ZEF Bonn
Zentrum für Entwicklungsforschung
Center for Development Research
Universität Bonn

John K. Mduma, Peter Wobst

Village Level Labor Market Development in Tanzania: Evidence from Spatial Econometrics

Number 96

ZEF – Discussion Papers on Development Policy
Bonn, January 2005

The CENTER FOR DEVELOPMENT RESEARCH (ZEF) was established in 1995 as an international, interdisciplinary research institute at the University of Bonn. Research and teaching at ZEF aims to contribute to resolving political, economic and ecological development problems. ZEF closely cooperates with national and international partners in research and development organizations. For information, see: http://www.zef.de.

ZEF – DISCUSSION PAPERS ON DEVELOPMENT POLICY are intended to stimulate discussion among researchers, practitioners and policy makers on current and emerging development issues. Each paper has been exposed to an internal discussion within the Center for Development Research (ZEF) and an external review. The papers mostly reflect work in progress.

John K. Mduma, Peter Wobst: Village Level Labor Market Development in Tanzania: Evidence from Spatial Econometrics, ZEF – Discussion Papers On Development Policy No. 96, Center for Development Research, Bonn, January 2005, pp. 42.

ISSN: 1436-9931

Published by:
Zentrum für Entwicklungsforschung (ZEF)
Center for Development Research
Walter-Flex-Strasse 3
D – 53113 Bonn
Germany
Phone: +49-228-73-1861
Fax: +49-228-73-1869
E-Mail: zef@uni-bonn.de
http://www.zef.de

The authors:
John K. Mduma, Center for Development Research (ZEF), Bonn, Germany
(contact: nashmduma@yahoo.com).
Peter Wobst, Center for Development Research (ZEF), Bonn, Germany
(contact: p.wobst@cgiar.org)

Contents

List of Tables

List of Figures

List of Abbreviations

DVLS	Dummy Variable Least Squares
FHM	Farm Household Model
HBS	Household Budget Survey
MCM	Carkov Chain Monte Carlo
MSG	Mud Spring Geographers, Inc.
SAR	Spatial Autoregressive Model
SEDA	Spatial Exploratory Data Analysis
SEM	Spatial Error Model
URT	United Republic of Tanzania (the Government of Tanzania)
VPO	Vice President Office (of the Government of Tanzania)

Acknowledgements

We are grateful for comments received at ZEFb Macroeconomic, Trade and Governance Group meeting, where an earlier draft of the paper was presented.

The research was made possible by the Robert Bosch Foundation under the Policy Analysis for Sustainable Agricultural Development (PASAD) Project at ZEF.

Abstract

While many empirical studies show that participation in rural labor markets is an important household livelihood strategy, data on Tanzania show that the participation in the rural labor markets is still relatively low. This study examines the factors behind the development of village labor markets in Tanzania. Using spatial econometric techniques, the study shows that, despite their incipient development, rural labor markets in Tanzania are significantly interlinked across space. Furthermore, underlying factors for development of rural labor markets, such as access to roads and availability of credit, have varying impacts across space. This implies that policy interventions such as making credit available to the rural households and investment in rural transport infrastructure would also have varying effects across space. The study reveals that interventions that reduce cash constraints such as rural credit schemes are likely to have greater impacts in the western part of the country than in the eastern part. However, interventions that reduce the time used in collecting firewood are likely to have more pronounced impacts in the eastern parts than in the western parts of the country. While east-west variations of most of these interventions are significant, most of the north-south variations are not significant. This phenomenon is partly attributed to east-west alignment of key infrastructure such as transport networks.

Kurzfassung

Während viele empirische Studien zeigen, dass die Partizipation in ländlichen Arbeitsmärkten eine wichtige Strategie zur Sicherung des Lebensunterhalts von Haushalten ist, ist die entsprechende Partizipation im Falle Tansanias immer noch verhältnismäßig gering. Diese Studie untersucht die für die Entwicklung der dörflichen Arbeitsmärkte in Tansania ausschlaggebenden Faktoren. Mittels räumlich-ökonometrischer Methoden, zeigt diese Studie, dass die ländlichen Arbeitsmärkte in Tansania—trotz ihrer bisher mässigen Entwicklung—stark räumlich Beziehungen aufweisen. Desweiteren haben die der Entwicklung der ländlichen Arbeitsmärkte zugrundeliegenden Faktoren, wie etwa der Zugang zu Transportwegen oder Krediten, sehr unterschiedliche rämliche/regionale Auswirkungen. Daraus ergibt sich, dass staatliche Maßnahmen wie etwa die Bereitstellung ländlicher Kredite oder Investitionen in ländliche Transportinfrastruktur ebenfalls sehr unterschiedliche räumliche/regionale Effekte haben. Die Studie verdeutlich, dass etwa Maßnahmen, die die Liquidität von Farmern erhöhen, wie etwa die Einführung eines ländlichen Kreditsystems, einen größeren Effekt auf den westlichen Teil des Landes hätten als auf den östlichen. Andererseits würden Interventionen, die zu einer Reduzierung der Zeit, die für das Sammeln von Feuerholz verwendet wird, führen, voraussichtlich stärker dem östlichen als dem westlichen Landesteil zugute kommen. Während die Ost-West-Abweichungen der meisten Interventionen signifikante sind, besteht keine eindeutige Nord-Süd-Abweichung. Dieses Phänomen ist zum Teil der Ost-West-Ausrichtung der bestehenden Infrastruktur, wie etwa dem Transportnetz zuzuschreiben.

1 Introduction

While direct agricultural income is still the backbone of the rural economy in many developing countries, evidence shows that incomes from wage labor and other non-farm activities are important for food security and poverty alleviation in general (cf. Bright et al. 2000; Lanjouw and Shariff 1999; Zucula and Massinga 1992; Ruben and Berger 2001; FAO 1998; Lanjouw 1998). In Tanzania, two consecutive household budget surveys (HBS), conducted in 1990/01 and 2000/01, reveal that, participation in rural labor markets has indeed positive bearing on the welfare of the rural population (NBS 2002)1. Moreover, the evidence that rural poverty can be reduced by diversifying away from agricultural income has been reflected in many Tanzanian policy documents such as the Rural Development Strategy, the Agricultural Sector Development Strategy, and most recently, the Poverty Reduction Strategy Paper (URT 2000, URT 2002). However, participation in the rural labor markets in Tanzania still remains low. The 2000/01 Integrated Labor Force Survey in Tanzania shows that only 11% of the rural population participated in the wage labor markets (NBS 2001). This figure is relatively low as compared to other countries in the region such as Madagascar (18%) and Malawi (50%) (cf. Leavy and White 2003).

Given this relatively low rural labor market participation rate, it is important to ask: what determines the flexibility with which the rural households react to the conditions in the rural labor markets? Indeed, there is a host of theoretical and empirical literature that explains the individual/household participation in the rural labor markets. However, most of the analyses done so far have concentrated on individual level or household level (Isguti 2003; Bright et al. 2000), which may overlook the spatial interconnectedness of rural labor market and other geographical aspects such as credit, land, and insurance markets (Rosenzweig 1988)2. These aspects are generally spatial in nature in the sense that they are localized in a particular area or their relationships vary from place to place (Anselin 2002).

Moreover, from the policy point of view, most micro-policies for rural poverty alleviation have spatial scale/scope, whereby they first target particular areas/locations and then households located therein (DFID 2002; World Bank 1999; Lanjouw 1998; and World Bank 1993). However, even in this era of renewed 'spatial thinking' (Anselin 2002), only few studies such as Isguti (2003), Bright et al. (2000), Jeong and Townsend (2003), and Kaboski and Townsend (2002) have analyzed rural labor markets at the village level.

[1] This report, however, does not show that modest reduction in poverty in the 1990s was contributed by increased participation in rural labor markets. What this report shows is: cross-sectionally, in the two surveys, households which participated in rural labor markets were less poor than those that did not.

[2] Over decades, researchers in agricultural economics have shown that failing markets/market imperfections (or non-existence of certain markets) are wide spread in rural areas (Stiglitz and Weiss 1981).

This paper argues that, even if the interlinked transactions in rural markets as observed by Rosenzweig (1988) are captured by the analysis at the individual level or household level, that treatment is not satisfactory because it fails to address the spatial variations and the externalities of the development of other markets as well as the differences in the underlying agro-ecological factors (Renkow, forthcoming; Bryceson 2000; Anselin 2002). For example, the analysis at the individual or household level may fail to capture the effect of one household's participation in rural credit market on other households' participation in rural labor markets. The strength of the connection of the two markets in this example is expected to diminish with distance (Hainig 1993). Moreover, accessibility to rural wage employment, credit or land, affects not only a single household but tends to have spatial effects – affecting relatively closely located households. Most of these factors are not idiosyncratic (as treated in other studies) because the households in a close neighborhood would be facing similar transaction costs, rationing and entry barriers in the rural labor markets. As noted by Isguti (2003), most of these constraints are dictated by their spatial locations.

Another example, where the standard analysis at individual level may fail to reveal the constraints to development in rural labor markets is the presence of spatial externalities (Anselin 2002). In the context of rural Tanzania, overstocking livestock is a typical example of these spatial externalities (VPO 1999). Overstocking of livestock due to ill-defined property rights may cause soil degradation in the village and reduce agricultural productivity. Since most rural activities hinge on the performance of the agricultural sector as discussed by DFID (2002), such market failure would slow down economic activities and halt development of the rural labor markets as affirmed by USAID (2004). These effects are, by and large, localized and will tend to affect not only the decisions of households individually, but they are likely to have an impact on several households in the vicinity of the affected areas.

Given the increased use of spatial targeting for poverty reduction in which poverty mapping is one of the analytical tools, this paper takes the analysis of the rural labor markets at higher levels of aggregation than household level, namely, at the village level. This approach has been used in Isguti (2003), Bright et al. (2000), Jeong and Townsend (2003), and Kaboski and Townsend (2002). Using a modified farm household model aggregated at village level, the objective of this paper is to analyze factors that influence rural labor markets in Tanzania. This paper takes the analysis at the village level because (i) rural labor markets are interconnected with other markets in spatial scale and (ii) rural micro-policies start by targeting particular locations. Thus, this paper attempts to answer the question: what are the factors that determine the development of rural labor market in terms of wage and casual employment? The need to understand these factors arise from the accumulating evidence that participation in rural labor markets has been an important strategy for poverty alleviation and food security (Ruben and van den Berg 2001; FAO 1998; Lanjouw 1998)3.

[3] Other studies show that incomes from wage labor and other non-farm activities have increasingly become important across space and over time in many developing countries (Bright *et al*. 2000; Lanjouw and Shariff. 1999; Zucula and Massinga 1992).

The rest of the paper is organized as follows: Section 2 presents the theoretical framework of the agricultural household model and how its implications can be analyzed at the village level. Section 3 describes the econometric models and the estimation procedures. Results and their policy implications are discussed in Section 4. Section 5 concludes.

2 The theoretical framework

Most studies that take rural labor at village level base their theoretical framework on the standard farm household framework (Isigut 2003). However, Jeong and Townsend (2003) and Kaboski and Townsend (2002) base their models on wealth-constrained occupation choice frameworks. The major weakness of the occupation choice framework refers to the restrictive assumptions about the production function, which does not allow the comparative static analysis needed in the present study. While this paper borrows the estimation approach from Jeong and Townsend (2003) and Kaboski and Townsend (2002) (the approach that integrates socio-economic data and spatial data), our starting point is the standard farm household model. This is because the farm household model is more versatile to analyzing aspects ranging from purely subsistence household, to where the household is a commercial farmer (Woldahanna 2000) and allows additional features that enrich its comparative static analysis (Taylor and Adelman 2003).

Another alternative theoretical framework could be endogenous class formation under imperfect market conditions (Eswaran and Kotwal 1986). Eswaran and Kotwal model is useful in explaining why some households become laborer and others entrepreneur. However, it is important to note that Eswaran and Kotwal (1986) conclusions depend crucially on the land ownership structures. Land ownership structure is also one of the aspects that derive Bardhan's study of the socio-economic class structure of the rural Indian societies (Bardhan 1982). In Tanzanian context, the class of rural landless is not well pronounced because almost every rural household has some rights to the customary land. Furthermore, it is human capital and financial capital (as opposed to physical capital such as land) which has been observed to play an increasingly important role in the way households allocate their labor resources (Davis *et al.* 2004). These important aspects, i.e. the human capital and financial capital, are common ingredients of farm household model which we present in the next subsection.

2.1 The core framework

Let the rural household's preference be presented by a scalar valued utility function U given in equation 1. The arguments of U are the vector of consumption goods (c); leisure (H); and taste shifters (a) such as age, education and other household characteristics. The standard assumptions that the function U is quasi-concave, twice continuously differentiable, and non-decreasing in c and H apply.

$$U = u(c, H, a) \tag{1}$$

The objective of the household is to maximize this utility function. However, as in a standard farm household model, the representative household faces a number of constraints. As

in Woldahanna (2000), the first one is the farm production technology constraint given by a vector valued implicit function summarized by equation 2.

$$Q\left(q\ ;x\ ,L_h,A\ ,K\ ,L_f;\Omega,Z\right)\geq 0 \qquad (2)$$

where *Q(.)* is a closed, bounded convex production possibility set; q is the vector of agricultural outputs; x represents farm variable inputs such as fertilizers; L_h hired farm labor; L_f own household farm labor; K other fixed capital; A agricultural land under various crops; Z farm and locational/spatial characteristics, particularly, the soil quality; and Ω is household characteristics that affect farm production. We assume that decline in soil quality Z has a negative effects to labor productivity. We formally state this assumption as:

$$\frac{\partial^2 q}{\partial L_k \partial Z} < 0, \qquad k \in \{f, h\} \qquad (3)$$

For simplicity, it is further assumed that land market does not exist and land available to the household is fixed[4]. Thus, if the household cultivates I number of crops (including some finite number of intercropping), then the land constraint is give by equation (4).

$$A = \sum_{i=1}^{I} A_i \qquad (4)$$

Other constraints to the households' maximization problems (which are frequently used in both theoretical and empirical literature) are labor constraints, and cash constraints. It is also assumed that the household faces both time and cash costs in participating in the rural labor markets. The household that hires labor pays a wage rate (w_h) and incurs supervision cost (s_p). The supervision cost is composed of two components, namely, the value of time needed in the supervision (s_t) and direct cash need for supervision (s_c). The two components of the supervision costs are assumed to be non-decreasing functions of the amount of hired labor (L_h).

For the labor supply side, it is assumed that the household has the option of selling labor to off-farm work at a market wage rate (w_o) and/or work on the farm[5]. For simplicity, the model rules out the case where wage rate is a function of hours worked and assumes that the market wage for off-farm labor is determined by standard Mincerian wage equation, in which the most

[4] This assumption is not very unrealistic because all the land in Tanzania is owned by the state and operated by rural households through the customary laws. In principle, therefore, there is no land market and particularly so, in the rural areas.

[5] Note, however, that w_o is not equal to w_h because of market imperfections that cause the wedge between wage paid and effective wage received.

important argument is human capital. Furthermore, as in Woldehanna (2000), hiring out labor also involves some transaction costs (τ), which can be decomposed into two major components. The first component is the commuting/search/time cost (τ_t), and cash transaction cost (τ_c). For simplicity, these components are assumed to be fixed proportion of labor sold to the local labor markets (L_m).

From this discussion on time recourse, the time constraint of the household can be represented by equation 5, which shows that the time endowment of the household is allocated to farm labor, off-farm labor and its time component of search cost, supervision of hired labor, and home time.

$$T = \sum_{i=1}^{I} L_{fi} + L_m + L_h s_t + L_m \tau_t + H \qquad (5)$$

Furthermore, the household faces rationing in the rural labor markets such that the level of labor supplied is truncated from above. In this case, the amount of labor supplied to the rural labor market (L_m) may fall short of the desired amounts. This constraint is represented in equation 6, where $\bar{L}_m$ is the ceiling of amount of labor that the household can supply to the local labor markets.

$$L_m \leq \bar{L}_m \qquad (6)$$

To derive the cash constraint of the household, the following notations are needed. Let P_i be the price of the i^{th} farm output and P_j as the price of the j^{th} consumption good and let v be the vector of exogenous cash incomes. Suppose further that G_i is the quantity of farm output of crop i sold and b_j is the quantity of consumption goods j purchased. Let P_x be the price of external farm inputs such as fertilizers. From this information, the cash constraint that the household faces is given by equation 7. To close the system we impose the commodity equilibrium condition specified in equation 8, such that in a given period, the amount of commodity consumed should equal the sum of what the household produced and purchased minus what the household sold[6].

$$\sum_{i-1}^{I}\left[P_i G_i\right] + w_m L_m + v - \sum_{j=1}^{J}\left[P_j b_j\right] - P_x X - w_h L_h - \tau_c L_m - s_c L_h \geq 0 \qquad (7)$$

$$c_n = q_n + b_n - G_n \qquad (8)$$

[6] This condition is a result of our assumption that the model is static.

This problem can be set as non-linear optimization problem (program), which yields the Lagrange equation given in equation 9, where one more set of new variables (Lagrange multipliers) is introduced[7].

$$\ell = u(c, H, a) + \psi\left[Q\left(q\,; x\,, L_h, A\,, K\,, L_f; \Omega_{\cdot}, Z\right)\right] + \delta\left[A - \sum_{i=1}^{I} A_i \right] \qquad (9)$$
$$+ \lambda\left[\sum_{i-1}^{I}\left[P_i G_i\right] + w_m L_m + v - \sum_{j=1}^{J}\left[P_j b_j\right] - P_x X - w_h L_h - \tau_c L_m - s_c L_h \right]$$
$$+ \gamma\left[T - \sum_{i=1}^{I} L_{fi} - L_m - L_h s_t - L_m \tau_t - H \right] + \mu\left[\bar{\mathrm{L}}_{\mathrm{m}} - \mathrm{L}_{\mathrm{m}}\right] + \sum_{n=1}^{N} \eta_n \left[\mathrm{q_n} + \mathrm{b_n} - \mathrm{G_n} - \mathrm{c_n}\right]$$

2.2 Comparative static analysis and extensions

From the assumptions of the model, the Kuhn-Tucker first order conditions are both necessary and sufficient conditions for the household maximization problem. From the Kuhn-Tucker first order conditions, and assuming a non-corner solution, it is possible to derive equation 10 (Mduma 2003)[8].

$$w_m^* = [\lambda.\tau_t + \gamma(1+\tau_c) + \mu]\lambda^{-1} \qquad (10)\,,$$

Equation 10 shows that the wage rate that the household is ready to accept is a function of (the sign shows the direction of the effect): marginal value of time (γ, +); the cash constant (λ , -); the rationing in the labor market (μ , +), transaction cash cost (τ_c , +); and transaction time cost (τ_t , +). Any exogenous factor that affects these variables (e.g. rural credit programs and infrastructure development) will affect household reservation wage. These factors are likely to exhibit strong spatial patterns due to their spatial coverage.

$$w^*_h = \left(\psi \frac{\partial Q(.)}{\partial L_h} - \lambda s_c - \gamma s_t \right) \lambda^{-1} \qquad (11)$$

For the empirical analysis, these supply-side implications of the model need to be integrated to the demand-side implications. Looking at the demand for hired labor in the rural labor markets, equation 11, which is also derived from the first order optimization conditions, shows factors that are likely to affect the wage the rural household (as an employer) is prepared

[7] These new variables are the Lagrange multipliers for farm production technology (ψ); cash constraints (λ); land constraint (δ); household time constraint (γ); rationing in the rural labor markets (μ); and commodity balance (η_n).

[8] For all derivations involved in this model, the reader is referred to Mduma (2003).

to offer. For example given in equation 12, which is the derivative of equation 11 with respect to λ, shows that tightening the cash constraints reduces the demand for labor. Although, equation 10 shows that, *ceteris paribus*, tightening the cash constraint forces the household to look for wage employment, at the market level, households which are not cash constrained are likely to offer opportunities for wage employment to other households (for example to work on their farms or other non-farm business).

$$\frac{\delta w_h^*}{\delta \lambda} = -\psi \frac{\partial Q(.)}{\partial L_h} \lambda^{-2} \leq 0 \qquad (12)$$

Moreover, equation 11 shows that factors that reduce farm labor productivity, particularly deterioration in the soil quality (Z), could affect the rural labor markets through the wage that the rural household (as an employer) can offer. Given the assumption made in equation 3, it can be shown that $\frac{\delta w^*_h}{\delta Z} < 0$. This implies that soil degradation would shift the labor demand downward in the $w^*_h - L_h$ plane. As the demand for labor shrinks in the local labor markets, it is expected that few households will participate in the village labor markets because of high transaction costs of participating in the labor markets in distant villages. The empirical strategy followed in analyzing these implications is presented in the next section.

3 Methodology

3.1 Handling the Spatial Nature of the Rural Labor Markets

To account for the spatial variations (spatial heterogeneity), many researchers have used Dummy Variable Least Squares (DVLS), by including regional dummies in their regressions (Readon *et al.* 2001; Bright *et al*. 2000). Although this is a move in the right direction in trying to account for spatial variation, it is not adequate if the studied phenomena have a spatial structure (Hainig 1993). For the purpose of this study, the regional dummy approach is clearly not even the 'second best' option in a large country like Tanzania, where rural labor markets are likely to operate in more localized areas than the administrative regional boundary.

For case studies that involve few spatial locations, location dummies could be used. Even though location dummies can be used to capture variations in the local labor market (see Woldahanna 2000; Readon *et al*. 2001; Bright *et al*. 2000), this approach may suffer from several problems. First, from the computational point of view, there is a limit in the number of village dummies to be included. For the present study, it is practically difficult to include all 660 village dummies in analyzing rural labor market participation in Tanzania using the 2000/01 Household Budget Survey. Isguti (2003) avoids the problem of adding many village dummies in the regression equation by analyzing a panel data of households observed over sampling clusters. While panel data regression is richer methodologically in terms of usage of sample information than Dummy Variable Least Squares (DVLS), it fails to capture spatial dependence and spatial heterogeneity that may exist. The panel data approach simply eliminates some spatial heterogeneity in the estimation process but does not fully address the problem (Anselin 2002). Thus to avoid all these problems, this paper uses spatial econometric estimation technique.

3.1.1. Spatial Econometric Models

Two problems arise when sample data have a location component (spatial structure), because the spatial structure causes violation of the Gauss-Markov assumption of traditional econometrics (Haining 1993; Pace 2000; LeSage 1999). The first component of spatial structure is the spatial dependence among observations in the locations that are near each other. The second one is the spatial heterogeneity of the relationship modeled across space. Spatial dependence or spatial heterogeneity in the rural labor markets are the results of various factors such as differences in geography, history, access to public services and other infrastructures as well as many other aspects of public policies (Jeong and Townsend 2003; Kaboski and Townsend 2002). Variables such as road density and road quality and differences in access to input and output markets have a significant bearing on the rural labor markets (Davis 2003).

Others factors that are likely to introduce spatial structure in the rural labor markets are differences in land tenure system such as the differences in the length of tenure.

This paper tests for the existence of spatial structure in our data using Moran's I test, Wald test, Likelihood ration test, and Langrage multiplier tests. All the tests indicate that there is significant spatial structure in our sample[9]. Spatial regression analysis is therefore called for in order to understand the spatial distribution of factors that are fundamental to development of the rural labor markets. A general regression model with spatial structure is present in equation 13.

$$y = \rho W_1 y + X\beta + u$$
$$u = \theta W_2 u + \varepsilon; \quad \varepsilon \sim N(0, \sigma^2 I) \tag{13}$$

where y is n-by-1 vector of dependent variable; θ is a parameter of first order spatial moving average-SMA(*1*) of *u*; ρ is a parameter of first order spatial autoregressive scheme-SAR(*1*) of *y*; *u* is a spatially auto-correlated error term; ε is white noise spatial error normal process; W*1* and W*2* are n-by-n matrix of spatial weights[10]. In general, W*1* and W*2* should not necessarily be different. However, Pace (1999) and LeSage (199) warn that when the two matrixes are the same, the model could be under-identified. To avoid the problem of model under-identification, LeSage (1999) suggests the construction of one *W* matrix based on contiguity principles and the other based on distances from a chosen center (e.g. the capital city). However, in the present study distance from the central city (Dar es Salaam, the commercial capital, or respective regional headquarters) represents an important factor in the development of the rural labor markets, which also needs to be modeled. In this case, the present study adopts the strategy of decomposing the general model into two components as suggested in LeSage (1999). These components are (i) Spatial Autoregressive Mixed (SAR) presented in equation 14 and (ii) Spatial Autoregressive Error (SEM) presented in equation 15.

$$y = \rho W y + X\beta + \varepsilon; \quad \varepsilon \sim N(0, \sigma^2 I) \tag{14}$$

$$y = X\beta + u$$
$$u = \theta W u + \varepsilon; \quad \varepsilon \sim N(0, \sigma^2 I) \tag{15}$$

To account for spatial heterogeneity, this paper uses Cessetti's spatial expansion method LeSage (1999), where the regression parameters are a function of geographical locations. There are essentially two approaches followed in modeling variation of the relationship over space (Fatheringham *et al.* 2004; Anselin 2002; Haining 1993). The first approach is based on the

[9] The results of these tests are available from the authors upon request.

[10] The matrix of spatial weights used in this study is produced using Delaunay Triangulation. Given a set of coplanar data points (points that lay on the same plane), Delaunay triangulation is a set of lines connecting each point to its natural neighbors. It is set of triangles such that no data points are contained in any triangle's circumcircle (Haining 1993).

premise that the parameters of the relationship are a function of the latitude and longitude coordinates. In this case, the location in Cartesian space represented by latitude and longitude forms the basis of computing variations (Anselin 2002). The variation in the modeled relationship is normally achieved by imposing the restrictions that nearby observations (in the Cartesian space) take on similar parameter values while distant observations take different parameter values That is, as the location varies, the regression relationship changes to accommodate a linear fit through observations (Haining 1993).

The second spatial expansion approach, which is more relevant for policy purposes than longitude-latitude variations, is the distance expansion (Fotheringham *et al.* 2004; Anselin 2002). In this approach, the expansion is done from a common central point (for the present study, Dar es Salaam, the commercial capital). Methodologically, this option has also another advantage over the longitude-latitude expansion in that it allows different weighting schemes (which are not available under longitude-latitude expansion). The most common weighting scheme used, which has policy relevance is that of "hollowing out" from the central city, where there is a gradual decay of influence with distance from the central point (Pace 2000; LeSage 1999). This is particularly important when one wants to analyze the influences of urban centers on the rural labor markets. For comparison purposes, the present study carries out both longitude-latitude expansion and distance expansion, taking Dar es Salaam as the common central reference point.

3.1.2 Estimation Strategy

The spatial exploratory data analysis conducted before parameter estimation showed the presence of outliers, which suggested yet another violation of Gauss-Markov assumption of constant variance the error term ε. To overcome this problem, the study uses the Bayesian estimation strategy. The estimations were carried by taking 1,100 draws using Markov Chain Monte Carlo simulations (Gibbs Sampler). However, the first 100 (burn in) simulations were dropped from the results in order to allow the Markov Chain process to attain a steady state (LeSage 1999). For comparison purpose, the paper uses both homoscedastic prior and heteroscedastic prior.

3.2. Variable Definitions and Sources

This paper uses two main sources of data, namely the 2000/01 Tanzania Household Budget Survey (HBS) and the International Food Policy Research Institute (IFPRI) GIS database on Tanzania11. The study combines the HBS and the GIS data by matching the HBS village names and the names of populated places in Tanzania from the GIS data base. By using this

[11] The original source of the GIS database on Tanzania is Mud Spring Geographer (MSG) Inc. However, most of the data used in this study has already been modified by IFPRI researchers to suit their poverty and malnutrition mapping project in Tanzania. We thank all IFPRI researchers who provided the data and technical assistance.

method, the present study was able to match 660 out of 853 HBS village names12. After combining the HBS data and the GIS data, GIS data relevant for the development of the rural labor markets as predicted/implied by the theoretical framework was then extracted and joined with the HBS data. The dependent variables for this study come from the HBS data, while the explanatory variables come from the HBS and GIS data base. The following is the description of each variable and its role in the estimation process.

3.2.1 Dependent Variables

As in Isgut (2003), the present study uses two related indicators of development in the rural labor markets. The first indicator is the proportion of households in the village which reported that wage labor is the main source of their cash incomes (hereafter referred to as wage labor). The second indicator is the proportion of households in the village which reported that casual labor is the main source of their cash incomes (hereafter referred to as casual labor). Wage labor tends to be permanent (with long formal or informal contracts) but casual labor is mainly based on daily contracts (NBS 2002). The reason for this distinction between casual and wage labor in this study is to allow assessment of the differential impacts of the explanatory variables on each of these employment categories.

3.2.2. Explanatory Variables from HBS

Besides the GIS-based explanatory variables to be discussed shortly, this study uses most of the explanatory variables from the HBS database. This subsection explains the way these explanatory variables were constructed from household or individual level data.

Apart from wage/salaries and casual labor employment, rural households in Tanzania engage in other activities, namely agriculture and petty trade. The 2000/01 Household Budget Survey (HBS) report shows that the proportion of households which worked on their own farm/fishing and livestock were 70% and 29%, respectively. The report also showed that 4% of households engaged in self employment (besides agriculture). Only 35% worked exclusively on one activity. Besides working on the farm, working on the livestock, and participating in other off-farm self employment, there are other household activities such as fetching water and firewood in which most rural households also participate. These activities are likely to have effects on the rural labor markets as discussed below.

Water and fuel availability: Collection of water has been documented as one of the time consuming activities in the rural communities, which is likely to reduce the participation in the rural labor markets (Loughran and Pritchett 1997). The easiness with which water is available in

[12] To implement this we needed the national, regional, and district boundaries maps because they provide the means for delineating HBS cluster locations. We started to locate the villages sampled in the HBS by comparing their names with those found in the Tanzanian maps of populated areas. When the village was not on the map, then the ward in which it is located (or the nearest village if known), was used as location proxy.

most of rural Tanzania is associated with less time needed for fetching it. This could release some labor resources to engage in other income generating activities. In doing so water availability is expected to increase participation in the rural labor market. To account for the effect of water availability, the study generates two proxies. The first one is the proportion of households whose main sources of drinking water is in-house, outside-house private tap, as well as protected and unprotected private wells (*Pr_water*). The second one is the proportion of the household in the village, whose water sources are in the community, as well as public protected and unprotected wells (*Pu_water*). The rest of other water sources are taken as a control group.

Another time consuming activity in rural communities is firewood collection. To capture the impact of firewood collection, the study includes the proportion of households in the villages whose main source of fuel is firewood (*Fuel_wood*). Time use for the collection of firewood is expected to reduce the participation in the rural labor markets because this activity is labor intensive. The expected sign of the coefficients for this variable is negative.

Rural Business and Commercial Farming: Development in rural labor markets is likely to be associated with the development in other markets, petty business and commercial farming. To capture this relationship, the paper generates a proxy variable (*N_business*) as the proportion of the households in the villages that operated non-farm businesses of any kind. The paper also includes a proxy of commercial farming (*N_comm_farm*), which is the proportion of the households whose main source of cash income is commercial farming. The intension of using these proxies is to find the interlinkage between self-employment, commercial orientation in farming, and the development of rural labor markets.

Cash Constraint: One aspect that the theoretical framework pointed out is that the cash constraint has indeterminate effects on the participation in the rural labor markets. To capture the village level cash constraint effect on the rural labor market development, the study creates two indicators of cash constraints. The first one is the proportion of individuals in the village who operate savings and/or current account and/or borrowed from the bank (*Bank_formal*). The second indicator of cash constraints (*Credit_informal*) is a proportion of individuals who participated in informal credit and informal savings groups[13].

Land and Livestock: Land and livestock are among the assets of the rural households that are expected to have bearing on the rural labor market participation. In this study, sum of per capita cultivated land and pasture land (*Land_head*) is used as a proxy of land availability. Other studies of the rural labor markets show that, theoretically, land availability has indeterminate effect on the participation in rural labor markets because land is both a wealth variable and production factor. First, as wealth variable, land may induce people who have large

[13] It has been pointed out that the way the second indicator of cash constraints is generated measures both cash constraints and social capital. If this is the case, then it will reinforce the positive effects of relaxing the cash constraints that come from the demand side of the rural labor markets because it is known that social capital increases participation in the labor market in general.

land to have confidence on their land (and what they can produce from it), which in turn reduce their participation in wage employment. This insurance effect reduces the incentives of looking for wage and casual employment (Yao 2001).

But when land is considered as a factor of production, it can be either complimentary to labor or substitute for it (Yao 2001). For the purpose of this study, the complimentary nature of land and labor is more expected to have dominant effect due to poor technology used in small scale farming in rural Tanzania. Most households in Tanzania still depend on hand hoes as their main tool of cultivation. In this case, large land availability in the village is likely to increase demand for hire labor. The paper also includes the square of the land (*Land_squared)* to capture this non-linearity of the effects of the land holding on the participation in the rural labor markets.

For the case of livestock, we use per capita number of cattle in the village (*Cattle_head*) as the proxy for livestock assets[14]. Per capita ruminant animals was also included in the earlier stages of estimation but was later dropped because it was highly insignificant and rendered the model unstable due to collinearity with the cattle variable.

Food Security: The experience shows that some amount of participation in the rural labor markets is a forced participation due to famine/hunger in some households (USAID 2004). To account for forced participation in the rural labor market due to hunger/famine, the study includes an explanatory variable (*Food_insecurity*), which is the proportion of the households who had difficulty in satisfying food needs in the year of the interview. The sign of the coefficient of this explanatory variable is expected to be positive. However, at some point as the famine crisis intensifies, the rural labor markets are expected to shrink (USAID 2004). Thus, the study includes the square of the variable (*Foodp_squared*) and is supposed to have a negative sign.

Education, Skills, and Experience: There are several ways of modeling these indicators. For skills, for which education level is normally used as the proxy, one option which is commonly used in the empirical literature is the percentage of individuals in the village who have attained secondary school level or higher (Kaboski and Townsend 2002). In this paper the proxy for skills (*Educ_SEC+*) is modeled as the proportion of individuals with education level above primary school in the population of 15 years old and over. The threshold of 15 years of age was chosen to make sure that we only deal with those who are not attending the compulsory primary school[15]. The choice of upper limit of 65 years of age is motivated by the retirement age of 60 years in the formal sector in Tanzania, but in the rural areas, people are likely to work slightly longer.

[14] This proxy is generated from the HBS data, unlike, cattle density, which is generated from the GIS database (see section 3.2.3).

[15] For detailed analysis of the structure of education systems in Tanzania the reader is referred to Seebens and Wobst (2003a 2003b).

The study also includes the average age (*Age*) and its square (*Age_squared*) of the population in the village aged between 15 and 65 year. As in individual or household level analysis, age is included as a proxy for experience (Taylor and Adelman 2003). In our case however, it may not have that direct interpretation because of the averaging effects. Nevertheless, it is included in the model because a village where majority of the people are aged may have different participation rates in the labor markets as compared to the villages where majority of the people are young.

Health Aspects and Household Size: Health is undoubtedly one of the important determinants of participation in the labor markets. Given the increasing spread of HIV/AIDS in Tanzania (Channing and Wobst 2002), it would have been interesting to include some indicators of this problem of HIV/AIDS because it reduces participation in the labor markets of both the sick person and of the family members who take care of the sick. Unfortunately, the HBS did not elicit information on these variables. To control for effects of diseases (in general) on the participation in the rural labor markets, the study includes the proportion of the individuals who fell sick in the last four weeks prior to the interviews (*Sickness*). The study also includes average size of the households (*Hh_size*) as one of the explanatory variables to control for labor endowment. Table 1 summarizes the definition, source, and expected sign of the explanatory variables from the HBS.

Table 1: Definitions of Explanatory Variables from the Household Budget Survey

Name	Definition	Sign
Hh_size	Average household size in the village	+
Age	Average age of 15-65 age group	+
Age_squared	The square of age	-
Educ_SEC+	Proportion of those with education level above primary education	+
Sickness	Proportion of individuals who fall sick in the past 4 weeks prior to the day of interview	-
Pr_water	Proportion of households with private tap water or well	+
Pu_water	Proportion of households with access to public tap water or well	+
Fuel_wood	Proportion of households using firewood as the main energy source	-
N_business	Proportion of households operating some petty business	+
N_comm_farm	Proportion of households whose main source of cash is commercial farming	+
Bank_formal	Proportion of individuals who have accounts with banks	+/-
Credit_informal	Proportion of individuals who participated in informal credit/savings groups	-/+
Land_head	Per capita cultivated land in the survey year and the pasture land	+
Land_squared	The square of per capita land	-
Cattle_head	Per capita number of cattle	-
Food_insecurity	Proportion of households who experienced regular food shortage problem in the survey year	+
Foodp_squared	The square of food insecurity	-

3.2.3. GIS Extracted Explanatory Variables

***Location coordinates*:** As mentioned earlier, the first important variables in the spatial analysis are the geo-coordinates (location coordinates) of the areas under analysis. The GIS data used in this study employs longitude and latitude co-ordinates as the geo-referencing coordinates. This study uses these coordinates to construct the matrix of spatial weights used in the estimation of the spatial dependence model. These coordinates are also used in spatial expansion for estimating spatial heterogeneity (Cassetti) model.

Environmental/natural variables: As implied in the theoretical framework, the development of the rural labor markets is influenced by environmental variables such as climate, hydrography, topography, and soil quality. Of these natural resources, soil quality/type have been shown to play a significant role in affecting rural labor allocation, such as occupational shift out of subsistence farming into other business activities. Felkner and Townsend (2004) argue that households in villages with high soil quality might have a higher opportunity cost of shifting from agriculture, because their agricultural productivity is relatively high[16]. For the present study, areas with fertile soil have relatively well developed infrastructure, particularly road networks. Therefore, the effect of soil types on the development of rural labor markets is not modeled directly in this study. Instead, its effects are captured by other variables such as distance to the road and population density. However, the study includes the average annual rainfall (*Av_Rainfall*) as the proxy of the length of the growing period.

Distance and Information costs: As shown in Benson (2002), Felkner and Townsend (2004), and Minot and Baulch (2003), transport costs and information costs are also important in affecting the development of the rural labor markets. The present study uses two measures of information and transport costs that have widely been used in the spatial analysis (Benson 2002). These measures are (i) the distance from each village to its respective regional headquarter (*Distance_reg*); and (ii) the distance from each village to the nearest road (*Distance_road*)[17]. Both distance variables capture a measure of the increasing transport and/or information costs. As distance from roads, urban centers, or markets increases, these costs are also expected to increase. In other studies cited in Wood *et al.* (1999), these distance measures have also been used as the proxy for market integration, where it is argued that the regional centers tend to also

[16] Since their main objective was to analyze occupation choices, Felkner and Townsend (2004) conclude that high soil quality could inhibit shifts into entrepreneurial activity (the non-farm activities). But this conclusion overlooks the possibility of using high quality soil to support profitable farming (relative to other poor soil location) and the development of other rural based business. In general therefore, the relationship between high quality soils may not be necessarily linear as portrayed in Felkner and Townsend (2004).

[17] The distance to nearest roads needs to be adjusted to travel speed as discussed in Wood *et al.* (1999) in order to reflect the terrain and the nature of the passage. Such adjustment is normally based on the quality of the transport network. However, we are not able to adjust for these aspects because of the lack of the information in the quality of the roads.

serve as major market and financial centers. Furthermore, proximity to road facilities could aid economic development, including increased access to financial credit.

Land degradation in the village: From the GIS database, the study also extracts cattle density as an indicator of land degradation (VPO 1999). Since land is the largest employer, the more it is degraded the more it is likely that crop production will fail. Falling agricultural productivity is also likely to be associated with decline in the development in rural labor markets. Thus, the expected sign of the coefficient of cattle density (*Cattle_density*) is negative. Since the relationship between cattle density and development in rural labor markets may not be linear, we also attempted to include the square of this variable in the regression. However, the square of this variable was dropped in the process of finding a parsimonious model because it was highly insignificant.

Population Density and Urbanization: This study also includes population density and its square *(Pop_density* and *Popd_squared*, respectively) because development of the rural labor markets is likely to be reflected by the extent to which a particular location is moving toward urbanization. High population density is likely to be associated with some features of urban areas, which support the development of labor markets. Thus, the expected sign of the population variables is positive. Table 2 summarizes the definition, source, and expected sign of the explanatory variables from the GIS database.

Table 2: List of GIS Extracted Explanatory Variables

Name	Definition	Sign
Distance_reg	Distance from the regional headquarter to the village	-
Distance_road	Distance from the nearest road to the village	-
Cattle_density	Cattle density in the village	-
Av_Rainfall	Average annual rainfall in the village	?
Pop_density	Village population density in the 1990s	+
Popd_squared	The square of the population density	+

4 Results and Policy Implications[18]

This section presents the estimation results and discusses their policy implications. The presentation starts with selected spatial exploratory data analysis in subsection 4.1, which forms the supporting base of the discussion of the regression results presented in subsection 4.2.

4.1. Spatial Exploratory Data Analysis (SEDA)

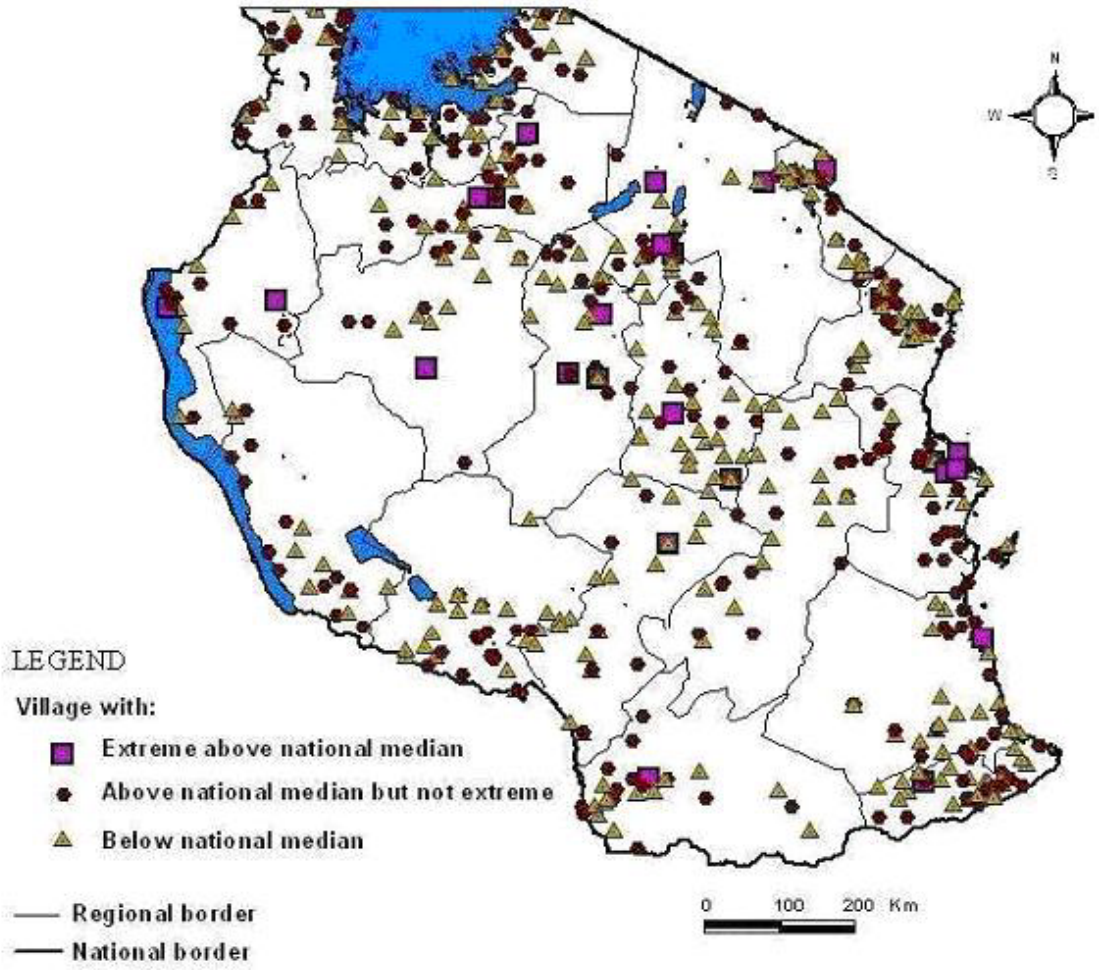
One major advantage of spatial exploratory data analysis (over the standard exploratory data analysis) is its ability to locate where (on the map) a particular phenomenon occurs (Haining 1993). In this paper, the SEDA starts by considering the distribution of the two indicators of the development of the rural labor markets, namely the proportion of households in the village whose main source of cash income is (i) wage labor and (ii) casual labor. To explore these dependent variables, the usual exploratory data analysis statistics (for example, using box-plots) are generated and then projected on the map of Tanzania in order to show spatial distributions of the phenomena.

Since development in the rural labor markets has been found to be positive for poverty reduction and food security in particular (Bright *et al*. 2000; Lanjouw and Shariff 1999; Zucula and Massinga 1992) it is important to see the distributions of the villages that are the best performers and those villages that perform below average. Thus, Map 1 for wage labor and Map 2 for casual labor show the three groups, namely (i) best performers-villages with extreme development in rural labor markets (sample points with values over 1.5 times inter-quintile range); (ii) poor performers-villages below national average (median); and (iii) other villages.

It is apparent from Map 1 that villages located close to the towns and near to the major roads constitute the majority of the villages classified as best performers. Indeed, this is as expected since being near to the town and road network tends to increase returns to off-farm activities relative to the on-farm activities through the reduction in the information and transportation costs. But apparent also is that the southern highlands seem to have lower development in the rural labor markets than their counterparts in the north. Generally, the south eastern regions have the least performers and the largest proportion of those below the national median for the case of wage labor. This could partly be explained by the recently increased youth migration from these regions to other parts of the country as observed in Diyamett *et al*. (2001).

[18] The estimation was done using Spatial Econometrics Toolbox for MATLAB developed by J. LeSage. More information can be found at http://www.spatial-econometrics.com.

Map 1
Distribution of Villages According to the Dependence on Wage Labor
as the main Source of Cash Income



Source: Authors' estimates from HBS and MSG database

However, migration alone cannot explain the low development of rural labor markets in the south-eastern regions. This is because other reports show that the northern regions, particularly the Kilimanjaro region, also have relatively high net out migration (URT 1998; URT 2002b). Yet still, our analysis shows that they have a significant number of villages where rural labor markets are fairly well developed. Thus, other factors should be sought to explain the observed spatial pattern (this is done in the regression analysis).

Apparent also in Map 2 is that villages with best performers in terms of the proportion of households for which casual wage labor is the main source of cash income are only located in the northern part of the country (particularly, north of the central railway line from Dar es Salaam city to Kigoma region). It can also be seen that the villages with below the national median are largely located in the southern part of the country.

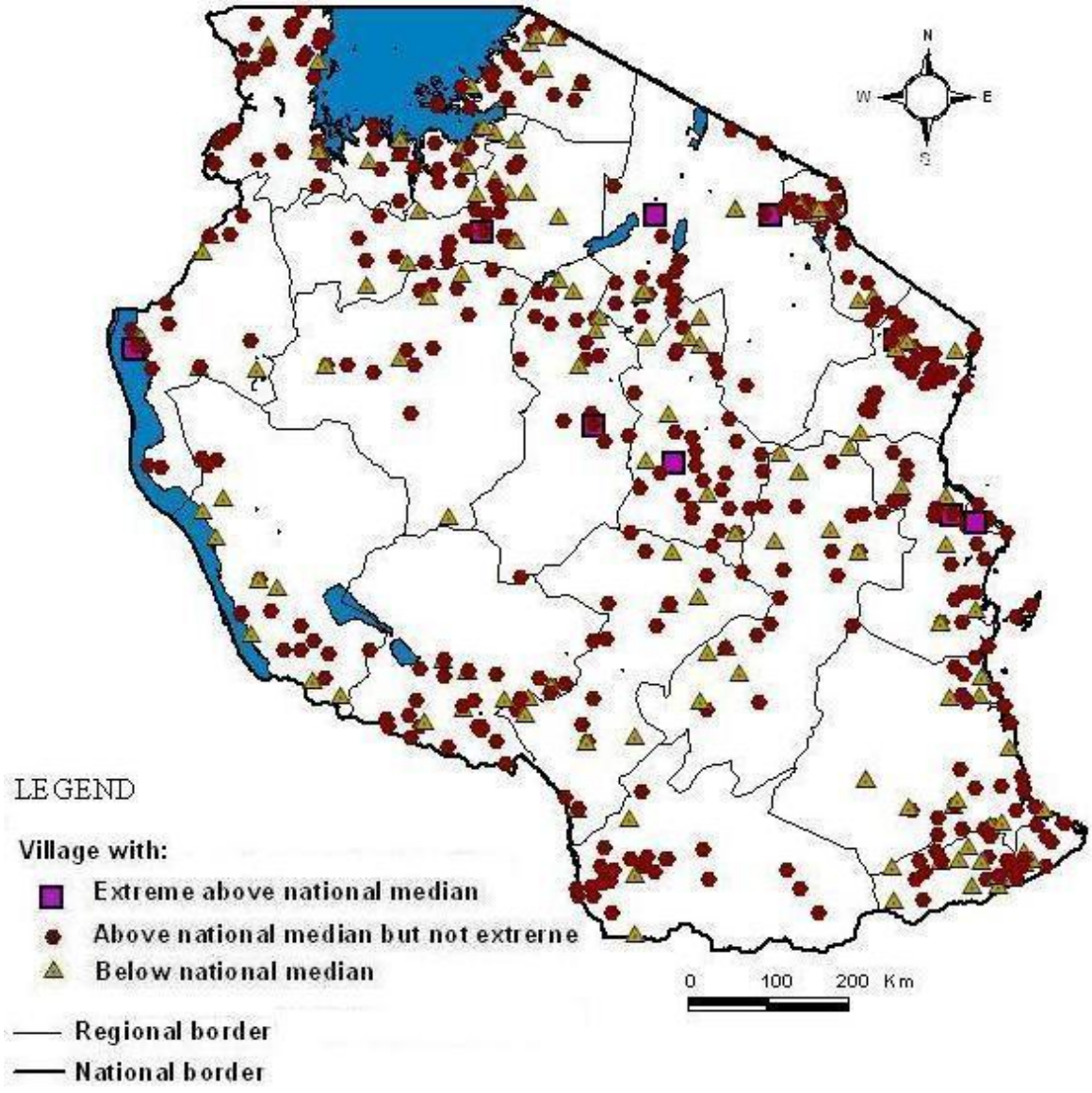
Moreover, comparing the two maps, there are two contrasts that can be made between the distribution of villages which are the best performers in terms of wage labor and casual labor. First, there is reduction in the number of the best performers in terms of casual labor; and second, there is a complete disappearance of best performers in terms of casual labor in the southern part of the country. This first contrast implies that casual labor is more uniformly distributed all over the country than wage labor (in relative terms because there are few extremes in casual labor). Indeed, this is what would have been expected because casual labor is more a result of natural rural setting as compared to some deliberate policy intervention in the case of wage labor. The second contrast implies that, since best performers of both wage and casual labor are located in the northern part of the country, which shows positive correlation between the two types of labor markets.

The preceding discussion shows that wage labor and casual labor exhibit strong spatial patterns. The spatial pattern in the dependent variables implies that the underlying factors for the development of the rural labor markets must also exhibit a spatial pattern (Anselin 2002). As noted in other studies, the major underlying factor in the rural economy is the agro-ecological factor (de Janvry and Sadoulet 1995, Jeong and Townsend 2003; Kaboski and Townsend 2002). To see how the underlying factors exhibit spatial patterns, the study carries out a spatial cluster analysis of all explanatory variables as follows. First, we run the seven group cluster analysis to mimic the seven major agro-ecological zones in Tanzania.

The resulting spatial clusters are then matched with the map of agro-ecological zones of Tanzania. However, the results were not able to follow closely the distribution of agro-ecological zones. The explanatory variables could also be spatially clustered according to other spatial factors such as the road density or population density. However, as Kaboski and Townsend (2002) observe, these variables are themselves not independent of the agro-ecological factor. Thus, the study uses another approach where the objective is simply to get as few spatial clusters as possible and characterize their respective locations. This approach gives four spatial clusters, which are presented in Map 3[19].

[19] It is important to note that, having no guiding criteria, we gradually reduced the number of clusters from seven to four using visual judgment of the distribution of each cluster on the map.

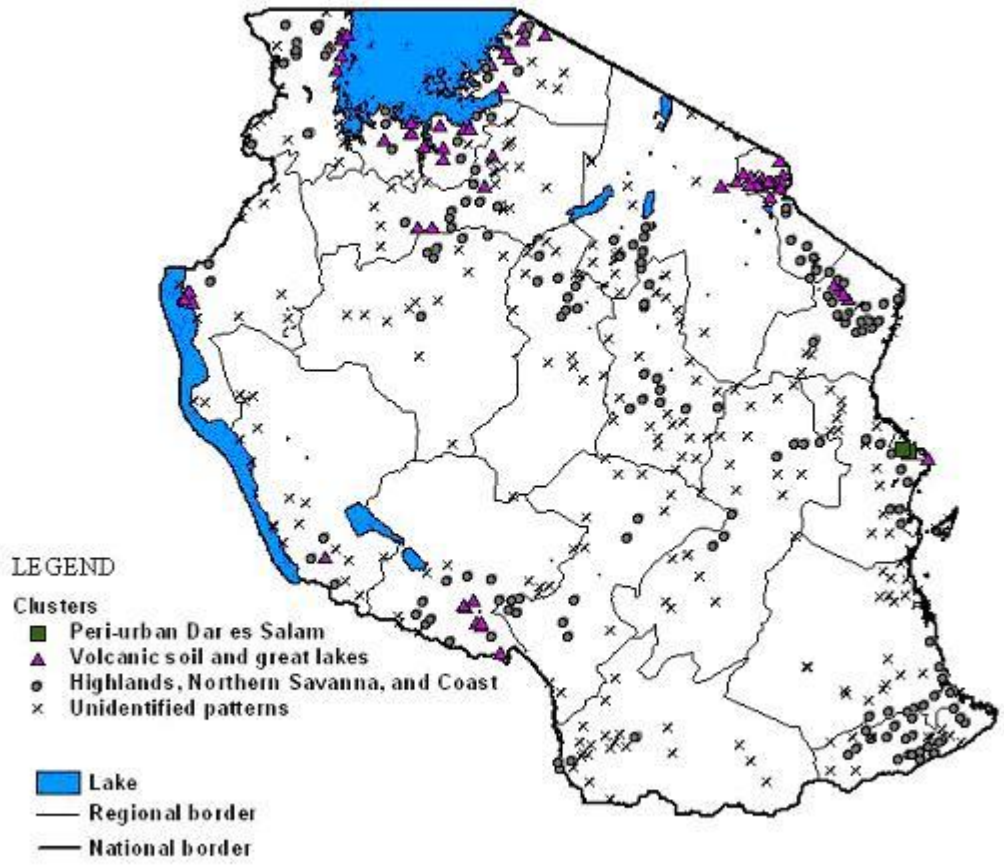
Map 2
Distribution of Villages According to the Dependence on Casual Labor as the main Source of Cash Income



Source: Authors' estimates from HBS and MSG database

Two out of the four clusters presented in Map 3 have spatial distribution that can readily be explained. The smallest group of villages (symbolized by gray cubes) is entirely comprised of the peri-urban population of the commercial capital Dar es Salaam. It is not surprising that peri-urban population of Dar es Salaam behaves completely different from other rural areas. This finding corroborates well with those of Sparrow *et al.* (2001) and Garrett *et al.* (2001) who show that this distinction arises because the peri-urban population of Dar es Salaam is highly affected by development of commercial infrastructure in Dar es Salaam city as compared to other rural areas.

Map3
Clusters of Villages According to the Development of the Rural Labor Markets



Source: Authors' estimates from HBS and MSG database

Symbolized by triangles in Map 3 is another group of villages which exhibit two spatial patterns. The first pattern is its concentration around the volcanic soils in the northern and southern parts of Tanzania, where coffee used to be the main cash crop. But due to the declining coffee prices in the world markets in recent years, these areas are now shifting to the cultivation of other crops. The crops that have mostly been favored in this inter-sectoral shift are mainly labor intensive crops such as vegetables and seasonal fruits (URT 1997; URT 2002b). The second pattern is the concentration of the locations along the major lakes, particularly Lake Victoria and few villages along the Lake Tanganyika. Fishing activities in these areas are also highly labor intensive because of the poor technologies employed. The fishing activities are also likely to stimulate growth of other off-farm activities such as fish trading[20].

Generally, spatial clustering suggests also spatial non-stationarity in the development of rural labor markets in Tanzania, such that the mean of the variables in our models varies from location to location and according to the direction one takes. For example, we find that the

[20] The other two groups, symbolized by dots on Map 3 do not have a clear spatial pattern and their description is omitted.

spatial trends of wage and casual labor decline southwards. Surprisingly, the west-east trend is not well pronounced. Neither the mean nor the median shows any significant spatial drift in west-east direction. This could partly be explained by the spatial differences in the development of transport infrastructure, whereby the north has relatively well developed infrastructure as compared to the south[21]. Most of these spatial aspects need a more rigorous spatial econometric estimation technique discussed in section 3.1, whose results are presented in the subsequent subsections.

4.2 Estimation Results and Discussions

This section presents the results of spatial dependence and spatial heterogeneity models discussed in section 3.1. For the spatial dependence models, the results are mainly present in tabular form. However, for the spatial heterogeneity models the results are mainly presented in graphical form because spatial heterogeneity models produce massive outputs, which are not amenable to tabular presentation[22]. We first present and discuss the spatial dependence model results in section 4.2.1 and later in section 4.2.2, we present and discuss the results of the spatial heterogeneity model.

4.2.1. Results of Spatial Dependence Analysis

This section presents the results of the spatial autocorrelation model (SAR) and spatial error model (SEM), which are the two components of the spatial dependence models described in Section 3.1.1. The estimations were carried by 1,100 draws using Markov Chain Monte Carlo (MCMC) simulation of the posterior density[23]. Even though the results of the Bayesian estimation with homoscedastic prior are presented alongside those of heteroscedastic prior for comparison purpose, the discussion of the policy implications of these results is mainly based on the results from the robustifying-heteroscedastic prior models.

Model Diagnostic

As noted in other studies, convergence of MCMC in SAR and SEM models is not a problem (cf. LeSage 1999). In this study, convergence was achieved in both models after 1,100

[21] Even though we only discuss east-west and north-south variations, we also measured these variations with respect to other directions by calibrating the rotational angle to 45 degree interval, thus producing eight sets of estimates. All maps for each direction are available from the authors upon request.

[22] These models produce estimates for each (660) sample location used in this study and it is difficult to see any pattern without the use of graphical aid.

[23] This study uses the fixed improper prior, first set to reproduce the maximum likelihood estimate (homescedastic assumption) and secondly, set to reflect our prior that the error terms are hetoroscedastic. If heteroscedasticity and outliers exist, the heteroscedastic prior employed here allows for sufficient divergence from unit of the relative variance terms to accommodate the non-constant variances and robustify against the outliers (LaSage 1999).

iterations (for which the first 100 iterations were burn-in). The adjusted R^2 is reasonably high, and all models explain more than 50% of the variation in the wage labor and casual labor[24].

Bayesian estimations with homoscedastic prior fail to detect spatial dependence in the SAR specification of wage labor and casual labor. However, with heteroscedastic prior, both wage labor and casual labor exhibit significant spatial dependence. But the spatial dependence is much stronger in casual labor than in wage labor. This could be because a significant number of those with some wage employment is located by purposeful policy interventions (e.g. teachers, rural medical practitioners, and in plantations) and only a few in wealthy households. Unlike wage labor, casual labor depends mainly on the rural natural environment (e.g. seasonal demand for labor in agriculture due to variation in rainfall).

For the SEM specifications for wage labor and causal labor, error terms have significant spatial autocorrelation under both assumptions of homoscedasticity and heteroscedasticity. This confirms our earlier claims that Ordinary Least Squares (OLS) estimation would not be appropriate for our models. Figure 1 display some selected model diagnostics for wage labor, where we compare the OLS residuals, standard (non-Bayesian) SAR residuals, and Bayesian SAR residuals.

[24] It is important to note that, unlike in the Ordinary Least Squares (OLS) estimations, the adjusted R^2 reported here is not a direct result of the Bayesian estimations but was computed after estimating the parameters.

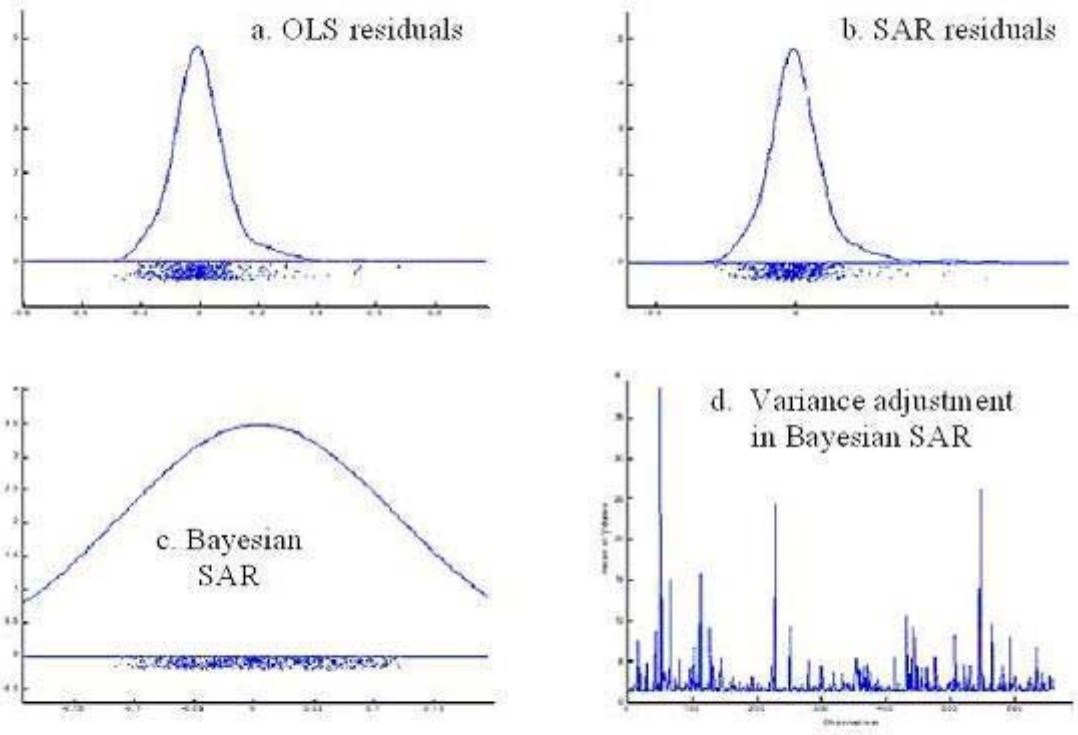


Figure 1.
Selected model diagnostic graphs for comparing performances of various estimation techniques

Source: Authors' estimates from HBS and MSG database

Panel (a) in Figure 1 shows that ordinary least squares (OLS) residuals suffer seriously from the presence of outliers in the right tail. The problem of outlier is also present in the standard (non-Bayesian) SAR residuals as shown in panel (b). However, the use of heteroscedastic prior in the Bayesian framework is able to adjust to the presence of these outliers. For example, panel (c) in Figure 1 shows that all outliers are now accommodated and no longer affect the estimates. Likewise, panel (d) shows that the relative variances of the error terms in the Bayesian estimation deviates greatly from unit to correct for the presence of the outliers. Generally, what we observe is the ability of our Bayesian heteroscedastic framework to robustify against the violation of standard (classical) regression assumptions. This makes our results more reliable as compared to those that would have been obtained under standard econometrics estimation techniques. The estimation of the model for casual labor generates similar pattern of diagnostic graphs and their discussion is omitted.

Estimated Parameters and their Interpretations

Here we present and interpret the coefficients of Bayesian estimation results of the spatial autocorrelation model (SAR) and the spatial error model SEM models. Table 3 and Table 4

show the results of parameter estimates for SAR and SEM for wage labor and casual labor, respectively. Note that the columns labeled homoscedastic and heteroscedastic contain results from homoscedastic and heteroscedastic priors, respectively. In view of the results presented in these tables, the following are the major findings and their policy implications:

1. For wage labor and casual labor, all parameters have the expected signs, with a few exceptions. Nevertheless, the coefficients for population density (and its square) are not statistically significant under both models. The first one is the population density (and its square) which was expected to be positive, but turned out to be negative. We argued in Section 3 that high population density increases urbanization features such as increased specialization and trade. Thus, population is expected to have positive impact on the development of the labor markets. The other unexpected sign is on the participation in informal rural credit, which is arguably capturing social capital as well. Again, this coefficient is not significant. As shown in Mduma (2003), this could possibly reflect the neutralization effects predicted in the farm household theoretical frameworks, where it is shown that relaxation of the cash constraints has two opposing effects. The effects, which enhance the development of the rural labor markets, come from the demand side while the repressive effects come from the supply side of the rural labor markets. Note however, the relaxation of cash constraints in the village through the participation in formal banking system has positive and significant association with wage and casual labor in the village. This implies that policies that increase the financial capital of the rural entrepreneurs will increase demand for wage and casual labor. On the labor supply side, it is likely that such policies will reduce the supply of wage and casual labor but increase the supply of entrepreneurs (Jeong and Townsend 2003).

Despite having expected signs, the following variables are not significant predictors of wage labor in the villages: the square of average age in the village, number of sick persons in the village, availability of public water, the square of the food insecurity, and participation in informal rural credit, average annual rainfall, commercial farming, as well as distance to the roads. In the estimated model for casual labor, private water availability, which was significant in wage labor estimation, becomes insignificant.

Table 3: Estimation Results of the Determinants of Wage Labor in Tanzanian Villages

	SAR				SEM			
	Homoscedastic		**Heteroscedastic**		**Homoscedastic**		**Heteroscedastic**	
Variable	Coefficient		Coefficient		Coefficient		Coefficient	
Constant	-0.219	***	-0.251	***	-0.239	***	-0.248	***
Hh_size	0.016	***	0.013	***	0.017	***	0.015	***
Age	0.110	***	0.137	***	0.119	***	0.133	***
Age_squared	0.000		-0.006		-0.001		-0.005	
Educ_SEC+	0.411	***	0.395	***	0.423	***	0.415	***
Sickness	-0.028		-0.019		-0.026		-0.023	
Pr_water	0.030	*	0.034	**	0.031	*	0.033	*
Pu_water	0.010		0.007		0.012		0.011	
Fuel_wood	-0.153	***	-0.153	***	-0.157	***	-0.158	***
N_business	0.077	***	0.032	**	0.077	***	0.054	***
N_comm_farm	0.008		-0.009		0.006		0.000	
Bank_formal	0.354	***	0.309	***	0.361	***	0.340	***
Credit_informal	-0.033		-0.020		-0.034		-0.026	
Land_head	-0.088	***	-0.056	***	-0.082	***	-0.066	***
Land_squared	0.019	**	0.013	*	0.017	**	0.013	*
Cattle_head	-0.005	**	-0.003	**	-0.005	**	-0.005	**
Food_insecurity	0.085	*	0.078	*	0.089	*	0.084	*
Foodp_squared	-0.086		-0.084		-0.101		-0.095	
distance_reg	-0.012	***	-0.006	*	-0.014	***	-0.012	**
distance_road	-0.001		-0.002		-0.001		-0.001	
Cattle_density	-0.003		-0.007	***	-0.002		-0.005	*
Av_Rainfall	-0.001		-0.002		0.001		0.000	
Pop_density	-0.007		-0.007		-0.009		-0.008	
Popd_squared	0.000		0.000		0.000		0.000	
ρ	0.060		0.061	*				
θ					0.231	***	0.225	***
Adj R^2 _	0.573		0.879		0.550		0.543	

*** = 1% sign ** = 5% sign * = 10% sign

Source: Authors' estimates from HBS and MSG database

2. As expected, the coefficient for food insecurity is positive and significant at 10%. On the supply side of the rural labor markets, this finding implies that food insecure households increase their participation in the rural labor markets. This finding corroborates well with the findings of Shariff (1991) and Dessing (2002) in their analysis of distress labor market participation. However, from the demand side, it could be argued that as the food insecurity in the village becomes critical, rural labor markets shrinks because of reduced number of potential employers. This is reflected in the negative sign of the square of the food insecurity variable, even though it turned out not to be significant. Nevertheless, this finding provides

some evidence that policies that stabilize the food security in the rural areas (e.g. small scale irrigation projects that reduce exclusive dependence on rainfall) will reduce the supply of distress labor.

3. *Asymmetric effect 1*: While the coefficient of sickness is not significant in the model for wage labor, it is significant at 10% in the model for causal labor. Since wage labor is comprised largely of contracts which are more permanent in nature as compared to casual labor, this asymmetric effect of sickness shows differences in income insurance. It indicates that the rural wage workers are relatively more insured than the casual laborers in an event of falling sick.

4. *Asymmetric effect II*: Likewise, average annual rainfall has an asymmetric effect on these two types of rural labor markets. It affects casual labor negatively but has no effects on wage labor. This could mean that the rural households in areas with relatively high average annual rainfall participate less in casual employment, thus derive most of their cash income from other sources (particularly from selling agricultural produces). But the rainfall variable does not matter for the wage employees, who are more likely to be located by deliberate government policies. They are also found in plantations and in some few relatively rich households, whose incomes are less vulnerable to vagaries of weather. Linking this finding with the distress labor due to food insecurity, it can be argued that policies that reduce direct dependence on rain-fed agriculture will first (in the short run) reduce labor supply in the rural labor markets. However, in the long rural, such policies are likely to enhance development in rural labor markets because they will foster a buoyant agricultural sector (Davis *et al*. 2004).

   Asymmetric effect III: Likewise, distance from the road does not affect wage labor markets but affects casual labor markets. This again is in line with observation 5 above and the explanation could be similar to the one given in observation 5, in that other allocation mechanisms such as deliberate government policies account for this phenomenon.

Table 4: Estimation Results of the Determinants of Casual Labor in Tanzanian Villages

	SAR				SEM			
	Homoscedastic		**Heteroscedastic**		**Homoscedastic**		**Heteroscedastic**	
Variable	Coefficient		Coefficient		Coefficient		Coefficient	
Constant	-0.180	**	-0.150	**	-0.187	**	-0.164	*
Hh_size	0.020	***	0.020	***	0.020	***	0.021	***
Age	0.172	***	0.159	***	0.197	***	0.183	***
Age_squared	-0.009		-0.006		-0.014		-0.011	
Educ_SEC+	0.430	***	0.390	***	0.442	***	0.421	***
Sickness	-0.056	*	-0.072	**	-0.054	*	-0.065	*
Pr_water	0.015		0.026		0.019		0.021	
Pu_water	0.001		-0.008		0.006		-0.001	
Fuel_wood	-0.207	***	-0.218	***	-0.211	***	-0.216	***
N_business	0.058	**	0.032	*	0.052	**	0.041	*
N_comm_farm	-0.022		-0.028		-0.035		-0.035	
Bank_formal	0.340	***	0.345	***	0.334	***	0.341	***
Credit_informal	-0.042	*	-0.025		-0.044		-0.032	
Land_head	-0.100	***	-0.073	***	-0.094	***	-0.081	**
Land_squared	0.017	*	0.011		0.016	*	0.012	
Cattle_head	-0.007	***	-0.006	***	-0.008	***	-0.007	**
Food_insecurity	0.117	*	0.135	**	0.112	*	0.117	*
Foodp_squared	-0.053		-0.047		-0.055		-0.045	
distance_reg	-0.009	*	-0.013	**	-0.013	**	-0.014	**
distance_road	-0.006	*	-0.004	*	-0.005		-0.005	
Cattle_density	-0.008	**	-0.010	***	-0.008	**	-0.009	**
Av_Rainfall	-0.009	**	-0.008	*	-0.007		-0.007	
Pop_density	0.002		0.000		0.000		0.000	
Popd_squared	0.000		0.000		0.000		0.000	
ρ	0.083	**	0.069	**				
θ					0.217	***	0.196	***
Adj R^2 _	0.579		0.851		0.567		0.564	

*** = 1% sign ** = 5% sign * = 10% sign

Source: Authors' estimates from HBS and MSG database

5. As expected, farm land shows its complimentary nature to labor in that large land endowment is associated with less labor allocated to the rural labor markets. However, the square of the land variable is positive and significant, which indicates that more hired labor will be demanded by households which have large amount of farm land relative to their family labor (Singh *et al.* 19986).

6. Cattle and cattle density have the expected effects and are significant. The effect of per capita number of livestock reduces reliance on the labor market because most of the household labor will be allocated to taking care of the household livestock. Also when considering cattle as assets, the wealth effect is likely to reduce involvement in the labor market. Furthermore,

land degradation caused by overstocking reduces both wage and casual labor markets in the village. Thus, as villagers pile up their number of cattle, the wealth effect and degradation effect works in the same direction and reinforce each other. By doing so, overstocking reduces the participation in the labor markets of livestock-wealthy households; it also reduces the availability of jobs to the poor households who would have been otherwise employed if crop production was vibrant.

7. Other variables can be interpreted in the usual ways as they are commonly interpreted in many empirical studies in this area. Thus, our results imply that villages with relatively educated population, increased access to water, and reduced reliance on firewood are associated with relatively increased participation in the rural labor markets. Moreover, self employment is also associated with high participation in paid labor. This implies that some rural petty businesses provide employment to their proprietors as well as to others, particularly the casual workers.

4.2.2 Results of Distance and Longitude-Latitude Expansion Models

In this section we present the results of the distance expansion and the longitude-latitude expansion. The distance expansion was done with reference to the commercial capital, Dar es Salaam. As mentioned earlier, these models produce a lot of output, therefore, only those results that are at least significant at 10% levels are presented and discussed. We first present the results of distance expansion from Dar es Salaam and then later we present longitude-latitude expansion. Moreover, to avoid repetitions, the discussion is only for the expanded coefficients because base coefficients are discussed under the Bayesian SAR and SEM specifications in section 4.2.1.

For graphical presentation, in the case of the longitude-latitude expansion, the location coordinates are sorted from small to high value of the longitudes and latitudes. As Tanzania is located in the east of the Greenwich, the longitudes increase from west to east, therefore the graphs show coefficient variation from west to east. Also, Tanzania being in the south of the Equator, latitudes increase from south to north, thus the plots show coefficient variations from south to north. For the case of distance expansion estimates, the plots present coefficients sorted by distance from the chosen central point (Dar es Salaam). The central observation is on the left of the graph and the longest distance on the right of the graph.

Distance Expansion from Dar es Salaam

For the wage labor model, the coefficient for firewood increases with distance from Dar es Salaam and that of the population decrease with the distances from Dar es Salaam. Note that in the base model the coefficient for firewood (wood) has a negative sign. Therefore, when we observe that effect of time for collecting firewood increases with distance, it means that the

magnitude of its impact in reducing rural labor markets declines. Figure 2 shows the variations in the coefficient of time used to collect firewood and the coefficient for participation in the formal financial institutions.

Figure 2 shows that there would be significant differences in the outcome of the intervention according to the location. For example, in villages near to Dar es Salaam, reduction in the time used to collect firewood may increase participation in rural labor markets more than in villages in the far remote countryside. This could be due to increased flexibility in job places near the city. But for the case of cash constraints, interventions that increase cash flows near the city have only a modest impact as compared to those faraway. The larger impact in this case is felt far away from Dar es Salaam than nearby.

For casual labor, the coefficient of average annual rainfall and relaxation of the cash constraint through participation in formal financial systems increases with distance from Dar es Salaam. Like the case for wage labor, interventions that reduce cash constraints in locations far away from Dar es Salaam are more likely to have greater impacts than close to Dar es Salaam. As such our analysis shows that greatest impact of credit is found in Tabora region, which is the largest tobacco producing region in Tanzania. It can be argued that, since tobacco farming is generally labor intensive and also requires substantial amount of fertilizers and pesticides, availability of credit/cash will increase the purchase of fertilizers and pesticides and promote the demand for labor.

It was also found that, the impact of cattle ownership decreases with distance from Dar es Salaam. This could be explained by the fact that the demand for milk in Dar es Salaam has increased employment in dairy cattle in the peri-urban of Dar es Salaam (Sparrow *et al*. 2001, Garret *et al.* 2001). The dairy cattle projects, particularly in the peri-urban, are labor intensive because of the limited grazing land and wide spread cattle diseases, which makes zero-grazing inevitable.

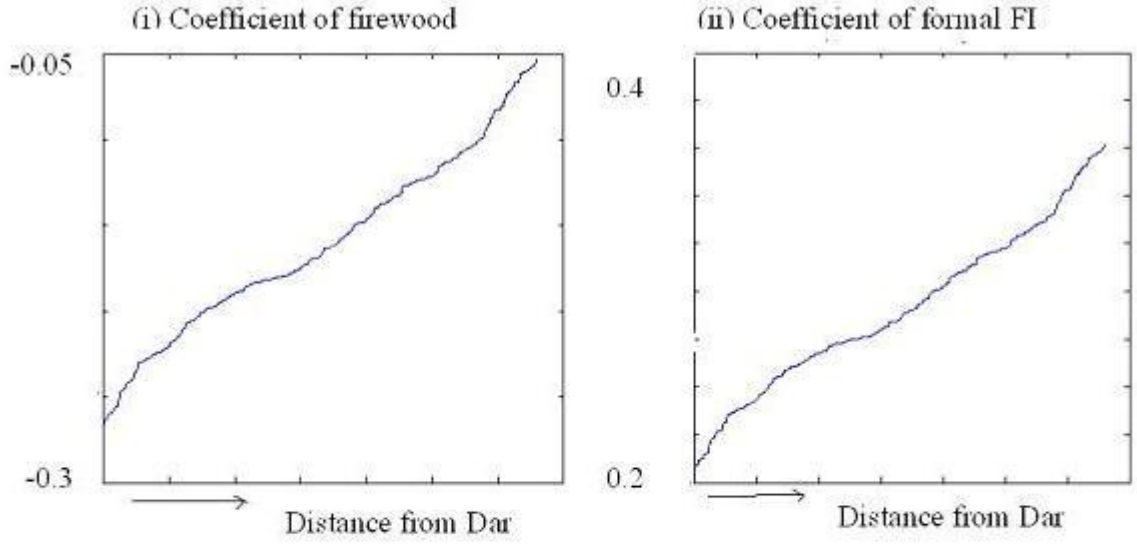


Figure 2.
Spatial variations of the impact of (i) time spent in collecting firewood and (ii) participation in formal financial institutions

Source: Authors' estimates from HBS and MSG database

Longitude-Latitude Expansion

This sub-section discusses the results of the parameters estimated from models with varying coefficients over longitude or latitude expansions. As stated earlier, we only present the coefficient results whose p-values are less than or equal to 0.1 (that is 10 percent significance level)[25]. Also, emphasis is put on those parameters that have more policy relevance than mere model calibration.

Table 5 shows that for both wage and casual labor, the distance from regional headquarters is negatively associated with the development in the rural labor markets. This association is however not stationary (constant) over space. The coefficient decreases as one moves from west to east, meaning that the adverse effect of the distances is strongly felt in western as compared to eastern parts of the country. Likewise, the time spent in collecting firewood has varying impacts which increase eastward. Table 5 also shows that the impact of average annual rainfall increases southwards. This means that reliable rainfall reduces participation in the rural labor markets for people in the south as compared to the people in the north.

[25] The model diagnostics were checked and found to be reasonably well. And since these models emphasize on the prediction across space (the emphasis which is shared with poverty mapping analysis) only the level of significance and the adjusted R^2 are reported. The omitted results can be obtained from the authors upon request.

Table 5: Results of Longitude (x)- Latitude (y) Expansion Models

Variable	Wage labor		Casual labor	
constant	-0.246	**	-0.253	*
distance_reg	-0.162	**	-0.162	**
Av_rainfall			0.147	*
Educ_SEC+	0.920	*		
Bank_formal			1.425	**
Fuel_wood	0.645	***		
x-distance_reg	0.005	**	0.004	*
x-Fuel_wood	-0.023	***		
x-Av_rainfall			-0.005	**
y-Av_rainfal	-0.005	*		
Adj_R^2	0.522		0.559	

Note ***, **, * stand for 1%, 5% and 10% significant level, respectively

Source: Authors' estimates from HBS and MSG database

The findings of this section, therefore provide evidence that the interventions to promote rural labor markets should not be expected to produce uniform results. For example, rural electrification policies, which are likely to reduce reliance on firewood, are likely to have greater impacts in the east (and village near to the Dar es Salaam city) than in the west (and villages far away from the Dar es Salaam city). This could partly be explained by the differences in other infrastructure and market opportunities such that labor released from collecting fuelwood could find alternative employment.

However, rural labor markets in the western parts of Tanzania (and villages away from Dar es Salaam) are likely to benefit more from policies that reduce distance to the roads than eastern parts (villages close to Dar es Salaam). Furthermore, interventions such as rural credit programs are likely to have great impact in villages which are far away form Dar es Salaam city, where credit is needed for financing farm inputs such as fertilizers and pesticides.

5 Conclusions

This paper has shown that the rural labor markets in Tanzania exhibit significant spatial variations, which are normally not captured in traditional econometric estimation. Using spatial econometric techniques, the paper has demonstrated that: (i) rural labor markets are interlinked across space as well as with other markets such as credit markets; (ii) the impacts of policy interventions (e.g. making credit available to the rural households, reducing time spent on fetching firewood, and rural road programs) on the development of rural labor markets are space-dependent. For example, interventions that reduce cash constraints such as rural credit schemes are likely to have greater impacts in the western part of the country than in the eastern part. However, interventions that reduce the time used in collecting firewood are likely to have more pronounced impacts in the eastern parts than in the western parts of the country.

All this implies that: (a) since there seems to be significant interconnectedness between rural labor markets and the development of other markets (particularly credit markets), a combined intervention in several markets (e.g. rural credit programs and farm input policies) is likely to have a stronger impact than separate interventions; (b) policy interventions in several locations are more likely to have strong impacts as compared to interventions fragmented and spread relatively away from each other and across a large area. Thus, spatial dependence can be exploited by launching policy interventions in areas that are close to each other.

References

Alexander, K. (2001). Development Dynamics in an Economy with Credit Rationing and Occupational Choice (2001) Department of Economics, University of Chicago: www.uchicago.edu/~akkaraiv/devdyn3a.pd ; accessed January 10, 2003.

Anselin, L. (2002). 'Spatial Externalities'. Forthcoming in *International Regional Science Review*. Online manuscript at: www.agec221.agecon.uiuc.edu/users/anselin/papers/intro_externalities.pdf; accessed April 29, 2004.

Anselin, L. (1988). *Spatial Econometrics: Methods and Models*, Dorddrecht: Kluwer Academic Publishers.

Aronsson, T. e*t al.* (2001). 'Estimating intrahousehold allocation in a collective model with household production'. *Journal of Population Economics*, 14 (4)569-584.

Bardhan, P. (1982). "Agrarian class formation in India", *Journal of Peasant Studies*, Vol. 10, pp. 73-94.

Benson, T. (2002). *Malawi-Atlas of Social Statistics.* National Statistics Office, Government of Malawi and International Food Policy Research Institute (IFPRI).

Binford, M., J. Lee, and R. Townsend (2004). Sampling Design for an Integrated Socio-Economic and Ecologic Survey Using Satellite Remote Sensing and Ordination. Geography Department, University of Florida http://www.clas.ufl.edu/users/mbinford; accessed July1, 2004.

Branson, W.H. (1997). *Macroeconomics: Theory and Policy*. Harper Row and Collins.

Bright, H. *et al*. (2000). Rural Non-Farm Livelihoods in Central and Eastern Europe and Central Asia and the Reform Process: A Literature Review. Natural Resources Institute Report No. 2633, (DFID)/World Bank. Available on http://www.nri.org/work/rnfl-transition.htm; accessed May 6, 2004.

Bryceson D. (2000). 'Rural Africa at the crossroads: Livelihood practices and policies'. *ODI Natural Resources Perspective 52*. www.odi.org.uk/nrp; accessed March 11, 2003.

Channing, A. and P. Wobst (2002). HIV/AIDS and labor markets in Tanzania. TMD discussion papers No 102, International Food Policy Research Institute (IFPRI). http://www.ifpri.org/divs/tmd/dp/papers/tmdp102.pdf; accessed June 21, 2004.

Davis, B. (2003). *Choosing a Method for Poverty Mapping*. Agriculture and Economic Analysis Division; FAO, Rome.

Davis, B. *et al*. (2002). Promoting farm/off-farm linkages for rural development: Case studies from Africa and Latin America. Food and Agriculture Organization of the United Nations, Rome.

Dessing, M. (2002). "Labor supply, the family and poverty: the S-shaped labor supply curve", *Journal of Economic Behavior and Organization*, Vol. 49, pp433-458.

DFID (2002). Non-Farm Income in Rural Areas: Policy Planning and Implementation. Keysheets No. 14. Department for International Development (DFID). www.keysheets.org; accessed January 20, 2003.

Diyamett, B. *et al*. (2001). Exploring rural-urban interactions in Tanzania, a critical review of the methods and tools used. International Institute for Environment and Development. http://www.iied.org/docs/urban/rururb_wp03.pdf; accessed May 20, 2004.

Eswaran, M. and A. Kotwal (1986). "Access to capital and agrarian production organization", Economic *Journal*, Vol. 96, pp.482-498.

FAO (1998). The State of Food and Agriculture. 'Part 3: Non-farm income in developing countries'. www.fao.org/docrep/w9500e/w9500e12.htm; accessed January 20, 2003.

Felkner, J.S and R.M. Townsend (2004). The Wealth of Villages: An Application of GIS and Spatial Statistics to Two Structural Economic Models. Social Science Computing Services, University of Chicago: www.src.uchicago.edu; accessed May 12, 2004.

Ferreira, L. (1996). 'Poverty and Inequality During Structural Adjustment in Rural Tanzania'. *World Bank Policy Research Working Paper* 1641, August 1996.

Fotheringham, A.S., C. Brunsdon and M. Charlton (2004). *Geographically Weighted Regression.* UK: Wiley and Sons.

Garrett, J. and J. Downen (2001). Rapid Assessments in Urban Areas: Lessons from Bangladesh and Tanzania. FCND Discussion Paper 107 Washington, D.C.: International Food Policy Research Institute.

Geweke, J. (1993). 'Bayesian Treatment of the Independent Student t Linear Model', *Journal of Applied Econometrics*, Vol. 8,pp. 19-40.

Haining, R. (1993). *Spatial data analysis in the social and environmental sciences.* New York: Cambridge University Press

Hall, G. *et al*. (undated). Problems and Prospects for GIS-based Decision Support Applications in Developing Countries. Faculty of Environmental Studies, University of Waterloo, Ontario www.fes.uwaterloo.ca/Tools/docs/saj1.pdf; accessed May 23, 2004.

Hall, G. *et al.* (1997). 'GIS-based Decision Support Architecture and Applications for Developing Countries'. *South African Journal of Geo-Information*, Vol 17 Part 3.

Isgut, A. (2003). Nonfarm income and employment in rural Honduras: Assessing the role of locational factors. Department of Economics, Wesleyan University, Middletown. Available on http://aisgut.web.wesleyan.edu/papers/Hnd98.v5.pdf; accessed May 23, 2003.

Jakle, J.A. *et al*. (1976). *Human spatial behavior: A social geography.* Massachusetts: Duxbury.

Janvry, A. *et al*. (1991). 'Peasant Household Behavior with Missing Markets: Some Paradoxes Explained'. *The Economic Journal* 101: 1400-1417.

Janvry, A. and E. Sadoulet (1995). 'Household Modeling for the Design of Poverty Alleviation Strategies'. *Revue d'Economie du Développement*, Vol.3, (1995), pp. 3-23.

Jeong, H. and R. M Townsend (2003). Models of growth and inequality: an evaluation, National Opinion Research Center, University of Chicago. www.uchicago.edu/~akkaraiv/devdyn3a.pd; accessed May 12, 2004.

Kaboski, J. and R.M. Townsend (2002). Policies and Impact: An Evaluation of Village-Level Microfinance Institutions. Department of Economics, University of Chicago: www.uchicago.edu/~akkaraiv/devdyn3a.pd; accessed May 12, 2004.

Khan, R. and P.F. Orazem and D.M. Ottoa (1998). Deriving Empirical Definitions of Spatial Labor Markets: The Roles of Competing Versus Complementary Growth. Department of Economics, Iowa State University. http://www.econ.iastate.edu/research/webpapers/NDN0019.pdf; accessed April 19, 2004.

Kumar, L and D. Misra (2003). GIS Based application for Rural Development - A Policy Warranted. CMRI and Central Mining Research Institute, Jharkhand: www.GISdevelopment.net; accessed May 12, 2004.

Lanjouw, P. (1998). "Rural Nonfarm Employment and Poverty: Evidence from Household Survey Data in Latin America." World Bank, Development Research Group, Washington, DC.

Lanjouw, P. and A. Shariff (1999). Rural poverty and non-farm employment in India: evidence from survey data. Mimeo. Department of Development Economics. Amsterdam: Free University of Amsterdam.

Leavy, J. and H. White (2003). Rural labor markets and poverty in Sub-Saharan Africa. Working paper, Institute of Development Studies, University of Sussex.

LeSage, J. (1999). Spatial Econometrics, Department of Economics, University of Toledo. http://www.spatial-econometrics.com/; accessed April 1, 2001.

LeSage,J.P. (1997). "Bayesian estimation of spatial autoregressive models", *International Regional Science Review*, Vol. 20,pp. 113-129.

Lofgren, H. and S. Robinson (1999). To Trade or not to Trade: Non-separable Farm Household Models in Partial and General Equilibrium TMD Discussion Paper No. 37, International Food Policy Research Institute.

Loughran, D. and L. Pritchett (1997). Environmental Scarcity, Resource Collection, and the Demand for Children in Nepal. Poverty, Environment, and Growth, World Bank.

Mduma, J. (2003). Village Level Analysis of the Factors Affecting Households' Participation in Rural Labor Markets in Tanzania. Center for Development Research, University of Bonn. Available at www.pasad.uni-bonn.de/pubs.htm; accessed April 13, 2004.

Minot, N. and B. Baulch (2003). Poverty Mapping with Aggregate Census Data: What is the Loss in Precision? MSSD Discussion Paper No. 49. International Food Policy Research Institute (IFPRI). http://www.ifpri.org/divs/mtid/dp/papers/mssdp49.pdf; accessed July 5, 2004.

NBS (2001). The Intergrated Labor Force Survey, 2000/2001 Preliminary Report For Three Quarters. Tanzania National Bureau of Statistics, Dar es Salaam.

NBS (2002). *Household Budget Survey 2000/01*. Tanzania National Bureau of Statistics, Dar es Salaam.

Pace, K.R. *et al*. (2000). "A Method for Spatial-Temporal Forecasting with an Application to Real Estate Prices," *International Journal of Forecasting*, Vol. 16, (2) pp. 229-246(18).

Pace K.R and J.P. LeSage (2003). "Likelihood Dominance Spatial Inference," *Geographical Analysis*, Vol. 35, No. 2.

Pace K.R. and D. Zau (2002). "Closed Form Maximum Likelihood Estimates of the Nearest Neighbor Spatial Dependence". *Geographical Analysis*, Vol. 32 (2).

Pace, K.R. and B.S, Sirmans (forthcoming), "Simultaneous Spatial and Functional Form Transformations," *Advances in Spatial Econometrics*, Florax and Anselin, Editors. http://www.spatial-statistics.com/pace_manuscripts.df.

Pace, R. K., and J. LeSage (2002). "Semiparametric Maximum Likelihood Estimates of Spatial Dependence", *Geographical Analysis*, 34, 75–90.

Pace, R.K. and R. Barry (1997). "Sparse Spatial Autoregressions", *Statistics and Probability Letters*, Vol. 33(3) pp. 291-297.

Reardon, T., J. Berdegué, and G. Escobar (2001). 'Rural Nonfarm Employment and Incomes in Latin America: Overview and Policy Implications', *World Development,* Vol.29, No.3, pp.395-409.

Renkow, M., (forthcoming). 'Rural non-farm employment and spatial economics', in P. Hazell, S. Haggblade and T. Reardon (eds.), Rural non-farm employment in developing countries, New York: Oxford University Press.

Rosenzweig, M.R. (1988). "Labor Markets in Low Income Countries". In H. Chenery and T.N. Srinivasan (eds), *Handbook of Development Economics*, Volume 1, Amsterdam: Elsevier Science Publisher B.V. pp 713-762.

Ruben, R. and M. van den Berg (2001). 'Nonfarm employment and poverty alleviation of rural farm households in Honduras', *World Development*, Vol.29, No.3, pp.549- 560.

Rudengren, J. (1973). Spatial differentiation at ward level: the case of Kahe-Kilimanjaro, region. Vol.4. Dar es Salaam: East African Universities.

Seebens, H. and W. Wobst (2003a). The Impact of Increased School Enrolment on Economic Growth in Tanzania, ZEF-Discussion Papers on Development Policy No. 74, Center for Development Research (ZEF), Bonn, October 2003

Seebens, H. and P. Wobst (2003b). Social and Individual Costs of Child Labor. Presented at the International Conference on Policy Modeling (EcoMod2003), Istanbul, July 5-6, 2003.

Sharif, M. (1991). "Poverty and the forward-falling labor supply function: a microeconomic analysis, *World Development*, Vol (19), No. 8, pp1075-1093.

Singh, I., L. Squire, and J. Strauss (1986). *Agricultural Household Models: Extensions, Applications, and Policy.* The Johns Hopkins University Press, Baltimore and London.

Sorton, S.; R. Kenbur, and D. Mazumdar (1994). *Labor Markets in an Era of Adjustment*, Volume I Issues Paper. Economic Development Institute of the World Bank, Washington, DC.

Sparrow, R., P. Lanjouw, and J. Quizon (2001). "Non-agricultural Earnings in Peri-urban Areas of Tanzania: Evidence from Household Survey Data". *Food Policy* (26) 385–403.

Stiglitz, J. and Weiss, A. (1881). Credit Rationing in Markets with Imperfect Information. *American Economic Review* 71(3) 392-410.

Taylor, J. E. and I. Adelman (2003). Agricultural Household Models: Genesis, Evolution, and Extensions, *Review of Economics of the Household*, Volume 1, Issue 1-2.

URT (1997). Mbeya Region: Socio-Economic Profile. Planning Commission, Dar es Salaam and Regional Commissioner's Office, Mbeya.

URT (1998). Kilimanjaro Region: Socio-Economic Profile. Planning Commission, Dar es Salaam and Regional Commissioner's Office, Kilimanjaro.

URT (2000). Poverty Reduction Strategy Paper. The United Republic of Tanzania, Dar es Salaam.

URT (2002a). Poverty and Human Development Report 2002. United Republic of Tanzania. Mkuki na Nyota Publishers Dar es Salaam.

URT (2002b). Kilimanjaro Region: Socio-Economic Profile. Planning Commission, Dar es Salaam and Regional Commissioner's Office, Mbeya.

USAID (2004). FEWS Tanzania Food Security Report: January 2004. US Agency for International Development. http://www.reliefweb.int/w/rwb.nsf; accessed March 31, 2004.

VPO (1999). Proposed national action program to combat desertification. Vice President Office. Dar es Salaam.

Woldehanna, T. (2000). Economic Analysis and Policy Implications of Farm and Off-farm Employment: A Case Study in the Tigray Region of Northern Ethiopia PhD thesis, Wageningen University.

Wood *et al*. (1999). Spatial Aspects of the Design and Targeting of Agricultural Development Strategies. EPTD Discussion Paper No. 44, Environment and Production Technology Division, International Food Policy Research Institute, Washington DC.

World Bank (1999). Policy Options for Employment in the Rural Non-Farm Sector. *Rural Development Note* No. 4, November.

World Bank (2003). *Reaching the Rural Poor*. Washington D.C.: World Bank.

Yao, Y. (2001). Egalitarian Land Distribution and Labor Migration in Rural China. China Center for Economic Research, Beijing University, Beijing http://www.ccer.edu.cn /download/478-2.pdf; accessed on December 9, 2003.

Zucula, P.F and J. Massinga (1992). The Determinants of Household Income and Consumption in Rural Nampula Province: Implications for Food Security and Agricultural Policy Reform. Working Paper N0. 6, MOA/MSU/UA Research Team, Maputo.

The following papers have been published so far:

No. 1	Ulrike Grote, Arnab Basu, Diana Weinhold	Child Labor and the International Policy Debate Zentrum für Entwicklungsforschung (ZEF), Bonn, September 1998, pp. 47.
No. 2	Patrick Webb, Maria Iskandarani	Water Insecurity and the Poor: Issues and Research Needs Zentrum für Entwicklungsforschung (ZEF), Bonn, Oktober 1998, pp. 66.
No. 3	Matin Qaim, Joachim von Braun	Crop Biotechnology in Developing Countries: A Conceptual Framework for Ex Ante Economic Analyses Zentrum für Entwicklungsforschung (ZEF), Bonn, November 1998, pp. 24.
No. 4	Sabine Seibel, Romeo Bertolini, Dietrich Müller-Falcke	Informations- und Kommunikationstechnologien in Entwicklungsländern Zentrum für Entwicklungsforschung (ZEF), Bonn, January 1999, pp. 50.
No. 5	Jean-Jacques Dethier	Governance and Economic Performance: A Survey Zentrum für Entwicklungsforschung (ZEF), Bonn, April 1999, pp. 62.
No. 6	Mingzhi Sheng	Lebensmittelhandel und Kosumtrends in China Zentrum für Entwicklungsforschung (ZEF), Bonn, May 1999, pp. 57.
No. 7	Arjun Bedi	The Role of Information and Communication Technologies in Economic Development – A Partial Survey Zentrum für Entwicklungsforschung (ZEF), Bonn, May 1999, pp. 42.
No. 8	Abdul Bayes, Joachim von Braun, Rasheda Akhter	Village Pay Phones and Poverty Reduction: Insights from a Grameen Bank Initiative in Bangladesh Zentrum für Entwicklungsforschung (ZEF), Bonn, June 1999, pp. 47.
No. 9	Johannes Jütting	Strengthening Social Security Systems in Rural Areas of Developing Countries Zentrum für Entwicklungsforschung (ZEF), Bonn, June 1999, pp. 44.
No. 10	Mamdouh Nasr	Assessing Desertification and Water Harvesting in the Middle East and North Africa: Policy Implications Zentrum für Entwicklungsforschung (ZEF), Bonn, July 1999, pp. 59.
No. 11	Oded Stark, Yong Wang	Externalities, Human Capital Formation and Corrective Migration Policy Zentrum für Entwicklungsforschung (ZEF), Bonn, August 1999, pp. 17.

No. 12	John Msuya	Nutrition Improvement Projects in Tanzania: Appropriate Choice of Institutions Matters Zentrum für Entwicklungsforschung (ZEF), Bonn, August 1999, pp. 36.
No. 13	Liu Junhai	Legal Reforms in China Zentrum für Entwicklungsforschung (ZEF), Bonn, August 1999, pp. 90.
No. 14	Lukas Menkhoff	Bad Banking in Thailand? An Empirical Analysis of Macro Indicators Zentrum für Entwicklungsforschung (ZEF), Bonn, August 1999, pp. 38.
No. 15	Kaushalesh Lal	Information Technology and Exports: A Case Study of Indian Garments Manufacturing Enterprises Zentrum für Entwicklungsforschung (ZEF), Bonn, August 1999, pp. 24.
No. 16	Detlef Virchow	Spending on Conservation of Plant Genetic Resources for Food and Agriculture: How much and how efficient? Zentrum für Entwicklungsforschung (ZEF), Bonn, September 1999, pp. 37.
No. 17	Arnulf Heuermann	Die Bedeutung von Telekommunikationsdiensten für wirtschaftliches Wachstum Zentrum für Entwicklungsforschung (ZEF), Bonn, September 1999, pp. 33.
No. 18	Ulrike Grote, Arnab Basu, Nancy Chau	The International Debate and Economic Consequences of Eco-Labeling Zentrum für Entwicklungsforschung (ZEF), Bonn, September 1999, pp. 37.
No. 19	Manfred Zeller	Towards Enhancing the Role of Microfinance for Safety Nets of the Poor Zentrum für Entwicklungsforschung (ZEF), Bonn, October 1999, pp. 30.
No. 20	Ajay Mahal, Vivek Srivastava, Deepak Sanan	Decentralization and Public Sector Delivery of Health and Education Services: The Indian Experience Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2000, pp. 77.
No. 21	M. Andreini, N. van de Giesen, A. van Edig, M. Fosu, W. Andah	Volta Basin Water Balance Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2000, pp. 29.
No. 22	Susanna Wolf, Dominik Spoden	Allocation of EU Aid towards ACP-Countries Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2000, pp. 59.

No. 23	Uta Schultze	Insights from Physics into Development Processes: Are Fat Tails Interesting for Development Research? Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2000, pp. 21.
No. 24	Joachim von Braun, Ulrike Grote, Johannes Jütting	Zukunft der Entwicklungszusammenarbeit Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2000, pp. 25.
No. 25	Oded Stark, You Qiang Wang	A Theory of Migration as a Response to Relative Deprivation Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2000, pp. 16.
No. 26	Doris Wiesmann, Joachim von Braun, Torsten Feldbrügge	An International Nutrition Index – Successes and Failures in Addressing Hunger and Malnutrition Zentrum für Entwicklungsforschung (ZEF), Bonn, April 2000, pp. 56.
No. 27	Maximo Torero	The Access and Welfare Impacts of Telecommunications Technology in Peru Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2000, pp. 30.
No. 28	Thomas Hartmann-Wendels Lukas Menkhoff	Could Tighter Prudential Regulation Have Saved Thailand's Banks? Zentrum für Entwicklungsforschung (ZEF), Bonn, July 2000, pp. 40.
No. 29	Mahendra Dev	Economic Liberalisation and Employment in South Asia Zentrum für Entwicklungsforschung (ZEF), Bonn, August 2000, pp. 82.
No. 30	Noha El-Mikawy, Amr Hashem, Maye Kassem, Ali El-Sawi, Abdel Hafez El-Sawy, Mohamed Showman	Institutional Reform of Economic Legislation in Egypt Zentrum für Entwicklungsforschung (ZEF), Bonn, August 2000, pp. 72.
No. 31	Kakoli Roy, Susanne Ziemek	On the Economics of Volunteering Zentrum für Entwicklungsforschung (ZEF), Bonn, August 2000, pp. 47.
No. 32	Assefa Admassie	The Incidence of Child Labour in Africa with Empirical Evidence from Rural Ethiopia Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2000, pp. 61.
No. 33	Jagdish C. Katyal, Paul L.G. Vlek	Desertification - Concept, Causes and Amelioration Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2000, pp. 65.

No. 34	Oded Stark	On a Variation in the Economic Performance of Migrants by their Home Country's Wage Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2000, pp. 10.
No. 35	Ramón Lopéz	Growth, Poverty and Asset Allocation: The Role of the State Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2001, pp. 35.
No. 36	Kazuki Taketoshi	Environmental Pollution and Policies in China's Township and Village Industrial Enterprises Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2001, pp. 37.
No. 37	Noel Gaston, Douglas Nelson	Multinational Location Decisions and the Impact on Labour Markets Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2001, pp. 26.
No. 38	Claudia Ringler	Optimal Water Allocation in the Mekong River Basin Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2001, pp. 50.
No. 39	Ulrike Grote, Stefanie Kirchhoff	Environmental and Food Safety Standards in the Context of Trade Liberalization: Issues and Options Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2001, pp. 43.
No. 40	Renate Schubert, Simon Dietz	Environmental Kuznets Curve, Biodiversity and Sustainability Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2001, pp. 30.
No. 41	Stefanie Kirchhoff, Ana Maria Ibañez	Displacement due to Violence in Colombia: Determinants and Consequences at the Household Level Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2001, pp. 45.
No. 42	Francis Matambalya, Susanna Wolf	The Role of ICT for the Performance of SMEs in East Africa – Empirical Evidence from Kenya and Tanzania Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2001, pp. 30.
No. 43	Oded Stark, Ita Falk	Dynasties and Destiny: On the Roles of Altruism and Impatience in the Evolution of Consumption and Bequests Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2001, pp. 20.
No. 44	Assefa Admassie	Allocation of Children's Time Endowment between Schooling and Work in Rural Ethiopia Zentrum für Entwicklungsforschung (ZEF), Bonn, February 2002, pp. 75.

No. 45	Andreas Wimmer, Conrad Schetter	Staatsbildung zuerst. Empfehlungen zum Wiederaufbau und zur Befriedung Afghanistans. (German Version) State-Formation First. Recommendations for Reconstruction and Peace-Making in Afghanistan. (English Version) Zentrum für Entwicklungsforschung (ZEF), Bonn, April 2002, pp. 27.
No. 46	Torsten Feldbrügge, Joachim von Braun	Is the World Becoming A More Risky Place? - Trends in Disasters and Vulnerability to Them – Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2002, pp. 42
No. 47	Joachim von Braun, Peter Wobst, Ulrike Grote	"Development Box" and Special and Differential Treatment for Food Security of Developing Countries: Potentials, Limitations and Implementation Issues Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2002, pp. 28
No. 48	Shyamal Chowdhury	Attaining Universal Access: Public-Private Partnership and Business-NGO Partnership Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2002, pp. 37
No. 49	L. Adele Jinadu	Ethnic Conflict & Federalism in Nigeria Zentrum für Entwicklungsforschung (ZEF), Bonn, September 2002, pp. 45
No. 50	Oded Stark, Yong Wang	Overlapping Zentrum für Entwicklungsforschung (ZEF), Bonn, August 2002, pp. 17
No. 51	Roukayatou Zimmermann, Matin Qaim	Projecting the Benefits of Golden Rice in the Philippines Zentrum für Entwicklungsforschung (ZEF), Bonn, September 2002, pp. 33
No. 52	Gautam Hazarika, Arjun S. Bedi	Schooling Costs and Child Labour in Rural Pakistan Zentrum für Entwicklungsforschung (ZEF), Bonn October 2002, pp. 34
No. 53	Margit Bussmann, Indra de Soysa, John R. Oneal	The Effect of Foreign Investment on Economic Development and Income Inequality Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2002, pp. 35
No. 54	Maximo Torero, Shyamal K. Chowdhury, Virgilio Galdo	Willingness to Pay for the Rural Telephone Service in Bangladesh and Peru Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2002, pp. 39
No. 55	Hans-Dieter Evers, Thomas Menkhoff	Selling Expert Knowledge: The Role of Consultants in Singapore´s New Economy Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2002, pp. 29

No. 56	Qiuxia Zhu Stefanie Elbern	Economic Institutional Evolution and Further Needs for Adjustments: Township Village Enterprises in China Zentrum für Entwicklungsforschung (ZEF), Bonn, November 2002, pp. 41
No. 57	Ana Devic	Prospects of Multicultural Regionalism As a Democratic Barrier Against Ethnonationalism: The Case of Vojvodina, Serbia´s "Multiethnic Haven" Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2002, pp. 29
No. 58	Heidi Wittmer Thomas Berger	Clean Development Mechanism: Neue Potenziale für regenerative Energien? Möglichkeiten und Grenzen einer verstärkten Nutzung von Bioenergieträgern in Entwicklungsländern Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2002, pp. 81
No. 59	Oded Stark	Cooperation and Wealth Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2003, pp. 13
No. 60	Rick Auty	Towards a Resource-Driven Model of Governance: Application to Lower-Income Transition Economies Zentrum für Entwicklungsforschung (ZEF), Bonn, February 2003, pp. 24
No. 61	Andreas Wimmer Indra de Soysa Christian Wagner	Political Science Tools for Assessing Feasibility and Sustainability of Reforms Zentrum für Entwicklungsforschung (ZEF), Bonn, February 2003, pp. 34
No. 62	Peter Wehrheim Doris Wiesmann	Food Security in Transition Countries: Conceptual Issues and Cross-Country Analyses Zentrum für Entwicklungsforschung (ZEF), Bonn, February 2003, pp. 45
No. 63	Rajeev Ahuja Johannes Jütting	Design of Incentives in Community Based Health Insurance Schemes Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2003, pp. 27
No. 64	Sudip Mitra Reiner Wassmann Paul L.G. Vlek	Global Inventory of Wetlands and their Role in the Carbon Cycle Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2003, pp. 44
No. 65	Simon Reich	Power, Institutions and Moral Entrepreneurs Zentrum für Entwicklungsforschung (ZEF), Bonn, March 2003, pp. 46
No. 66	Lukas Menkhoff Chodechai Suwanaporn	The Rationale of Bank Lending in Pre-Crisis Thailand Zentrum für Entwicklungsforschung (ZEF), Bonn, April 2003, pp. 37

No. 67	Ross E. Burkhart Indra de Soysa	Open Borders, Open Regimes? Testing Causal Direction between Globalization and Democracy, 1970-2000 Zentrum für Entwicklungsforschung (ZEF), Bonn, April 2003, pp. 24
No. 68	Arnab K. Basu Nancy H. Chau Ulrike Grote	On Export Rivalry and the Greening of Agriculture – The Role of Eco-labels Zentrum für Entwicklungsforschung (ZEF), Bonn, April 2003, pp. 38
No. 69	Gerd R. Rücker Soojin Park Henry Ssali John Pender	Strategic Targeting of Development Policies to a Complex Region: A GIS-Based Stratification Applied to Uganda Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2003, pp. 41
No. 70	Susanna Wolf	Private Sector Development and Competitiveness in Ghana Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2003, pp. 29
No. 71	Oded Stark	Rethinking the Brain Drain Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2003, pp. 17
No. 72	Andreas Wimmer	Democracy and Ethno-Religious Conflict in Iraq Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2003, pp. 17
No. 73	Oded Stark	Tales of Migration without Wage Differentials: Individual, Family, and Community Contexts Zentrum für Entwicklungsforschung (ZEF), Bonn, September 2003, pp. 15
No. 74	Holger Seebens Peter Wobst	The Impact of Increased School Enrollment on Economic Growth in Tanzania Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2003, pp. 25
No. 75	Benedikt Korf	Ethnicized Entitlements? Property Rights and Civil War in Sri Lanka Zentrum für Entwicklungsforschung (ZEF), Bonn, November 2003, pp. 26
No. 76	Wolfgang Werner	Toasted Forests – Evergreen Rain Forests of Tropical Asia under Drought Stress Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2003, pp. 46
No. 77	Appukuttannair Damodaran Stefanie Engel	Joint Forest Management in India: Assessment of Performance and Evaluation of Impacts Zentrum für Entwicklungsforschung (ZEF), Bonn, October 2003, pp. 44

No. 78	Eric T. Craswell Ulrike Grote Julio Henao Paul L.G. Vlek	Nutrient Flows in Agricultural Production and International Trade: Ecology and Policy Issues Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 62
No. 79	Richard Pomfret	Resource Abundance, Governance and Economic Performance in Turkmenistan and Uzbekistan Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 20
No. 80	Anil Markandya	Gains of Regional Cooperation: Environmental Problems and Solutions Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 24
No. 81	Akram Esanov, Martin Raiser, Willem Buiter	Gains of Nature's Blessing or Nature's Curse: The Political Economy of Transition in Resource-Based Economies Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 22
No. 82	John M. Msuya Johannes P. Jütting Abay Asfaw	Impacts of Community Health Insurance Schemes on Health Care Provision in Rural Tanzania Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 26
No. 83	Bernardina Algieri	The Effects of the Dutch Disease in Russia Zentrum für Entwicklungsforschung (ZEF), Bonn, January 2004, pp. 41
No. 84	Oded Stark	On the Economics of Refugee Flows Zentrum für Entwicklungsforschung (ZEF), Bonn, February 2004, pp. 8
No. 85	Shyamal K. Chowdhury	Do Democracy and Press Freedom Reduce Corruption? Evidence from a Cross Country Study Zentrum für Entwicklungsforschung (ZEF), Bonn, March2004, pp. 33
No. 86	Qiuxia Zhu	The Impact of Rural Enterprises on Household Savings in China Zentrum für Entwicklungsforschung (ZEF), Bonn, May 2004, pp. 51
No. 87	Abay Asfaw Klaus Frohberg K.S.James Johannes Jütting	Modeling the Impact of Fiscal Decentralization on Health Outcomes: Empirical Evidence from India Zentrum für Entwicklungsforschung (ZEF), Bonn, June 2004, pp. 29

No. 88	Maja B. Micevska Arnab K. Hazra	The Problem of Court Congestion: Evidence from Indian Lower Courts Zentrum für Entwicklungsforschung (ZEF), Bonn, July 2004, pp. 31
No. 89	Donald Cox Oded Stark	On the Demand for Grandchildren: Tied Transfers and the Demonstration Effect Zentrum für Entwicklungsforschung (ZEF), Bonn, September 2004, pp. 44
No. 90	Stefanie Engel Ramón López	Exploiting Common Resources with Capital-Intensive Technologies: The Role of External Forces Zentrum für Entwicklungsforschung (ZEF), Bonn, November 2004, pp. 32
No. 91	Hartmut Ihne	Heuristic Considerations on the Typology of Groups and Minorities Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2004, pp. 24
No. 92	Johannes Sauer Klaus Frohberg Heinrich Hockmann	Black-Box Frontiers and Implications for Development Policy – Theoretical Considerations Zentrum für Entwicklungsforschung (ZEF), Bonn, December 2004, pp. 38
No. 93	Hoa Nguyen Ulrike Grote	Agricultural Policies in Vietnam: Producer Support Estimates, 1986-2002 ZEF-Discussion Papers on Development Policy No. 93, Center for Development Research (ZEF), Bonn, December 2004
No. 94	Oded Stark You Qiang Wang	Towards a Theory of Self- Segregation as a Response to Relative Deprivation: Steady-State Outcames and Social Welfare ZEF-Discussion Papers on Development Policy No. 94, Center for Development Research (ZEF), Bonn, December 2004
No. 95	Oded Stark	Status Aspirations, Wealth Inequality, and Economic Growth ZEF-Discussion Papers on Development Policy No. 95, Center for Development Research (ZEF), Bonn, February 2005
No. 96	John K. Mduma, Peter Wobst	Village Level Labor Market Development in Tanzania: Evidence from Spatial Econometrics ZEF-Discussion Papers on Development Policy No. 96, Center for Development Research (ZEF), Bonn, January 2005

ISSN: 1436-9931

The papers can be ordered free of charge from:

Zentrum für Entwicklungsforschung (ZEF)
Center for Development Research
Walter-Flex-Str. 3
D – 53113 Bonn, Germany

Phone: +49-228-73-1861
Fax: +49-228-73-1869
E-Mail: zef@uni-bonn.de
http://www.zef.de