VON NEUMANN RATIO = 1.7225 RHO = 0.12967
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3476

9. NL_{on}

I. DEPENDENT VARIABLE = AW 394 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.15128	0.67056E-02	22.560	0.7524	1.3679	0.52577	0.0000
FR	-0.30889E-01	0.47221E-01	-0.65413	-0.0331	-0.31882E-01	-0.15049E-01	0.2565
QW	-0.14646E-01	0.29697E-02	-4.9319	-0.2423	-0.23592	-0.15099	0.0000
CONSTANT	0.40542	0.28175E-01	14.389	0.5889	0.00000E+00	0.64027	0.0000

DURBIN-WATSON = 1.6714 VON NEUMANN RATIO = 1.6756 RHO = 0.16385
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5085

II. DEPENDENT VARIABLE = RA 394 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.56497E-01	0.45613E-02	12.386	0.5318	1.2557	2.5192	0.0000
FR	0.91446	0.53985	1.6939	0.0856	0.10438	0.12819	0.0451
QW	0.98673E-01	0.20899E-01	4.7214	0.2328	0.17577	0.29269	0.0000
FZ	0.79737E-02	0.14672E-01	0.54345	0.0275	0.71749E-02	0.62468E-02	0.2934
CONSTANT	-4.2833	0.49035	-8.7352	-0.4050	0.00000E+00	-1.9463	0.0000

DURBIN-WATSON = 1.9942 VON NEUMANN RATIO = 1.9993 RHO = 0.00062
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2212

III. DEPENDENT VARIABLE = W 394 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.25746	0.16458E-01	-15.643	-0.6214	-1.7236	-2.2935	0.0000
AN	-0.63230E-04	0.14672E-03	-0.43097	-0.0218	-0.81789E-02	-0.55282E-02	0.3332
FR	-3.2458	2.2055	-1.4716	-0.0744	-0.11159	-0.90904E-01	0.0706
CL	-0.73346E-02	0.18818	-0.38976E-01	-0.0020	-0.66053E-03	-0.93626E-03	0.4845
CONSTANT	37.352	1.8458	20.236	0.7161	0.00000E+00	3.3909	0.0000

DURBIN-WATSON = 1.9575 VON NEUMANN RATIO = 1.9624 RHO = 0.01991
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2229

IV. DEPENDENT VARIABLE = S 394 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.0402	1.5232	-2.6524	-0.1343	-0.60349	-0.45352	0.0040
QW	0.80395E-01	0.22911	0.35091	0.0179	0.64434E-02	0.53482E-02	0.3628
AN	-0.32755E-03	0.67481E-03	-0.48541	-0.0248	-0.63288E-02	-0.32147E-02	0.3137
FR	-12.620	8.5721	-1.4723	-0.0750	-0.64812E-01	-0.39676E-01	0.0705
T1	-2.2393	14.926	-0.15003	-0.0077	-0.27969E-01	-0.81665E-02	0.4404
T2	-2.4562	14.973	-0.16405	-0.0084	-0.28866E-01	-0.71152E-02	0.4348
T3	-2.1518	14.893	-0.14448	-0.0074	-0.22121E-01	-0.42297E-02	0.4426
T1W	0.18304	1.4666	0.12481	0.0064	0.32045E-01	0.78209E-02	0.4503
T2W	0.20077	1.4725	0.13634	0.0070	0.31195E-01	0.66830E-02	0.4458
T3W	0.14595	1.4717	0.99170E-01	0.0051	0.17429E-01	0.28124E-02	0.4605
CONSTANT	146.53	15.265	9.5991	0.4404	0.00000E+00	1.4933	0.0000

DURBIN-WATSON = 1.9592 VON NEUMANN RATIO = 1.9642 RHO = 0.01905
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2244

10. SL_{on}

I. DEPENDENT VARIABLE = AW 451 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18042	0.48864E-02	36.924	0.8678	1.2906	0.56427	0.0000
FR	0.94915E-01	0.41982E-01	2.2608	0.1063	0.87035E-01	0.62234E-01	0.0119
QW	0.11106E-02	0.94579E-03	1.1743	0.0555	0.44738E-01	0.14826E-01	0.1201
CONSTANT	0.18623	0.20378E-01	9.1387	0.3968	0.00000E+00	0.35867	0.0000

DURBIN-WATSON = 1.8254 VON NEUMANN RATIO = 1.8294 RHO = 0.08180
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5955

II. DEPENDENT VARIABLE = RA 451 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.54985E-01	0.52595E-02	10.454	0.4436	1.3632	2.8647	0.0000
FR	-0.66322	0.45504	-1.4575	-0.0689	-0.85018E-01	-0.13904	0.0725
QW	-0.62682E-02	0.53853E-02	-1.1639	-0.0550	-0.35298E-01	-0.26755E-01	0.1222
FZ	-0.12519E-02	0.44968E-02	-0.27841	-0.0132	-0.19200E-02	-0.13565E-02	0.3904
CONSTANT	-2.7565	0.47260	-5.8326	-0.2662	0.00000E+00	-1.6975	0.0000

DURBIN-WATSON = 1.9647 VON NEUMANN RATIO = 1.9691 RHO = 0.01547
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2442

III. DEPENDENT VARIABLE = W 451 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.29712	0.27888E-01	-10.654	-0.4504	-1.7580	-1.7439	0.0000
AN	0.13166E-05	0.10065E-03	0.13081E-01	0.0006	0.10247E-03	0.74538E-04	0.4948
FR	0.73051	2.3029	0.31722	0.0150	0.22348E-01	0.17253E-01	0.3755
CL	0.14864E-01	0.68260E-01	0.21775	0.0103	0.18711E-02	0.12484E-02	0.4138
CONSTANT	39.284	2.4814	15.831	0.5998	0.00000E+00	2.7253	0.0000

DURBIN-WATSON = 1.9069 VON NEUMANN RATIO = 1.9111 RHO = 0.04628
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2985

IV. DEPENDENT VARIABLE = S 451 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.2094	2.0037	-1.6017	-0.0761	-0.54243	-0.54683	0.0546
QW	-0.30149E-02	0.10729	-0.28100E-01	-0.0013	-0.68480E-03	-0.24701E-03	0.4888
AN	-0.12439E-04	0.21009E-02	-0.59211E-02	-0.0003	-0.16363E-03	-0.11999E-03	0.4976
FR	2.7625	9.6211	0.28712	0.0137	0.14283E-01	0.11116E-01	0.3870
T1	2.6432	30.590	0.86407E-01	0.0041	0.29444E-01	0.83823E-02	0.4656
T2	2.2727	31.304	0.72602E-01	0.0035	0.17293E-01	0.27400E-02	0.4711
T3	2.4368	30.654	0.79494E-01	0.0038	0.27215E-01	0.77915E-02	0.4683
T1W	-0.15336	2.0384	-0.75234E-01	-0.0036	-0.27378E-01	-0.69493E-02	0.4700
T2W	-0.13983	2.0761	-0.67354E-01	-0.0032	-0.17006E-01	-0.24628E-02	0.4731
T3W	-0.15849	2.0749	-0.76387E-01	-0.0036	-0.28424E-01	-0.71074E-02	0.4696
CONSTANT	129.75	30.357	4.2743	0.1997	0.00000E+00	1.5337	0.0000

DURBIN-WATSON = 1.9029 VON NEUMANN RATIO = 1.9071 RHO = 0.04825
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2985

11. VS_{on}

I. DEPENDENT VARIABLE = AW 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.13888	0.56680E-02	24.503	0.7763	1.1667	0.51845	0.0000
FR	0.30829E-01	0.31109E-01	0.99102	0.0497	0.33415E-01	0.15380E-01	0.1608
QW	-0.36845E-03	0.62366E-03	-0.59078	-0.0297	-0.19561E-01	-0.38058E-02	0.2773
CONSTANT	0.32111	0.19946E-01	16.100	0.6290	0.00000E+00	0.46998	0.0000

DURBIN-WATSON = 1.8942 VON NEUMANN RATIO = 1.8989 RHO = 0.04574
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6587

II. DEPENDENT VARIABLE = RA 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.47478E-01	0.27232E-02	17.434	0.6594	1.1672	2.0203	0.0000
FR	-0.24911	0.30145	-0.82638	-0.0415	-0.32142E-01	-0.33291E-01	0.2043
QW	0.46188E-02	0.43151E-02	1.0704	0.0538	0.29192E-01	0.12780E-01	0.1422
FZ	0.50178E-02	0.16844E-01	0.29790	0.0150	0.48517E-02	0.23575E-02	0.3829
CONSTANT	-2.5561	0.31951	-8.0001	-0.3734	0.00000E+00	-1.0022	0.0000

DURBIN-WATSON = 2.1044 VON NEUMANN RATIO = 2.1096 RHO = -0.06267
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5741

III. DEPENDENT VARIABLE = W 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.18480	0.11692E-01	-15.806	-0.6224	-1.3419	-2.1951	0.0000
AN	0.23298E-03	0.16374E-03	1.4229	0.0714	0.33333E-01	0.30983E-01	0.0774
FR	2.1834	1.2973	1.6829	0.0844	0.83207E-01	0.81444E-01	0.0462
CL	0.71635	0.17979	3.9844	0.1966	0.93712E-01	0.10584	0.0000
CONSTANT	27.201	1.4033	19.383	0.6982	0.00000E+00	2.9768	0.0000

DURBIN-WATSON = 1.5117 VON NEUMANN RATIO = 1.5155 RHO = 0.24276
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4572

IV. DEPENDENT VARIABLE = S 400 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-0.92857	1.5767	-0.58894	-0.0298	-0.12788	-0.78175E-01	0.2780
QW	-0.20537E-01	0.68774E-01	-0.29862	-0.0151	-0.52799E-02	-0.13354E-02	0.3826
AN	0.91241E-03	0.10217E-02	0.89305	0.0452	0.17978E-01	0.10215E-01	0.1859
FR	4.4216	7.7350	0.57163	0.0290	0.23207E-01	0.13886E-01	0.2838
T1	38.400	12.062	3.1836	0.1594	0.35099	0.79607E-01	0.0007
T2	41.092	14.026	2.9297	0.1469	0.40494	0.10696	0.0017
T3	40.921	14.288	2.8639	0.1437	0.32837	0.60325E-01	0.0021
T1W	-4.0687	1.3687	-2.9726	-0.1490	-0.42958	-0.76662E-01	0.0015
T2W	-4.2952	1.5839	-2.7117	-0.1362	-0.50387	-0.10863	0.0033
T3W	-4.3490	1.6217	-2.6817	-0.1347	-0.42201	-0.61207E-01	0.0037
CONSTANT	114.51	12.855	8.9072	0.4116	0.00000E+00	1.0550	0.0000

DURBIN-WATSON = 1.7584 VON NEUMANN RATIO = 1.7628 RHO = 0.11953
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3672

12. MN_{on}

I. DEPENDENT VARIABLE = AW 297 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18462	0.77968E-02	23.678	0.8104	1.1380	0.50022	0.0000
FR	0.10848	0.40308E-01	2.6913	0.1553	0.10364	0.65064E-01	0.0036
QW	-0.57424E-02	0.25934E-02	-2.2142	-0.1283	-0.81215E-01	-0.58282E-01	0.0134
CONSTANT	0.26331	0.23724E-01	11.099	0.5441	0.00000E+00	0.49300	0.0000

DURBIN-WATSON = 1.6323 VON NEUMANN RATIO = 1.6378 RHO = 0.17796
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6681

II. DEPENDENT VARIABLE = RA 297 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.44786E-01	0.35982E-02	12.447	0.5888	1.2176	2.5993	0.0000
FR	0.16158	0.36789	0.43921	0.0257	0.25045E-01	0.35767E-01	0.3303
QW	0.30623E-01	0.14878E-01	2.0583	0.1196	0.70266E-01	0.11471	0.0198
FZ	0.11009E-02	0.68565E-02	0.16057	0.0094	0.16741E-02	0.16067E-02	0.4362
CONSTANT	-2.5345	0.33550	-7.5546	-0.4043	0.00000E+00	-1.7514	0.0000

DURBIN-WATSON = 1.6453 VON NEUMANN RATIO = 1.6508 RHO = 0.17252
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4062

III. DEPENDENT VARIABLE = W 297 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24822	0.20068E-01	-12.369	-0.5864	-1.3874	-1.4909	0.0000
AN	0.20090E-04	0.99262E-04	0.20239	0.0118	0.28502E-02	0.14041E-02	0.4198
FR	-4.1382	2.0503	-2.0184	-0.1173	-0.13188	-0.94800E-01	0.0218
CL	-0.15911E-01	0.15184	-0.10478	-0.0061	-0.12926E-02	-0.19922E-02	0.4583
CONSTANT	36.165	1.8593	19.451	0.7513	0.00000E+00	2.5863	0.0000

DURBIN-WATSON = 1.7223 VON NEUMANN RATIO = 1.7281 RHO = 0.13729
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3757

IV. DEPENDENT VARIABLE = S 297 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.7748	0.77014	-4.9014	-0.2784	-0.67532	-0.62845	0.0000
QW	0.11356	0.21031	0.53997	0.0319	0.95844E-02	0.73294E-02	0.2946
AN	0.25718E-03	0.70372E-03	0.36546	0.0216	0.65278E-02	0.29925E-02	0.3574
FR	-16.162	8.0979	-1.9958	-0.1172	-0.92145E-01	-0.61641E-01	0.0230
T1	3.5361	11.585	0.30523	0.0180	0.44134E-01	0.16302E-01	0.3801
T2	2.2465	12.019	0.18691	0.0111	0.17600E-01	0.27918E-02	0.4259
T3	3.4954	11.913	0.29342	0.0173	0.35960E-01	0.84074E-02	0.3846
T1W	-0.22914	0.77546	-0.29548	-0.0175	-0.46462E-01	-0.14219E-01	0.3838
T2W	-0.22221	0.81701	-0.27198	-0.0161	-0.22709E-01	-0.30554E-02	0.3928
T3W	-0.25516	0.79436	-0.32121	-0.0190	-0.44341E-01	-0.92776E-02	0.3740
CONSTANT	141.00	12.326	11.440	0.5603	0.00000E+00	1.6788	0.0000

DURBIN-WATSON = 1.7258 VON NEUMANN RATIO = 1.7316 RHO = 0.13561
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3745

APPENDIX F

Estimates of structural equations with ecological zone dummy.

1. NL

I. DEPENDENT VARIABLE = AW 504 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.12588	0.35612E-02	35.346	0.8451	1.2715	0.45980	0.0000
FR	0.16526E-02	0.36905E-01	0.44780E-01	0.0020	0.19234E-02	0.83520E-03	0.4821
QW	-0.24249E-02	0.14927E-02	-1.6244	-0.0725	-0.68373E-01	-0.25554E-01	0.0521
CONSTANT	0.35610	0.19396E-01	18.359	0.6346	0.00000E+00	0.56492	0.0000

DURBIN-WATSON = 1.7750 VON NEUMANN RATIO = 1.7786 RHO = 0.10999
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4501

II. DEPENDENT VARIABLE = RA 504 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.75278E-01	0.60203E-02	12.504	0.4884	1.5681	3.2321	0.0000
FR	1.2375	0.57219	2.1628	0.0964	0.14258	0.17122	0.0153
QW	0.15863E-01	0.12470E-01	1.2721	0.0569	0.44280E-01	0.45765E-01	0.1017
FZ	-0.16490E-01	0.13747E-01	-1.1995	-0.0536	-0.14905E-01	-0.13933E-01	0.1152
CONSTANT	-5.6070	0.65896	-8.5089	-0.3560	0.00000E+00	-2.4351	0.0000

DURBIN-WATSON = 1.9152 VON NEUMANN RATIO = 1.9190 RHO = 0.04165
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1624

III. DEPENDENT VARIABLE = W 504 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.28035	0.22439E-01	-12.494	-0.4881	-1.9660	-2.4958	0.0000
AN	0.16165E-04	0.85572E-04	0.18891	0.0085	0.26545E-02	0.16785E-02	0.4251
FR	-4.6699	2.1582	-2.1638	-0.0964	-0.18113	-0.13396	0.0152
CL	-0.79055E-01	0.17129	-0.46153	-0.0207	-0.69355E-02	-0.96329E-02	0.3222
CONSTANT	40.397	2.4776	16.305	0.5896	0.00000E+00	3.6377	0.0000

DURBIN-WATSON = 1.9047 VON NEUMANN RATIO = 1.9085 RHO = 0.04716
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1637

IV. DEPENDENT VARIABLE = S 504 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.1599	8.8677	-0.35634	-0.0160	-0.45061	-0.35496	0.3608
QW	0.42102E-01	0.19108	0.22034	0.0099	0.56418E-02	0.28290E-02	0.4128
AN	0.12119E-03	0.10411E-02	0.11640	0.0052	0.28378E-02	0.14135E-02	0.4537
FR	-16.593	8.2490	-2.0115	-0.0900	-0.91774E-01	-0.53468E-01	0.0221
Z1	2.5558	70.792	0.36103E-01	0.0016	0.15578E-01	0.24365E-01	0.4856
Z2	5.3640	75.516	0.71031E-01	0.0032	0.10800E-01	0.32296E-03	0.4717
Z1W	-0.34264	8.8287	-0.38810E-01	-0.0017	-0.52903E-01	-0.36901E-01	0.4845
Z2W	-0.59751	9.3284	-0.64053E-01	-0.0029	-0.10285E-01	-0.27581E-03	0.4745
CONSTANT	140.05	71.092	1.9700	0.0882	0.00000E+00	1.4167	0.0244

DURBIN-WATSON = 1.9035 VON NEUMANN RATIO = 1.9073 RHO = 0.04779
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1701

2. SL

I. DEPENDENT VARIABLE = AW 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.20662	0.81011E-02	25.505	0.7741	1.4447	0.61259	0.0000
FR	0.61537E-01	0.45062E-01	1.3656	0.0653	0.57287E-01	0.35782E-01	0.0860
QW	0.16329E-02	0.11045E-02	1.4784	0.0707	0.61143E-01	0.20103E-01	0.0696
CONSTANT	0.17751	0.23799E-01	7.4588	0.3367	0.00000E+00	0.33153	0.0000

DURBIN-WATSON = 1.6951 VON NEUMANN RATIO = 1.6989 RHO = 0.14496
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5464

II. DEPENDENT VARIABLE = RA 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.46621E-01	0.43538E-02	10.708	0.4572	1.2810	2.4758	0.0000
FR	-0.21662	0.44776	-0.48379	-0.0232	-0.28841E-01	-0.42484E-01	0.3143
QW	-0.50495E-02	0.62491E-02	-0.80804	-0.0388	-0.27042E-01	-0.20968E-01	0.2095
FZ	0.77603E-02	0.83211E-02	0.93260	0.0447	0.12659E-01	0.10887E-01	0.1755
CONSTANT	-2.2595	0.40992	-5.5119	-0.2558	0.00000E+00	-1.4233	0.0000

DURBIN-WATSON = 1.8685 VON NEUMANN RATIO = 1.8727 RHO = 0.06314
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2270

III. DEPENDENT VARIABLE = W 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.28855	0.23505E-01	-12.276	-0.5077	-1.8610	-1.7722	0.0000
AN	0.64229E-03	0.22099E-03	2.9064	0.1382	0.55595E-01	0.40283E-01	0.0018
FR	1.2325	2.4179	0.50971	0.0245	0.38518E-01	0.27954E-01	0.3051
CL	1.3886	0.24716	5.6180	0.2604	0.10625	0.16775	0.0000
CONSTANT	34.813	2.2310	15.604	0.5995	0.00000E+00	2.5362	0.0000

DURBIN-WATSON = 1.6302 VON NEUMANN RATIO = 1.6340 RHO = 0.18476
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2234

IV. DEPENDENT VARIABLE = S 439 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	0.74191	1.2150	0.61062	0.0294	0.11503	0.12080	0.2707
QW	0.24932E-02	0.84014E-01	0.29676E-01	0.0014	0.48594E-03	0.19495E-03	0.4882
AN	0.15252E-03	0.14523E-02	0.10502	0.0051	0.20469E-02	0.15575E-02	0.4582
FR	-0.25406	8.9950	-0.28245E-01	-0.0014	-0.12311E-02	-0.93827E-03	0.4887
Z1	53.914	15.627	3.4500	0.1641	0.65436	0.33068	0.0003
Z2	56.154	16.411	3.4217	0.1628	0.56163	0.14414	0.0003
Z1W	-4.1226	1.2098	-3.4075	-0.1622	-0.82181	-0.34843	0.0003
Z2W	-4.2269	1.2489	-3.3845	-0.1611	-0.66830	-0.15533	0.0004
CONSTANT	76.492	15.259	5.0128	0.2350	0.00000E+00	0.90732	0.0000

DURBIN-WATSON = 1.6379 VON NEUMANN RATIO = 1.6416 RHO = 0.18102
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1638

3. VS

I. DEPENDENT VARIABLE = AW 461 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.14177	0.51085E-02	27.752	0.7922	1.2246	0.54184	0.0000
FR	0.97101E-02	0.30486E-01	0.31851	0.0149	0.10717E-01	0.49632E-02	0.3750
QW	-0.92109E-03	0.72294E-03	-1.2741	-0.0595	-0.42018E-01	-0.94154E-02	0.1013
CONSTANT	0.31542	0.18928E-01	16.664	0.6148	0.00000E+00	0.46261	0.0000

DURBIN-WATSON = 1.8500 VON NEUMANN RATIO = 1.8540 RHO = 0.07300
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6494

II. DEPENDENT VARIABLE = RA 461 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.50908E-01	0.27270E-02	18.668	0.6582	1.1787	2.0978	0.0000
FR	-0.10375E-01	0.31165	-0.33292E-01	-0.0016	-0.13257E-02	-0.13875E-02	0.4867
QW	0.87177E-02	0.50537E-02	1.7250	0.0805	0.46039E-01	0.23316E-01	0.0423
FZ	0.11794E-01	0.12991E-01	0.90783	0.0425	0.10273E-01	0.64819E-02	0.1820
CONSTANT	-2.9349	0.32210	-9.1118	-0.3925	0.00000E+00	-1.1262	0.0000

DURBIN-WATSON = 2.0609 VON NEUMANN RATIO = 2.0654 RHO = -0.03137
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4996

III. DEPENDENT VARIABLE = W 461 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.20185	0.11283E-01	-17.890	-0.6422	-1.3924	-2.3353	0.0000
AN	0.24340E-03	0.13481E-03	1.8055	0.0842	0.32254E-01	0.27722E-01	0.0355
FR	1.2619	1.2854	0.98172	0.0459	0.48040E-01	0.47380E-01	0.1631
CL	1.5273	0.22790	6.7014	0.2994	0.12027	0.27662	0.0000
CONSTANT	27.693	1.3745	20.147	0.6863	0.00000E+00	2.9835	0.0000

DURBIN-WATSON = 1.7138 VON NEUMANN RATIO = 1.7175 RHO = 0.14217
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4390

IV. DEPENDENT VARIABLE = S 461 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	3.7451	2.2110	1.6939	0.0794	0.54291	0.32371	0.0451
QW	-0.84104E-01	0.11771	-0.71449	-0.0336	-0.19184E-01	-0.54585E-02	0.2375
AN	-0.23599E-02	0.16039E-02	-1.4714	-0.0690	-0.45335E-01	-0.23233E-01	0.0706
FR	1.2057	7.5066	0.16062	0.0076	0.66542E-02	0.39130E-02	0.4362
Z1	61.434	14.132	4.3472	0.2003	0.63793	0.39214	0.0000
Z2	56.452	11.531	4.8956	0.2244	0.43652	0.72982E-01	0.0000
Z1W	-8.2516	2.1655	-3.8104	-0.1764	-1.3262	-0.52872	0.0001
Z2W	-7.6590	1.8069	-4.2386	-0.1955	-0.66830	-0.90351E-01	0.0000
CONSTANT	91.817	13.325	6.8906	0.3083	0.00000E+00	0.85502	0.0000

DURBIN-WATSON = 1.8899 VON NEUMANN RATIO = 1.8940 RHO = 0.05443
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2444

4. MN

I. DEPENDENT VARIABLE = AW 314 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.21569	0.10519E-01	20.504	0.7587	1.2703	0.55635	0.0000
FR	0.91566E-01	0.40664E-01	2.2518	0.1269	0.96151E-01	0.58774E-01	0.0122
QW	-0.30532E-02	0.26945E-02	-1.1331	-0.0642	-0.46335E-01	-0.32493E-01	0.1286
CONSTANT	0.21994	0.26812E-01	8.2031	0.4223	0.00000E+00	0.41737	0.0000

DURBIN-WATSON = 1.7036 VON NEUMANN RATIO = 1.7090 RHO = 0.13753
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6454

II. DEPENDENT VARIABLE = RA 314 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.37552E-01	0.38887E-02	9.6566	0.4815	1.1144	2.2830	0.0000
FR	-0.61816E-01	0.30885	-0.20015	-0.0114	-0.11022E-01	-0.15383E-01	0.4207
QW	0.12108E-01	0.13350E-01	0.90694	0.0515	0.31200E-01	0.49956E-01	0.1822
FZ	0.18573E-03	0.36254E-02	0.51230E-01	0.0029	0.52560E-03	0.33175E-03	0.4796
CONSTANT	-1.7914	0.33819	-5.2970	-0.2885	0.00000E+00	-1.3179	0.0000

DURBIN-WATSON = 1.7738 VON NEUMANN RATIO = 1.7795 RHO = 0.10485
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3610

III. DEPENDENT VARIABLE = W 314 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24248	0.25472E-01	-9.5192	-0.4762	-1.4138	-1.4110	0.0000
AN	0.47109E-05	0.11761E-03	0.40055E-01	0.0023	0.69722E-03	0.33493E-03	0.4840
FR	-2.3416	1.9923	-1.1753	-0.0667	-0.82038E-01	-0.55776E-01	0.1199
CL	0.13328E-01	0.29359	0.45396E-01	0.0026	0.65248E-03	0.17635E-02	0.4819
CONSTANT	35.000	2.2159	15.795	0.6684	0.00000E+00	2.4647	0.0000

DURBIN-WATSON = 1.8440 VON NEUMANN RATIO = 1.8499 RHO = 0.07729
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3276

IV. DEPENDENT VARIABLE = S 314 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.2161	1.1965	-3.5237	-0.1978	-0.72308	-0.72451	0.0002
QW	0.15153	0.24260	0.62460	0.0357	0.13158E-01	0.10284E-01	0.2661
AN	0.14659E-03	0.61123E-03	0.23983	0.0137	0.37209E-02	0.17910E-02	0.4052
FR	-9.4012	7.8607	-1.1960	-0.0683	-0.56488E-01	-0.38481E-01	0.1159
Z1	-1.8331	14.788	-0.12396	-0.0071	-0.22513E-01	-0.77710E-02	0.4507
Z2	-3.2059	15.409	-0.20805	-0.0119	-0.31144E-01	-0.66718E-02	0.4176
Z1W	0.11516	1.1116	0.10360	0.0059	0.24288E-01	0.73141E-02	0.4587
Z2W	0.20989	1.1479	0.18284	0.0105	0.34918E-01	0.68675E-02	0.4275
CONSTANT	144.71	15.801	9.1585	0.4644	0.00000E+00	1.7512	0.0000

DURBIN-WATSON = 1.8537 VON NEUMANN RATIO = 1.8596 RHO = 0.07239
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3261

5. NL_O

I. DEPENDENT VARIABLE = AW 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.15809	0.73766E-02	21.431	0.7402	1.3515	0.54582	0.0000
FR	-0.42840E-01	0.49114E-01	-0.87225	-0.0448	-0.42177E-01	-0.20374E-01	0.1915
QW	-0.12857E-01	0.28620E-02	-4.4924	-0.2249	-0.21123	-0.13451	0.0000
CONSTANT	0.38260	0.28562E-01	13.395	0.5668	0.00000E+00	0.60906	0.0000

DURBIN-WATSON = 1.7702 VON NEUMANN RATIO = 1.7748 RHO = 0.11258
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5183

II. DEPENDENT VARIABLE = RA 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.56714E-01	0.42525E-02	13.337	0.5657	1.3227	2.5683	0.0000
FR	0.90206	0.55683	1.6200	0.0830	0.10388	0.12425	0.0526
QW	0.82830E-01	0.19913E-01	4.1597	0.2092	0.15917	0.25099	0.0000
FZ	0.83287E-02	0.19777E-01	0.42112	0.0217	0.77741E-02	0.64378E-02	0.3368
CONSTANT	-4.2291	0.45548	-9.2849	-0.4309	0.00000E+00	-1.9499	0.0000

DURBIN-WATSON = 2.0087 VON NEUMANN RATIO = 2.0139 RHO = -0.00550
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2340

III. DEPENDENT VARIABLE = W 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.27040	0.16187E-01	-16.705	-0.6517	-1.7963	-2.3776	0.0000
AN	-0.66415E-04	0.17321E-03	-0.38343	-0.0197	-0.88351E-02	-0.57498E-02	0.3507
FR	-3.0179	2.4605	-1.2266	-0.0630	-0.98992E-01	-0.80718E-01	0.1100
CL	0.51309E-01	0.27752	0.18488	0.0095	0.43950E-02	0.64526E-02	0.4267
CONSTANT	38.621	1.8517	20.857	0.7315	0.00000E+00	3.4576	0.0000

DURBIN-WATSON = 1.9271 VON NEUMANN RATIO = 1.9321 RHO = 0.03565
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2088

IV. DEPENDENT VARIABLE = S 383 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.8308	5.6523	-0.85466	-0.0442	-0.72719	-0.54940	0.1964
QW	0.59852E-01	0.21027	0.28464	0.0147	0.49315E-02	0.40049E-02	0.3880
AN	-0.30962E-03	0.70660E-03	-0.43818	-0.0227	-0.62002E-02	-0.30485E-02	0.3306
FR	-11.340	9.2188	-1.2301	-0.0635	-0.55994E-01	-0.34494E-01	0.1093
Z1	-7.6191	37.345	-0.20402	-0.0105	-0.41222E-01	-0.74133E-01	0.4192
Z2	-10.896	43.749	-0.24906	-0.0129	-0.20630E-01	-0.57933E-03	0.4017
Z1W	1.1485	5.6319	0.20393	0.0105	0.18288	0.12710	0.4192
Z2W	1.4625	6.2422	0.23429	0.0121	0.22837E-01	0.62206E-03	0.4074
CONSTANT	150.26	38.495	3.9034	0.1978	0.00000E+00	1.5299	0.0000

DURBIN-WATSON = 1.9257 VON NEUMANN RATIO = 1.9307 RHO = 0.03637
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2121

6. SL_O

I. DEPENDENT VARIABLE = AW 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18396	0.28253E-02	65.111	0.9660	1.3519	0.55961	0.0000
FR	0.13177	0.56679E-01	2.3248	0.1322	0.11893	0.82725E-01	0.0100
QW	0.13060E-02	0.13668E-02	0.95549	0.0547	0.48494E-01	0.16744E-01	0.1697
CONSTANT	0.17984	0.24737E-01	7.2699	0.3848	0.00000E+00	0.34092	0.0000

DURBIN-WATSON = 1.6900 VON NEUMANN RATIO = 1.6955 RHO = 0.14601
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5416

II. DEPENDENT VARIABLE = RA 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.50734E-01	0.61549E-02	8.2428	0.4280	1.3008	2.7026	0.0000
FR	-0.20712	0.59022	-0.35092	-0.0202	-0.25439E-01	-0.42746E-01	0.3628
QW	-0.71830E-02	0.76426E-02	-0.93987	-0.0539	-0.36294E-01	-0.30274E-01	0.1736
FZ	-0.77847E-03	0.24981E-02	-0.31163	-0.0179	-0.14043E-02	-0.12013E-02	0.3777
CONSTANT	-2.6130	0.60001	-4.3549	-0.2427	0.00000E+00	-1.6284	0.0000

DURBIN-WATSON = 1.8997 VON NEUMANN RATIO = 1.9059 RHO = 0.04723
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1857

III. DEPENDENT VARIABLE = W 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.27952	0.33911E-01	-8.2429	-0.4280	-1.7577	-1.6864	0.0000
AN	0.85084E-05	0.69319E-04	0.12274	0.0071	0.75566E-03	0.50896E-03	0.4512
FR	-2.7901	2.9773	-0.93713	-0.0538	-0.84046E-01	-0.65213E-01	0.1743
CL	-0.19500E-01	0.80599E-01	-0.24194	-0.0139	-0.14326E-02	-0.23057E-02	0.4044
CONSTANT	39.012	3.2578	11.975	0.5668	0.00000E+00	2.7534	0.0000

DURBIN-WATSON = 1.9329 VON NEUMANN RATIO = 1.9392 RHO = 0.03322
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2398

IV. DEPENDENT VARIABLE = S 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.9156	4.2501	-0.92131	-0.0532	-0.62270	-0.64904	0.1784
QW	-0.18907E-02	0.20157	-0.93799E-02	-0.0005	-0.37259E-03	-0.14959E-03	0.4963
AN	0.22490E-03	0.29636E-02	0.75890E-01	0.0044	0.31765E-02	0.22300E-02	0.4698
FR	-9.7972	13.103	-0.74773	-0.0432	-0.46932E-01	-0.37956E-01	0.2273
Z1	-5.7903	56.627	-0.10225	-0.0059	-0.71621E-01	-0.29471E-01	0.4593
Z2	-4.3218	56.887	-0.75972E-01	-0.0044	-0.45635E-01	-0.11819E-01	0.4697
Z1W	0.38381	4.1675	0.92095E-01	0.0053	0.77677E-01	0.27261E-01	0.4633
Z2W	0.32151	4.1940	0.76660E-01	0.0044	0.57017E-01	0.13592E-01	0.4694
CONSTANT	144.06	56.419	2.5535	0.1461	0.00000E+00	1.6854	0.0053

DURBIN-WATSON = 1.9442 VON NEUMANN RATIO = 1.9506 RHO = 0.02755
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2462

7. VS_o

I. DEPENDENT VARIABLE = AW 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18396	0.28253E-02	65.111	0.9660	1.3519	0.55961	0.0000
FR	0.13177	0.56679E-01	2.3248	0.1322	0.11893	0.82725E-01	0.0100
QW	0.13060E-02	0.13668E-02	0.95549	0.0547	0.48494E-01	0.16744E-01	0.1697
CONSTANT	0.17984	0.24737E-01	7.2699	0.3848	0.00000E+00	0.34092	0.0000

DURBIN-WATSON = 1.6900 VON NEUMANN RATIO = 1.6955 RHO = 0.14601
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5416

II. DEPENDENT VARIABLE = RA 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.50734E-01	0.61549E-02	8.2428	0.4280	1.3008	2.7026	0.0000
FR	-0.20712	0.59022	-0.35092	-0.0202	-0.25439E-01	-0.42746E-01	0.3628
QW	-0.71830E-02	0.76426E-02	-0.93987	-0.0539	-0.36294E-01	-0.30274E-01	0.1736
FZ	-0.77847E-03	0.24981E-02	-0.31163	-0.0179	-0.14043E-02	-0.12013E-02	0.3777
CONSTANT	-2.6130	0.60001	-4.3549	-0.2427	0.00000E+00	-1.6284	0.0000

DURBIN-WATSON = 1.8997 VON NEUMANN RATIO = 1.9059 RHO = 0.04723
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1857

III. DEPENDENT VARIABLE = W 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.27952	0.33911E-01	-8.2429	-0.4280	-1.7577	-1.6864	0.0000
AN	0.85084E-05	0.69319E-04	0.12274	0.0071	0.75566E-03	0.50896E-03	0.4512
FR	-2.7901	2.9773	-0.93713	-0.0538	-0.84046E-01	-0.65213E-01	0.1743
CL	-0.19500E-01	0.80599E-01	-0.24194	-0.0139	-0.14326E-02	-0.23057E-02	0.4044
CONSTANT	39.012	3.2578	11.975	0.5668	0.00000E+00	2.7534	0.0000

DURBIN-WATSON = 1.9329 VON NEUMANN RATIO = 1.9392 RHO = 0.03322
RESIDUAL SUM = 0.10427E-11 RESIDUAL VARIANCE = 95.836
SUM OF ABSOLUTE ERRORS= 2372.5
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2398

IV. DEPENDENT VARIABLE = S 308 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.9156	4.2501	-0.92131	-0.0532	-0.62270	-0.64904	0.1784
QW	-0.18907E-02	0.20157	-0.93799E-02	-0.0005	-0.37259E-03	-0.14959E-03	0.4963
AN	0.22490E-03	0.29636E-02	0.75890E-01	0.0044	0.31765E-02	0.22300E-02	0.4698
FR	-9.7972	13.103	-0.74773	-0.0432	-0.46932E-01	-0.37956E-01	0.2273
Z1	-5.7903	56.627	-0.10225	-0.0059	-0.71621E-01	-0.29471E-01	0.4593
Z2	-4.3218	56.887	-0.75972E-01	-0.0044	-0.45635E-01	-0.11819E-01	0.4697
Z1W	0.38381	4.1675	0.92095E-01	0.0053	0.77677E-01	0.27261E-01	0.4633
Z2W	0.32151	4.1940	0.76660E-01	0.0044	0.57017E-01	0.13592E-01	0.4694
CONSTANT	144.06	56.419	2.5535	0.1461	0.00000E+00	1.6854	0.0053

DURBIN-WATSON = 1.9442 VON NEUMANN RATIO = 1.9506 RHO = 0.02755
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2462

8. MN_O

I. DEPENDENT VARIABLE = AW 273 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.21784	0.11952E-01	18.226	0.7433	1.2670	0.57392	0.0000
FR	0.92674E-01	0.43906E-01	2.1107	0.1276	0.93092E-01	0.57416E-01	0.0174
QW	-0.44250E-02	0.28447E-02	-1.5555	-0.0944	-0.65153E-01	-0.45366E-01	0.0599
CONSTANT	0.21953	0.28927E-01	7.5891	0.4199	0.00000E+00	0.41403	0.0000

DURBIN-WATSON = 1.7316 VON NEUMANN RATIO = 1.7379 RHO = 0.12148
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6772

II. DEPENDENT VARIABLE = RA 273 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.38224E-01	0.39723E-02	9.6228	0.5067	1.1498	2.2764	0.0000
FR	0.58570E-01	0.33222	0.17630	0.0108	0.10116E-01	0.13773E-01	0.4300
QW	0.18969E-01	0.13768E-01	1.3777	0.0839	0.48021E-01	0.73814E-01	0.0841
FZ	-0.59555E-03	0.77742E-02	-0.76606E-01	-0.0047	-0.98163E-03	-0.94033E-03	0.4695
CONSTANT	-1.9040	0.35374	-5.3826	-0.3123	0.00000E+00	-1.3630	0.0000

DURBIN-WATSON = 1.7272 VON NEUMANN RATIO = 1.7336 RHO = 0.11091
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4107

III. DEPENDENT VARIABLE = W 273 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24939	0.26452E-01	-9.4280	-0.4991	-1.4551	-1.4715	0.0000
AN	0.66088E-05	0.12095E-03	0.54643E-01	0.0033	0.99084E-03	0.46359E-03	0.4782
FR	-3.1557	2.2081	-1.4292	-0.0870	-0.10572	-0.73527E-01	0.0765
CL	0.46385E-02	0.33022	0.14047E-01	0.0009	0.21198E-03	0.62184E-03	0.4944
CONSTANT	35.867	2.4021	14.932	0.6739	0.00000E+00	2.5440	0.0000

DURBIN-WATSON = 1.7902 VON NEUMANN RATIO = 1.7967 RHO = 0.09084
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3664

IV. DEPENDENT VARIABLE = S 273 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.2109	3.7610	-1.1196	-0.0687	-0.72173	-0.71366	0.1314
QW	0.99853E-01	0.66297	0.15061	0.0093	0.84038E-02	0.65247E-02	0.4401
AN	-0.24114E-04	0.19043E-02	-0.12663E-01	-0.0008	-0.61965E-03	-0.28668E-03	0.4949
FR	-12.540	10.743	-1.1673	-0.0717	-0.72003E-01	-0.49518E-01	0.1215
Z1	-2.6357	47.486	-0.55504E-01	-0.0034	-0.32224E-01	-0.12418E-01	0.4779
Z2	-1.8780	49.102	-0.38247E-01	-0.0024	-0.15332E-01	-0.27288E-02	0.4847
Z1W	0.21073	3.6900	0.57110E-01	0.0035	0.45964E-01	0.15394E-01	0.4772
Z2W	0.19786	3.7888	0.52222E-01	0.0032	0.27522E-01	0.44083E-02	0.4792
CONSTANT	145.77	47.184	3.0895	0.1868	0.00000E+00	1.7523	0.0010

DURBIN-WATSON = 1.7947 VON NEUMANN RATIO = 1.8013 RHO = 0.08851
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3622

9. NL_{on}

I. DEPENDENT VARIABLE = AW 389 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.15116	0.71037E-02	21.280	0.7352	1.3686	0.52392	0.0000
FR	-0.32959E-01	0.47621E-01	-0.69213	-0.0353	-0.34132E-01	-0.16062E-01	0.2444
QW	-0.15345E-01	0.30047E-02	-5.1072	-0.2519	-0.24769	-0.15816	0.0000
CONSTANT	0.41038	0.28540E-01	14.379	0.5911	0.00000E+00	0.65030	0.0000

DURBIN-WATSON = 1.6441 VON NEUMANN RATIO = 1.6483 RHO = 0.17751
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5038

II. DEPENDENT VARIABLE = RA 389 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.57468E-01	0.58576E-02	9.8108	0.4477	1.2761	2.5698	0.0000
FR	1.0206	0.56758	1.7982	0.0914	0.11674	0.14351	0.0361
QW	0.10302	0.21358E-01	4.8236	0.2390	0.18368	0.30636	0.0000
FZ	0.39142E-02	0.17842E-01	0.21939	0.0112	0.35464E-02	0.31026E-02	0.4132
CONSTANT	-4.4242	0.61753	-7.1643	-0.3434	0.00000E+00	-2.0228	0.0000

DURBIN-WATSON = 1.9614 VON NEUMANN RATIO = 1.9665 RHO = 0.01712
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2167

III. DEPENDENT VARIABLE = W 389 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.26168	0.24403E-01	-10.723	-0.4801	-1.7522	-2.3100	0.0000
AN	-0.53999E-04	0.15860E-03	-0.34047	-0.0174	-0.70321E-02	-0.47144E-02	0.3668
FR	-3.6689	2.3519	-1.5600	-0.0794	-0.12655	-0.10184	0.0594
CL	-0.11692E-02	0.22359	-0.52293E-02	-0.0003	-0.10115E-03	-0.15029E-03	0.4979
CONSTANT	37.856	2.5868	14.634	0.5984	0.00000E+00	3.4167	0.0000

DURBIN-WATSON = 1.9090 VON NEUMANN RATIO = 1.9139 RHO = 0.04419
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2165

IV. DEPENDENT VARIABLE = S 389 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-9.7095	75.099	-0.12929	-0.0066	-1.4501	-1.0999	0.4486
QW	-0.18692	3.2565	-0.57397E-01	-0.0029	-0.15008E-01	-0.12430E-01	0.4771
AN	0.91930E-03	0.19507E-01	0.47126E-01	0.0024	0.17879E-01	0.90920E-02	0.4812
FR	-12.441	29.971	-0.41510	-0.0212	-0.64088E-01	-0.39119E-01	0.3390
Z1	-39.367	580.62	-0.67803E-01	-0.0035	-0.24763	-0.37768	0.4730
Z1W	5.8298	75.330	0.77390E-01	0.0040	0.93879	0.63177	0.4692
CONSTANT	184.68	575.56	0.32088	0.0164	0.00000E+00	1.8883	0.3742

DURBIN-WATSON = 1.8791 VON NEUMANN RATIO = 1.8839 RHO = 0.05922
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2086

10. SL_{on}

I. DEPENDENT VARIABLE = AW 327 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18895	0.36561E-02	51.681	0.9445	1.3110	0.55962	0.0000
FR	0.13489	0.54447E-01	2.4775	0.1366	0.11886	0.85391E-01	0.0066
QW	0.10351E-02	0.97262E-03	1.0642	0.0591	0.50777E-01	0.14946E-01	0.1436
CONSTANT	0.17436	0.23157E-01	7.5292	0.3864	0.00000E+00	0.34004	0.0000

DURBIN-WATSON = 1.7280 VON NEUMANN RATIO = 1.7333 RHO = 0.12702
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5527

II. DEPENDENT VARIABLE = RA 327 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.53241E-01	0.64200E-02	8.2930	0.4195	1.4423	2.9753	0.0000
FR	-0.60201	0.59419	-1.0132	-0.0564	-0.76449E-01	-0.12867	0.1555
QW	-0.55447E-02	0.52726E-02	-1.0516	-0.0585	-0.39202E-01	-0.27031E-01	0.1465
FZ	-0.14051E-02	0.30987E-02	-0.45344	-0.0253	-0.24544E-02	-0.22007E-02	0.3251
CONSTANT	-2.7601	0.59648	-4.6272	-0.2497	0.00000E+00	-1.8174	0.0000

DURBIN-WATSON = 1.9403 VON NEUMANN RATIO = 1.9463 RHO = 0.02660
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1796

III. DEPENDENT VARIABLE = W 327 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.30117	0.36388E-01	-8.2766	-0.4188	-1.8890	-1.7496	0.0000
AN	-0.10060E-05	0.76612E-04	-0.13131E-01	-0.0007	-0.88514E-04	-0.58465E-04	0.4948
FR	-0.62119	3.1180	-0.19923	-0.0111	-0.18264E-01	-0.13802E-01	0.4210
CL	-0.89666E-02	0.90207E-01	-0.99400E-01	-0.0055	-0.66229E-03	-0.10249E-02	0.4604
CONSTANT	40.385	3.3396	12.093	0.5589	0.00000E+00	2.7645	0.0000

DURBIN-WATSON = 1.9194 VON NEUMANN RATIO = 1.9253 RHO = 0.03984
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2441

IV. DEPENDENT VARIABLE = S 327 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.7893	7.7049	-0.49180	-0.0276	-0.60413	-0.65225	0.3114
QW	-0.74174E-02	0.22529	-0.32924E-01	-0.0018	-0.19358E-02	-0.64707E-03	0.4869
AN	0.18523E-03	0.45331E-02	0.40862E-01	0.0023	0.25984E-02	0.18530E-02	0.4837
FR	-2.0420	15.508	-0.13168	-0.0074	-0.95725E-02	-0.78099E-02	0.4476
Z1	-7.3261	106.23	-0.68967E-01	-0.0039	-0.91306E-01	-0.39070E-01	0.4725
Z2	-4.9615	106.81	-0.46453E-01	-0.0026	-0.51219E-01	-0.12693E-01	0.4815
Z1W	0.50491	7.6271	0.66200E-01	0.0037	0.10564	0.38552E-01	0.4736
Z2W	0.39186	7.6700	0.51090E-01	0.0029	0.70436E-01	0.16266E-01	0.4796
CONSTANT	140.53	105.97	1.3261	0.0742	0.00000E+00	1.6558	0.0924

DURBIN-WATSON = 1.9348 VON NEUMANN RATIO = 1.9407 RHO = 0.03218
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2474

11. VS_{on}

I. DEPENDENT VARIABLE = AW 476 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.14323	0.49974E-02	28.661	0.7969	1.1918	0.54508	0.0000
FR	-0.85310E-02	0.31330E-01	-0.27229	-0.0125	-0.87136E-02	-0.43688E-02	0.3927
QW	-0.79470E-03	0.72681E-03	-1.0934	-0.0503	-0.34334E-01	-0.83713E-02	0.1371
CONSTANT	0.31189	0.18336E-01	17.010	0.6165	0.00000E+00	0.46766	0.0000

DURBIN-WATSON = 1.8768 VON NEUMANN RATIO = 1.8808 RHO = 0.06060
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6556

II. DEPENDENT VARIABLE = RA 476 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.52130E-01	0.27507E-02	18.952	0.6578	1.2133	2.1606	0.0000
FR	0.22542	0.32440	0.69488	0.0320	0.27670E-01	0.30334E-01	0.2436
QW	0.78398E-02	0.50287E-02	1.5590	0.0717	0.40707E-01	0.21701E-01	0.0595
FZ	0.14723E-01	0.14685E-01	1.0026	0.0461	0.12992E-01	0.86053E-02	0.1580
CONSTANT	-3.0995	0.32082	-9.6613	-0.4067	0.00000E+00	-1.2213	0.0000

DURBIN-WATSON = 2.0835 VON NEUMANN RATIO = 2.0879 RHO = -0.04324
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5058

III. DEPENDENT VARIABLE = W 476 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.22114	0.12526E-01	-17.654	-0.6310	-1.4781	-2.4045	0.0000
AN	0.29033E-03	0.15860E-03	1.8306	0.0841	0.36139E-01	0.31704E-01	0.0336
FR	0.92866	1.4744	0.62985	0.0290	0.32736E-01	0.32784E-01	0.2644
CL	1.1664	0.26350	4.4265	0.1998	0.87215E-01	0.20440	0.0000
CONSTANT	30.335	1.5123	20.059	0.6788	0.00000E+00	3.1356	0.0000

DURBIN-WATSON = 1.7451 VON NEUMANN RATIO = 1.7488 RHO = 0.12673
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4157

IV. DEPENDENT VARIABLE = S 476 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	4.4830	2.9810	1.5039	0.0694	0.67071	0.41230	0.0663
QW	-0.68903E-01	0.10917	-0.63114	-0.0292	-0.15371E-01	-0.46017E-02	0.2640
AN	-0.17246E-02	0.17266E-02	-0.99884	-0.0462	-0.32117E-01	-0.17320E-01	0.1589
FR	1.6052	7.7686	0.20663	0.0096	0.84660E-02	0.52119E-02	0.4181
Z1	67.393	20.543	3.2806	0.1501	0.68601	0.44820	0.0005
Z2	67.852	21.537	3.1504	0.1443	0.54288	0.98924E-01	0.0008
Z1W	-8.9000	2.9483	-3.0186	-0.1383	-1.4533	-0.61003	0.0013
Z2W	-8.8680	3.0369	-2.9201	-0.1339	-0.84170	-0.12185	0.0017
CONSTANT	83.013	19.473	4.2630	0.1935	0.00000E+00	0.78916	0.0000

DURBIN-WATSON = 1.9405 VON NEUMANN RATIO = 1.9446 RHO = 0.02925
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2470

12. MN_{on}

I. DEPENDENT VARIABLE = AW 277 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18790	0.88523E-02	21.226	0.7891	1.1924	0.51771	0.0000
FR	0.10326	0.41664E-01	2.4785	0.1483	0.10217	0.61777E-01	0.0066
QW	-0.60061E-02	0.27175E-02	-2.2102	-0.1326	-0.87383E-01	-0.60197E-01	0.0135
CONSTANT	0.26215	0.25839E-01	10.145	0.5233	0.00000E+00	0.48071	0.0000

DURBIN-WATSON = 1.6084 VON NEUMANN RATIO = 1.6142 RHO = 0.18921
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6728

II. DEPENDENT VARIABLE = RA 277 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.43108E-01	0.39887E-02	10.808	0.5481	1.1731	2.4223	0.0000
FR	0.76265E-01	0.36382	0.20962	0.0127	0.11890E-01	0.16559E-01	0.4170
QW	0.30393E-01	0.15255E-01	1.9923	0.1199	0.69678E-01	0.11056	0.0232
FZ	-0.31316E-03	0.69479E-02	-0.45072E-01	-0.0027	-0.47420E-03	-0.45804E-03	0.4820
CONSTANT	-2.3274	0.36746	-6.3337	-0.3585	0.00000E+00	-1.5489	0.0000

DURBIN-WATSON = 1.6755 VON NEUMANN RATIO = 1.6816 RHO = 0.15674
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4176

III. DEPENDENT VARIABLE = W 277 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.24247	0.22721E-01	-10.672	-0.5433	-1.3965	-1.5002	0.0000
AN	0.15658E-05	0.99599E-04	0.15721E-01	0.0010	0.23075E-03	0.11268E-03	0.4937
FR	-3.5226	2.0577	-1.7119	-0.1032	-0.11624	-0.84215E-01	0.0435
CL	-0.48448E-02	0.26752	-0.18110E-01	-0.0011	-0.23108E-03	-0.66649E-03	0.4928
CONSTANT	35.275	2.0783	16.973	0.7172	0.00000E+00	2.5849	0.0000

DURBIN-WATSON = 1.8092 VON NEUMANN RATIO = 1.8157 RHO = 0.09365
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3996

IV. DEPENDENT VARIABLE = S 277 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.2762	2.3104	-1.8509	-0.1123	-0.74247	-0.69115	0.0321
QW	0.83065E-01	0.37832	0.21956	0.0134	0.69981E-02	0.53773E-02	0.4131
AN	0.32486E-04	0.10917E-02	0.29756E-01	0.0018	0.83123E-03	0.37783E-03	0.4881
FR	-14.471	8.9871	-1.6102	-0.0979	-0.82910E-01	-0.55917E-01	0.0537
Z1	-2.3789	28.858	-0.82435E-01	-0.0050	-0.29505E-01	-0.11494E-01	0.4672
Z2	-2.6499	29.860	-0.88746E-01	-0.0054	-0.21084E-01	-0.35126E-02	0.4646
Z1W	0.16735	2.2412	0.74666E-01	0.0046	0.35752E-01	0.11663E-01	0.4702
Z2W	0.18343	2.3078	0.79484E-01	0.0049	0.24191E-01	0.36550E-02	0.4683
CONSTANT	146.99	29.381	5.0030	0.2923	0.00000E+00	1.7410	0.0000

DURBIN-WATSON = 1.8151 VON NEUMANN RATIO = 1.8217 RHO = 0.09070
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3955

APPENDIX G

Estimates of structural equations with crop dummy.

1. NL

I. DEPENDENT VARIABLE = AW 356 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.15305	0.83457E-02	18.339	0.6990	1.1104	0.53025	0.0000
FR	-0.62512E-01	0.49751E-01	-1.2565	-0.0668	-0.52544E-01	-0.30734E-01	0.1045
QW	-0.14734E-01	0.29630E-02	-4.9726	-0.2562	-0.20171	-0.16163	0.0000
CONSTANT	0.39996	0.30226E-01	13.232	0.5764	0.00000E+00	0.66211	0.0000

DURBIN-WATSON = 1.8408 VON NEUMANN RATIO = 1.8460 RHO = 0.07873
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5451

II. DEPENDENT VARIABLE = RA 356 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.54812E-01	0.78046E-02	7.0230	0.3510	1.4715	2.5715	0.0000
FR	1.1537	0.73115	1.5779	0.0839	0.13367	0.16372	0.0573
QW	0.11460	0.23106E-01	4.9596	0.2559	0.21625	0.36285	0.0000
FZ	0.28055E-01	0.26778E-01	1.0477	0.0558	0.26486E-01	0.22628E-01	0.1474
CONSTANT	-4.4383	0.81935	-5.4168	-0.2778	0.00000E+00	-2.1207	0.0000

DURBIN-WATSON = 2.0716 VON NEUMANN RATIO = 2.0774 RHO = -0.03890
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2047

III. DEPENDENT VARIABLE = W 356 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.25808	0.30497E-01	-8.4626	-0.4117	-1.6753	-2.1316	0.0000
AN	-0.98228E-04	0.29426E-03	-0.33381	-0.0178	-0.70576E-02	-0.71055E-02	0.3693
FR	-3.4473	2.9267	-1.1779	-0.0627	-0.96576E-01	-0.86125E-01	0.1194
CL	0.53309E-02	0.29976	0.17784E-01	0.0009	0.38849E-03	0.64873E-03	0.4929
CONSTANT	38.328	3.2894	11.652	0.5281	0.00000E+00	3.2242	0.0000

DURBIN-WATSON = 1.9723 VON NEUMANN RATIO = 1.9779 RHO = 0.00904
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1710

IV. DEPENDENT VARIABLE = S 356 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-1.5250	7.6376	-0.19967	-0.0107	-0.23492	-0.18464	0.4209
QW	-0.62212	1.5292	-0.40683	-0.0218	-0.43728E-01	-0.41986E-01	0.3421
AN	0.22228E-03	0.63511E-02	0.34999E-01	0.0019	0.24602E-02	0.19468E-02	0.4860
FR	-17.253	21.843	-0.78985	-0.0422	-0.74457E-01	-0.52186E-01	0.2148
C1	36.157	104.08	0.34740	0.0186	0.34667	0.28136	0.3641
C1W	-2.4071	7.4771	-0.32193	-0.0172	-0.38900	-0.21093	0.3738
CONSTANT	118.45	97.784	1.2114	0.0647	0.00000E+00	1.2064	0.1129

DURBIN-WATSON = 1.9616 VON NEUMANN RATIO = 1.9672 RHO = 0.01314
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1471

2. SL

I. DEPENDENT VARIABLE = AW 431 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.19459	0.79708E-02	24.413	0.7633	1.1730	0.61676	0.0000
FR	0.76219E-01	0.49925E-01	1.5267	0.0737	0.59626E-01	0.53576E-01	0.0634
QW	0.16004E-02	0.15418E-02	1.0380	0.0502	0.40312E-01	0.20498E-01	0.1496
CONSTANT	0.15374	0.26577E-01	5.7846	0.2696	0.00000E+00	0.30916	0.0000

DURBIN-WATSON = 1.8500 VON NEUMANN RATIO = 1.8543 RHO = 0.07448
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5406

II. DEPENDENT VARIABLE = RA 431 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.65624E-01	0.75192E-02	8.7275	0.3895	2.1315	3.6205	0.0000
FR	-0.34939	0.78698	-0.44396	-0.0215	-0.45343E-01	-0.77485E-01	0.3285
QW	-0.30872E-02	0.96990E-02	-0.31831	-0.0154	-0.12901E-01	-0.12476E-01	0.3751
FZ	0.46211E-02	0.18333E-01	0.25207	0.0122	0.71885E-02	0.62909E-02	0.4005
CONSTANT	-3.9983	0.70835	-5.6445	-0.2638	0.00000E+00	-2.5369	0.0000

DURBIN-WATSON = 1.8282 VON NEUMANN RATIO = 1.8324 RHO = 0.08571
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0719

III. DEPENDENT VARIABLE = W 431 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.37659	0.37373E-01	-10.076	-0.4387	-2.4595	-2.2236	0.0000
AN	0.68475E-03	0.46255E-03	1.4804	0.0715	0.44701E-01	0.37250E-01	0.0694
FR	2.2174	4.4143	0.50232	0.0243	0.57863E-01	0.52632E-01	0.3077
CL	0.58437	0.28105	2.0792	0.1002	0.56570E-01	0.56439E-01	0.0188
CONSTANT	45.317	3.6440	12.436	0.5161	0.00000E+00	3.0773	0.0000

DURBIN-WATSON = 1.8154 VON NEUMANN RATIO = 1.8197 RHO = 0.09192
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0532

IV. DEPENDENT VARIABLE = S 431 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-0.32886	2.0423	-0.16102	-0.0079	-0.50354E-01	-0.55695E-01	0.4360
QW	-0.12394	0.16608	-0.74630	-0.0364	-0.15945E-01	-0.90783E-02	0.2277
AN	0.16430E-02	0.23744E-02	0.69197	0.0337	0.16423E-01	0.15137E-01	0.2445
FR	-2.1643	14.059	-0.15394	-0.0075	-0.86474E-02	-0.87000E-02	0.4388
C1	37.480	32.210	1.1636	0.0567	0.34468	0.18201	0.1223
C2	32.117	29.270	1.0973	0.0535	0.19953	0.47134E-01	0.1363
C3	38.502	32.372	1.1894	0.0579	0.29138	0.92461E-01	0.1171
C1W	-2.4038	2.0076	-1.1973	-0.0583	-0.37712	-0.16831	0.1156
C2W	-2.0010	1.7638	-1.1345	-0.0553	-0.21140	-0.42768E-01	0.1283
C3W	-2.4316	2.0253	-1.2006	-0.0585	-0.33455	-0.87073E-01	0.1150
CONSTANT	89.986	29.106	3.0917	0.1492	0.00000E+00	1.0349	0.0010

DURBIN-WATSON = 1.8022 VON NEUMANN RATIO = 1.8064 RHO = 0.09868
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0542

3. VS

I. DEPENDENT VARIABLE = AW 524 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.18986	0.10041E-01	18.909	0.6383	1.2606	0.53038	0.0000
FR	0.61717E-01	0.33337E-01	1.8513	0.0809	0.67573E-01	0.44127E-01	0.0321
QW	-0.88131E-03	0.11511E-02	-0.76560	-0.0336	-0.27539E-01	-0.87743E-02	0.2220
CONSTANT	0.24265	0.21793E-01	11.134	0.4388	0.00000E+00	0.43427	0.0000

DURBIN-WATSON = 1.6746 VON NEUMANN RATIO = 1.6778 RHO = 0.16107
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5713

II. DEPENDENT VARIABLE = RA 524 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.37620E-01	0.28840E-02	13.044	0.4969	1.0942	1.7823	0.0000
FR	-0.15161	0.24447	-0.62017	-0.0272	-0.25002E-01	-0.38805E-01	0.2676
QW	0.78535E-02	0.60516E-02	1.2977	0.0569	0.36961E-01	0.27989E-01	0.0972
FZ	0.22730E-01	0.11378E-01	1.9978	0.0874	0.26841E-01	0.24334E-01	0.0229
CONSTANT	-1.2423	0.23225	-5.3488	-0.2286	0.00000E+00	-0.79587	0.0000

DURBIN-WATSON = 1.9431 VON NEUMANN RATIO = 1.9468 RHO = 0.02615
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3992

III. DEPENDENT VARIABLE = W 524 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.21034	0.16518E-01	-12.734	-0.4879	-1.3691	-1.2015	0.0000
AN	0.42046E-03	0.22039E-03	1.9078	0.0835	0.34970E-01	0.19052E-01	0.0282
FR	0.71463	1.4019	0.50975	0.0224	0.26370E-01	0.22052E-01	0.3051
CL	0.25738	0.11754	2.1897	0.0957	0.20731E-01	0.34222E-01	0.0143
CONSTANT	27.527	1.3717	20.067	0.6610	0.00000E+00	2.1262	0.0000

DURBIN-WATSON = 1.9112 VON NEUMANN RATIO = 1.9148 RHO = 0.04407
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3424

IV. DEPENDENT VARIABLE = S 524 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-2.9111	0.85737	-3.3954	-0.1480	-0.44726	-0.50964	0.0003
QW	0.55106E-01	0.38266E-01	1.4401	0.0633	0.89164E-02	0.41453E-02	0.0749
AN	0.19981E-02	0.10241E-02	1.9511	0.0857	0.25532E-01	0.15850E-01	0.0255
FR	2.3681	6.3176	0.37484	0.0165	0.13426E-01	0.12793E-01	0.3539
C1	23.383	10.942	2.1370	0.0938	0.24472	0.11163	0.0163
C2	23.171	10.573	2.1914	0.0961	0.20595	0.65175E-01	0.0142
C1W	-1.8019	0.84007	-2.1449	-0.0941	-0.28657	-0.11271	0.0160
C2W	-1.7388	0.79473	-2.1879	-0.0960	-0.23169	-0.61383E-01	0.0143
C3	25.386	8.1444	3.1170	0.1361	0.20591	0.56339E-01	0.0009
C4	20.242	6.4042	3.1607	0.1379	0.17007	0.49101E-01	0.0008
C3W	-1.9984	0.64509	-3.0978	-0.1353	-0.22202	-0.52549E-01	0.0010
C4W	-1.6571	0.52245	-3.1718	-0.1384	-0.24984	-0.66196E-01	0.0008
CONSTANT	104.89	10.533	9.9579	0.4018	0.00000E+00	1.4183	0.0000
CONSTANT	109.02	11.415	9.5502	0.3879	0.00000E+00	1.4741	0.0000

DURBIN-WATSON = 1.9439 VON NEUMANN RATIO = 1.9476 RHO = 0.02735
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.3503

4. MN

I. DEPENDENT VARIABLE = AW 327 OBSERVATIONS

ASYMPTOTIC

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.23938	0.13075E-01	18.308	0.7136	1.3868	0.61412	0.0000
FR	0.66697E-01	0.44656E-01	1.4936	0.0828	0.66794E-01	0.42562E-01	0.0676
QW	-0.40251E-02	0.29661E-02	-1.3571	-0.0753	-0.59062E-01	-0.44198E-01	0.0874
CONSTANT	0.19987	0.29036E-01	6.8837	0.3577	0.00000E+00	0.38751	0.0000

DURBIN-WATSON = 1.7465 VON NEUMANN RATIO = 1.7518 RHO = 0.11505

R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6354

II. DEPENDENT VARIABLE = RA 327 OBSERVATIONS

ASYMPTOTIC

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.27803E-01	0.46119E-02	6.0284	0.3185	0.97845	1.8067	0.0000
FR	0.23350	0.35252	0.66239	0.0369	0.40365E-01	0.58083E-01	0.2539
QW	0.12794E-01	0.16031E-01	0.79809	0.0444	0.32404E-01	0.54760E-01	0.2124
FZ	0.20693E-03	0.63210E-02	0.32736E-01	0.0018	0.58664E-03	0.36682E-03	0.4869
CONSTANT	-1.2173	0.39923	-3.0491	-0.1675	0.00000E+00	-0.91995	0.0011

DURBIN-WATSON = 1.6807 VON NEUMANN RATIO = 1.6858 RHO = 0.14999

R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2439

III. DEPENDENT VARIABLE = W 327 OBSERVATIONS

ASYMPTOTIC

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.19997	0.33134E-01	-6.0351	-0.3188	-1.3606	-1.1830	0.0000
AN	0.99143E-04	0.30361E-03	0.32654	0.0182	0.13300E-01	0.67082E-02	0.3720
FR	-3.7149	2.4546	-1.5135	-0.0840	-0.12416	-0.84122E-01	0.0651
CL	-0.11289E-01	0.29725	-0.37979E-01	-0.0021	-0.92280E-03	-0.13681E-02	0.4849
CONSTANT	32.875	2.8892	11.378	0.5355	0.00000E+00	2.2618	0.0000

DURBIN-WATSON = 1.6897 VON NEUMANN RATIO = 1.6949 RHO = 0.15399

R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2239

IV. DEPENDENT VARIABLE = S 327 OBSERVATIONS

ASYMPTOTIC

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-3.1832	11.422	-0.27870	-0.0156	-0.46785	-0.53809	0.3902
QW	0.52189	1.1100	0.47015	0.0264	0.37560E-01	0.34374E-01	0.3191
AN	0.29167E-02	0.17246E-02	1.6913	0.0944	0.57506E-01	0.33359E-01	0.0454
FR	-13.749	25.233	-0.54489	-0.0305	-0.67536E-01	-0.52629E-01	0.2929
C1	14.348	155.33	0.92376E-01	0.0052	0.15301	0.66338E-01	0.4632
C2	10.872	147.59	0.73661E-01	0.0041	0.68385E-01	0.11599E-01	0.4706
C1W	-1.1441	11.357	-0.10074	-0.0056	-0.21736	-0.81543E-01	0.4599
C2W	-1.0424	10.849	-0.96075E-01	-0.0054	-0.11083	-0.17683E-01	0.4617
C3	4.9937	18.713	0.26686	0.0150	0.38175E-01	0.83472E-02	0.3948
C4	15.947	19.161	0.83223	0.0466	0.11008	0.20984E-01	0.2026
C3W	-0.16809	1.2502	-0.13446	-0.0075	-0.19956E-01	-0.39634E-02	0.4465
C4W	-0.83835	1.2872	-0.65129	-0.0365	-0.88174E-01	-0.14610E-01	0.2574
CONSTANT	132.79	158.04	0.84020	0.0471	0.00000E+00	1.5443	0.2004

DURBIN-WATSON = 1.7261 VON NEUMANN RATIO = 1.7313 RHO = 0.13626

R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.2254

6. SL_O

I. DEPENDENT VARIABLE = AW 329 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.19052	0.96164E-02	19.812	0.7396	1.2666	0.57008	0.0000
FR	0.13300	0.59890E-01	2.2207	0.1223	0.10991	0.87696E-01	0.0132
QW	0.13456E-02	0.14810E-02	0.90858	0.0503	0.44933E-01	0.17039E-01	0.1818
CONSTANT	0.16766	0.30056E-01	5.5783	0.2956	0.00000E+00	0.32518	0.0000

DURBIN-WATSON = 1.7016 VON NEUMANN RATIO = 1.7068 RHO = 0.14069
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.4947

II. DEPENDENT VARIABLE = RA 329 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.55312E-01	0.96748E-02	5.7171	0.3027	2.1181	3.0038	0.0000
FR	0.62517	0.96802	0.64582	0.0359	0.77707E-01	0.13776	0.2592
QW	-0.41170E-02	0.95317E-02	-0.43192	-0.0240	-0.20678E-01	-0.17423E-01	0.3329
FZ	0.62044E-02	0.17028E-01	0.36436	0.0202	0.10544E-01	0.10114E-01	0.3578
CONSTANT	-3.2926	0.92632	-3.5545	-0.1937	0.00000E+00	-2.1342	0.0002

DURBIN-WATSON = 1.7610 VON NEUMANN RATIO = 1.7664 RHO = 0.11857
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0331

III. DEPENDENT VARIABLE = W 329 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.28944	0.57571E-01	-5.0274	-0.2690	-2.4803	-1.7347	0.0000
AN	0.39356E-03	0.58111E-03	0.67725	0.0376	0.31819E-01	0.22840E-01	0.2491
FR	-3.3577	5.7900	-0.57992	-0.0322	-0.93395E-01	-0.81661E-01	0.2810
CL	2.2664	0.54881	4.1297	0.2236	0.17123	0.26661	0.0000
CONSTANT	35.323	5.5303	6.3872	0.3344	0.00000E+00	2.5269	0.0000

DURBIN-WATSON = 1.8030 VON NEUMANN RATIO = 1.8085 RHO = 0.09838
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0293

IV. DEPENDENT VARIABLE = S 329 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	2.5228	1.9491	1.2944	0.0724	0.29441	0.42093	0.0978
QW	-0.76796E-01	0.21372	-0.35934	-0.0201	-0.10073E-01	-0.59845E-02	0.3597
AN	0.10859E-02	0.34485E-02	0.31490	0.0177	0.10245E-01	0.10515E-01	0.3764
FR	-27.652	18.403	-1.5026	-0.0840	-0.89756E-01	-0.11221	0.0665
C1	81.978	30.039	2.7290	0.1513	0.68979	0.53831	0.0032
C2	86.624	31.682	2.7342	0.1516	0.42178	0.94279E-01	0.0031
C3	84.312	30.081	2.8029	0.1553	0.54708	0.18047	0.0025
C1W	-5.5599	2.1278	-2.6130	-0.1450	-0.81245	-0.54159	0.0045
C2W	-5.8758	2.2921	-2.5635	-0.1423	-0.41523	-0.82284E-01	0.0052
C3W	-5.5357	2.0874	-2.6520	-0.1471	-0.54687	-0.14781	0.0040
CONSTANT	54.070	25.641	2.1087	0.1174	0.00000E+00	0.64537	0.0175

DURBIN-WATSON = 1.6976 VON NEUMANN RATIO = 1.7028 RHO = 0.15107
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.0534

7. VS_o

I. DEPENDENT VARIABLE = AW 359 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.16156	0.56561E-02	28.564	0.8348	1.1629	0.55679	0.0000
FR	-0.85130E-01	0.35881E-01	-2.3726	-0.1249	-0.81247E-01	-0.53957E-01	0.0088
QW	-0.49251E-04	0.80207E-03	-0.61405E-01	-0.0033	-0.19127E-02	-0.58098E-03	0.4755
CONSTANT	0.28985	0.19619E-01	14.773	0.6170	0.00000E+00	0.49775	0.0000

DURBIN-WATSON = 1.7063 VON NEUMANN RATIO = 1.7111 RHO = 0.14284
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6887

II. DEPENDENT VARIABLE = RA 359 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.47218E-01	0.25929E-02	18.210	0.6955	1.1482	2.1965	0.0000
FR	-0.79041E-01	0.30891	-0.25587	-0.0136	-0.10480E-01	-0.14537E-01	0.3990
QW	0.30900E-03	0.49267E-02	0.62719E-01	0.0033	0.16672E-02	0.10576E-02	0.4750
FZ	0.84021E-03	0.67336E-02	0.12478	0.0066	0.58968E-03	0.40023E-03	0.4503
CONSTANT	-2.3750	0.26661	-8.9081	-0.4279	0.00000E+00	-1.1834	0.0000

DURBIN-WATSON = 2.0935 VON NEUMANN RATIO = 2.0993 RHO = -0.04956
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5660

III. DEPENDENT VARIABLE = W 359 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.22850	0.13138E-01	-17.392	-0.6788	-1.3348	-1.7018	0.0000
AN	-0.15606E-04	0.65603E-04	-0.23788	-0.0126	-0.12909E-02	-0.98228E-03	0.4060
FR	2.9317	1.5963	1.8365	0.0971	0.93383E-01	0.86323E-01	0.0331
CL	0.11614E-02	0.49611E-01	0.23410E-01	0.0012	0.12574E-03	0.12259E-03	0.4907
CONSTANT	32.795	1.3509	24.277	0.7904	0.00000E+00	2.6163	0.0000

DURBIN-WATSON = 1.9016 VON NEUMANN RATIO = 1.9069 RHO = 0.04896
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5006

IV. DEPENDENT VARIABLE = S 359 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	ASYMPTOTIC STANDARD ERROR	T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-4.1479	2.3217	-1.7866	-0.0951	-0.71005	-0.55693	0.0370
QW	0.43793E-02	0.74716E-01	0.58613E-01	0.0031	0.97168E-03	0.32222E-03	0.4766
AN	0.27728E-04	0.10276E-02	0.26984E-01	0.0014	0.39265E-03	0.23434E-03	0.4892
FR	12.908	7.4327	1.7367	0.0924	0.70382E-01	0.51031E-01	0.0412
C1	2.8170	27.362	0.10295	0.0055	0.30212E-01	0.16811E-01	0.4590
C2	2.7660	27.520	0.10051	0.0054	0.22716E-01	0.51993E-02	0.4600
C1W	-0.23263	2.2924	-0.10148	-0.0054	-0.44336E-01	-0.17894E-01	0.4596
C2W	-0.22556	2.2981	-0.98151E-01	-0.0052	-0.26844E-01	-0.52562E-02	0.4609
C4	2.2262	11.270	0.19754	0.0106	0.15288E-01	0.27234E-02	0.4217
C6	1.0356	11.111	0.93201E-01	0.0050	0.67160E-02	0.11124E-02	0.4629
C4W	-0.16340	0.86367	-0.18919	-0.0101	-0.18524E-01	-0.28813E-02	0.4250
C6W	-0.12267	0.88170	-0.13912	-0.0074	-0.10667E-01	-0.13432E-02	0.4447
CONSTANT	140.64	28.427	4.9475	0.2557	0.00000E+00	1.5065	0.0000

DURBIN-WATSON = 1.9014 VON NEUMANN RATIO = 1.9067 RHO = 0.04903
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.5048

8. MN_O

I. DEPENDENT VARIABLE = AW 288 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
RA	0.25810	0.11570E-01	22.307	0.7979	1.3353	0.68319	0.0000
FR	0.40944E-02	0.53310E-01	0.76802E-01	0.0046	0.37275E-02	0.28543E-02	0.4694
QW	-0.10782E-01	0.38221E-02	-2.8211	-0.1651	-0.13548	-0.12021	0.0024
CONSTANT	0.21432	0.33112E-01	6.4726	0.3585	0.00000E+00	0.43416	0.0000

DURBIN-WATSON = 1.7950 VON NEUMANN RATIO = 1.8012 RHO = 0.08897
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.6225

II. DEPENDENT VARIABLE = RA 288 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	0.23620E-01	0.44061E-02	5.3607	0.3036	0.93855	1.3172	0.0000
FR	0.97490	0.41427	2.3533	0.1385	0.17155	0.25675	0.0093
QW	0.44416E-01	0.17429E-01	2.5483	0.1498	0.10787	0.18707	0.0054
FZ	0.21889E-02	0.11212E-01	0.19522	0.0116	0.40343E-02	0.39725E-02	0.4226
CONSTANT	-0.99962	0.37376	-2.6745	-0.1570	0.00000E+00	-0.76501	0.0037

DURBIN-WATSON = 1.6198 VON NEUMANN RATIO = 1.6254 RHO = 0.18300
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1536

III. DEPENDENT VARIABLE = W 288 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
S	-0.18837	0.30917E-01	-6.0928	-0.3405	-1.2921	-0.90378	0.0000
AN	0.21159E-03	0.25930E-03	0.81601	0.0484	0.24430E-01	0.12719E-01	0.2072
FR	-7.7628	2.7193	-2.8547	-0.1673	-0.23581	-0.17590	0.0022
CL	0.11709	0.36417	0.32154	0.0191	0.70473E-02	0.14162E-01	0.3739
CONSTANT	31.177	2.6133	11.930	0.5785	0.00000E+00	2.0528	0.0000

DURBIN-WATSON = 1.7785 VON NEUMANN RATIO = 1.7847 RHO = 0.10918
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1911

IV. DEPENDENT VARIABLE = S 288 OBSERVATIONS

VARIABLE NAME	ESTIMATED COEFFICIENT	STANDARD ERROR	ASYMPTOTIC T-RATIO ***** DF	PARTIAL CORR.	STANDARDIZED COEFFICIENT	ELASTICITY AT MEANS	P-VALUE
W	-13.898	68.499	-0.20290	-0.0122	-2.0262	-2.8968	0.4196
QW	0.51252	5.2358	0.97887E-01	0.0059	0.31325E-01	0.38709E-01	0.4610
AN	-0.34925E-02	0.17201E-01	-0.20304	-0.0122	-0.58786E-01	-0.43755E-01	0.4196
FR	-43.250	59.886	-0.72221	-0.0434	-0.19154	-0.20426	0.2351
C1	-123.93	993.63	-0.12473	-0.0075	-1.0471	-0.46063	0.4504
C2	-147.03	997.15	-0.14745	-0.0089	-0.99632	-0.30127	0.4414
C3	-126.25	994.54	-0.12694	-0.0076	-0.85549	-0.25869	0.4495
C1W	8.2538	68.319	0.12081	0.0073	1.2110	0.45544	0.4519
C2W	9.5392	68.181	0.13991	0.0084	1.2663	0.35046	0.4444
C3W	8.7208	68.378	0.12754	0.0077	1.0403	0.27177	0.4493
C4	376.86	325.81	1.1567	0.0691	2.4250	0.68240	0.1237
C5	380.01	321.09	1.1835	0.0707	3.3066	1.5573	0.1183
C4W	-23.696	20.950	-1.1311	-0.0676	-2.3804	-0.57924	0.1290
C5W	-24.792	20.858	-1.1886	-0.0710	-3.7273	-1.5098	0.1173
CONSTANT	295.04	993.51	0.29697	0.0178	0.00000E+00	4.0490	0.3832

DURBIN-WATSON = 1.7612 VON NEUMANN RATIO = 1.7673 RHO = 0.11842
R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.1846