

## **The determinants of household expenditures in Savannakhet, Lao PDR: A Seemingly Unrelated Regression analysis**

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### **ABSTRACT**

Household expenditure data are widely used for monitoring the quality of life of household living standards, household wellbeing and consumption/expenditure patterns. We raise three questions for the Savannakhet household: 1. “What are the determinants of the household’s food, education, health and transportation expenditures?” 2. “Does the East-West Economic Corridor or transportation sector significantly relate to the household’s food, education, health and transportation expenditures?” 3. What specific policies could be applied in Savannakhet province to improve household welfare and render consumption patterns more effective? To answer these questions, we test four hypotheses based on the previous literature and development theory on the significance and signs of the determinants of household expenditures using seemingly unrelated regression techniques. All four hypotheses are rejected. This important finding implies that the previous literature and broad economic theory are inadequate guides to development in the specific context of present-day Savannakhet; and that the type of research reported in this paper is often essential in developing economies if policies are to be correctly formulated.

*Keywords:* Lao PDR, Poverty, household expenditures, Seemingly Unrelated Regression.

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## 1. Introduction

Although Lao PDR is one of the economically least developed countries in the world -- the United Nations Human Development Index 2010 ranked it 122 out of 169 countries -- it was nonetheless “*one of the 10 ‘top movers’ in the world in terms of progress on human development over the past 20 years*” (<http://www.ruralpovertyportal.org>). Since the introduction of economic reforms in the mid-1980s, the head-count ratio (or “incidence of poverty”) dropped from 39% of the population in the mid-1990s to 27.6 % in 2010; while the country enjoyed rapid economic growth, with the annual GDP rising from 4.1% in 1999 to 7.9 % in 2010 (International Monetary Fund, 2011). Although still the least developed economy in the Greater Mekong Subregion (GMS), Lao’s social indicators have been significantly improved as the economy has become more fully interconnected with the economies of neighboring countries. Indeed, Laos has set the goal of eliminating poverty by 2015 and graduating from least developed country status by 2020 (IUCN and NERI, 2011).

As a transition economy moving from central planning to a greater role of markets, Lao PDR also stands to benefit more fully from regional growth than the other members of the GMS and the ASEAN community. One engine of that growth is the 1,450-km long East West Economic Corridor (EWEC), which traverses four countries and links the Central Region of Lao PDR with Thailand and Vietnam through Savannakhet. The EWEC connects with other main north-south and east-west roads, including the Yangon – Dawei road in Myanmar, the Tak – Mukdahan road in Thailand, Road 9 in Savannakhet, Laos PDR, and the Quang Tri - Danang City road in Vietnam. The asserted aim of the EWEC initiative is to help develop trade toward the north and the south to the major commercial centers of Bangkok and Ho Chi Minh, bringing practical and long-term benefits to the member countries (ADB, 2008). Additionally, the EWEC is a gateway to ASEAN regional and international markets that will shorten the length access time to seaports in the region and beyond. All of these benefits will tend both to improve economic welfare and to make consumption patterns more efficient.

For developing countries, consumption quantities and expenditure values are important factors to be considered for the measurement and evaluation of welfare because they vary much less and are less subject to over- or under-reporting in household surveys than direct measures of income. Furthermore, household expenditure data directly reflect consumers’ purchasing power and lifestyles. Indeed, the “*correlation between consumer demographics and expenditure on recreation, hobbies and travelling reveals are the driving factors of spending*” (MGP Information Systems Ltd., 2012). Therefore, it is common for consumption to be used as a proxy for overall expenditure and in turn as a superior measure of well-being than income (Committee for planning and cooperation national statistical centre, 2011).

Economic theory holds that household expenditures depend upon income, relative prices, household size and composition, particular needs associated with location, cultural demands, and personal preferences. Thus, low budgets or rising prices may strain consumption and lead to major social inequalities. Three major reasons lead economists to analyze inequalities and determinants of household:

- 1) *“at a most general level it may provide insights into general consumption behavior as a major source of human well-being and respective choices and restrictions;*
- 2) *investigating household expenditures and consumption patterns is considered to be the key for the monitoring and explanation of inequalities and changes in material living standards and general welfare;*
- 3) *studying expenditures and consumption behavior of private households also seems to be an important and promising strategy to extend and supplement mainstream approaches of studying inequality as a key topic of sociological and economic research”* (Noll, 2007).

The Committee for Planning and Cooperation of the National Statistical Centre (2011) has analyzed household expenditure and consumption data from the LECS4.<sup>2</sup> They have concluded that during the five years from 2002-2003 to 2007-2008, average household consumption per month has increased from 1.09 million to 2.17 million kip. A high share (22.7%) of Lao households' expenditure goes to food. But during the last 15 years, it can be noted that this expenditure has dropped substantially, as compared to 64.3% in 1992-1993. Over the same period, the consumption of transport and telecommunication services has soared from 6% to 19.8%.

Furthermore, the expenditure on education and recreation activities is also increasing as a proportion of total consumption, while the consumption of alcohol and tobacco as well as medical care has declined. This could be an indication that the reduction of smoking and drinking alcohol in Laos will make them become much healthier. Over the past 5 years, Laos have oriented their consumption more towards goods and services than food. This implies that *“the living conditions of the people have been improved and it indicates that the Lao people are on the path of overcoming poverty, on a gradual basis. Typically, poor people have to spend a higher share of their consumption on food”* (Committee for planning and cooperation national statistical centre, 2011). These are all potentially positive signs of movement towards the consumption patterns of middle-income countries.

## 2. Scope of the study

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<sup>2</sup> We wish to thank Professor David Roland Holst for his enormous help in accessing this database.

Against this general background, the coverage of the present research study will be limited to only the Savannakhet, Laos PDR segment of the economic corridor. Savannakhet Province lies at the centre of Laos at the junction of the East West Economic Corridor (Road no. 9) and the North-South Axis (Road no. 13). Savannakhet population of 843 thousand represents one-twelfth of the national population (2011) on one-ninth of the national area (21,774 sq km.). Although the Lao government has given top priority to road infrastructural development, a full one-tenth of the population (84,000 people in 14,286 households) still lives below the poverty line. Studying the patterns and structure of expenditures to explain the inequalities and living standards of households thus becomes a key pre-condition to the formulation and/or realignment development policies.

### **3. Goal of the study**

The overall goal of this paper is to identify, sign, and test the significance of the determinants of food, education, health and transportation expenditures for rural, semi-urban and urban households in Savannakhet Province. The specific objectives of will be to

- 1) Measure the extent to which the EWEC or transportation sectors significantly related to the household's food, education, health and transportation expenditures.
- 2) Formulate recommendations for public and private-sector policies that could enhance the welfare effects of the EWEC initiative.

To do so, we shall apply the econometric modeling technique known as Seemingly Unrelated Regression.

### **4. Review of literature**

Since expenditures reflect acquired consumption patterns, they are generally assumed to best reflect a household's permanent income. *"If spending is maintained at a more constant level over time even while incomes are fairly volatile, it may be that spending is a better representation of an individual's average ... income. If so, then disparities in expenditure tell us something about permanent inequalities in living standards and well-being that variation in income cannot"* (Brewer, Goodman, and Leicester 2006: 2 refer to (Noll, 2007).

The Engel coefficient, which expresses the ratio of food to non-food expenditures, could be a crucial tool in evaluating household welfare (Baptiste, 2002), particularly in the early stages of economic development. Indeed, patterns of food consumption reflect income, wealth and behavior/lifestyle. Household expenditures thus point to *"the ability to use and their allocation of income based on their priorities and their level"* (Lar, Calkins, Leeahtam, Wiboonpongse, Phuangsaichai, & Nimanussornkul, 2011). Since the poor spend a proportionately greater percentage of their income on food, the share

of food consumption is one reflection of income distribution, as described by Engel (1857). By extension, the (relatively small) size of non-food consumption is a useful indicator of the severity of poverty (Haq & Bhatti, 2001). Non-food consumption on many items such as housing, utilities, clothing and footwear, furniture and fixtures, and miscellaneous, is significantly different between urban and rural areas. The amounts of non-food consumption in rural households are less than urban households because many items are simply not available (Secretariat of the Pacific Community, 2007). Non-food share in total consumption could be used as a poverty threshold: households whose share was lower than their threshold could be considered poor. Indeed, “*the non-food consumption share is generally found to be increasing function of real income, and thus can be considered a valid welfare indicator*” (Haq & Bhatti, 2001).

In contrast, the previous literature explains the quite varied effects of economic development on health care expenditure, concluding that “*health care expenditure varies widely in different countries with similar levels of economic development, and is even more different in countries with different levels of economic development*” (Wang, 2011). On the one hand, we may expect healthcare costs to rise with economic development and improvement of lifestyles. This is because people will spend more on both *ex ante* prevention and *ex post* sickness and accident treatment because they now have the money to do so. Indeed, healthcare expenditures have been advanced as a potential indicator of life expectancy. On the other hand, we could also reasonably expect health care spending to fall in both absolute and relative terms because economic growth allows people to buy more nutritious food with their increased income; improving their health status and reducing their actual need for healthcare.

Empirical studies have attempted to sort out which of these two effects is strong. Wang (2011) found a positive significant increase of health expenditures in countries with medium and high levels of economic growth. In Vietnam as well, Wagstaff (2007) and Beraldo et al. (2009) found that, while both health and educational expenditures increased as a result of growth, health expenditures rose faster. In these cases, it is clear that the prevention component of healthcare expenditures has increased faster than the treatment part.<sup>3</sup> Yet in China, Wang, Zhang, and Hsiao (2006) showed that households in rural areas are unable to increase their income enough to compensate the rising cost of health care. This causes them to reduce overall consumption, including food consumption.

Travel time and expenditure budgets of households are another key factor for policy makers to consider in their analysis of transportation policy. Yet, as in the case of health care, the relationship between road access and household welfare remains

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<sup>3</sup> Although the effect in terms of disease reduction is clear; the effect of economic growth on the incidence of accidents remains uncertain. Development may increase the danger of injury to the extent that it brings greater use of machines and high-speed vehicles.

complex. On the one hand, we might expect transportation expenditures to decline as improved road quality and public transportation cut travel times, fuel expenditures, and vehicle repair costs. On the other hand, we might expect transportation expenditures to increase as economic development connects remote areas to new household occupations, more urban lifestyles, and greater consumption possibilities. (Dalal, Sikder, & Goulias, 2008).

The standard assumption is that poor road infrastructure, closed access to schools, lack of access to healthcare services, lack of entry onto world markets, etc may lead households to have lower income. Households or farms located at a greater distance from markets are expected to be poorer than those nearer to input and output markets because high transactions costs reduce net incomes. In addition, rural households suffer from poor and unreliable infrastructure compared with urban areas. Because the travel mode choice of rural households are restricted, walking or non-motorized cycling are the only options. Poor road system is caused of the slow development in this area and can thus be used as an indicator to determine the cost for travel of rural passengers.

To sort out these effects Dalal et al. (2008) explored transportation expenditures for subsamples of different income groups and residential environments. Their results showed that households with higher income in urban areas are not negatively affected by their natural and built environments and have opportunities to access most destinations which could increase the transportation expenditures. Meanwhile, the urban poor are limited by distance because most of their travel is on foot. On the other hand, the effects of environmental indicators of rural workers are much weaker, possibly road networks near their area of residence are poorly developed.

## 5. Methods

The ‘seemingly unrelated regression equations (SURE) model’ was developed by Arnold Zellner in 1962. The model is a generalization of a linear regression model that explains a set of dependent variables when error variables are reasonably correlated. Separate analysis of univariate models may lead the covariate effect are inefficient estimate result (Alaba, Olubusoye, & Ojo, 2010). The model can be estimated through equation-by-equation using standard ordinary least squares (OLS) which is well know that the least squares estimators are best linear unbiased estimators by Gauss Markov theorem and maximum likelihood estimators when single equation normal likelihood functions are employed (Zellner, 2006). Thus, ‘seemingly unrelated regression equations (SURE) model’ give us the model that the estimates result are efficient in the coefficients and standard errors.

Following Greene (2002), a seemingly unrelated regressions (SUR) model can be written as (Greene, 2002)

$$y_i = X_i\beta_i + \varepsilon_i \quad i=1,\dots,M$$

Where  $y$  is vector of dependent variables,  $X$  is  $K \times K$  matrix,  $i$  is number of regressors, and  $M$  is the number of equations.

The disturbance formulation is

$$E(\varepsilon_i \varepsilon_j' | X_1, X_2, \dots, X_M) = \sigma_{ij} I_T = \Omega = \begin{bmatrix} \sigma_{11} I & \sigma_{12} I & \dots & \sigma_{1M} I \\ \sigma_{21} I & \sigma_{22} I & \ddots & \sigma_{2M} I \\ \vdots & \vdots & & \vdots \\ \sigma_{M1} I & \sigma_{M2} I & \dots & \sigma_{MM} I \end{bmatrix} = \Sigma \otimes I$$

Where  $\Sigma = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \dots & \sigma_{1M} \\ \sigma_{21} & \sigma_{22} & \ddots & \sigma_{2M} \\ \vdots & \vdots & & \vdots \\ \sigma_{M1} & \sigma_{M2} & \dots & \sigma_{MM} \end{bmatrix}$

$\Sigma$  is variance and covariance matrix.  $\Omega = \Sigma \otimes I$  with  $\Omega^{-1} = \Sigma^{-1} \otimes I$

The generalized regression model applies to the stacked model is written as followings,

$$y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_M \end{bmatrix} = \begin{bmatrix} X_1 & 0 & \dots & 0 \\ 0 & X_2 & \dots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \dots & X_M \end{bmatrix} \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_M \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_M \end{bmatrix} = X\beta + \varepsilon$$

The efficient estimator of SUR is the Generalized Least Squares (GLS). The GLS estimator is given as following,

$$\hat{\beta} = [X' \Omega^{-1} X]^{-1} X' \Omega^{-1} y = (X' (\Sigma^{-1} \otimes I) X)^{-1} X' (\Sigma^{-1} \otimes I) y$$

The important result is in the SUR model, when the error terms are uncorrelated between the equations; truly unrelated and all equations have the same set of regressors, the efficient estimator is single-equation ordinary least squares; OLS is the same as GLS. Hence, for linear SUR models *“it is well known that the greater the correlation of the errors, the greater the efficiency gain when using SUR”* (Alaba, Olubusoye, & Ojo, 2010).

### 6. Data

The primary data for this study were collected in 2011 from households in Savannakhet, Lao PDR. Due to the incomplete nature of the LECSIV database for consumption expenditure analysis, an open ended questionnaire was designed and converted into a closed-form questionnaire and used for household level interviews of 243 households. We focused only on Kaysone Phomvihane district in Savannakhet, the urban district that surrounds the EWEC road as it cuts through the province. Outhoumphone district is also included because it includes the intersection of the EWEC with the north-sound road no.13. The target population is thus limited to households who live along EWEC in both districts. This target population is divided into sub-groups, as well as rural, semi-

urban and urban categories at varying distances in time and kilometers from the EWEC. Data were collected on household characteristics, household revenue and consumption expenditures, and household expenditure on production process.

Given the objective of identifying, signing and testing the significance of the determinants of food, health, transportation and non-food items expenditures by different types of household in Savannakhet Province, we shall endeavour to answer three empirical questions:

- *Do the EWEC and transportation-related sectors significantly affect households' food, health, transportation and non-food items expenditures?"*
- *What are the key policy-operable determinants of the household's expenditures in Savannakhet province?*
- *What specific policies could be applied in Savannakhet province to improve household welfare and render consumption patterns more effective?*

We further formulated four hypotheses for econometric testing:

**Hypothesis 1:** The household's food consumption expenditure share decreases with proximity to the EWEC, income per capita, household size, share of agricultural income and hired labour status.

**Hypothesis 2:** The household's health expenditure share decreases with proximity to the EWEC, landholding per capita, and household size; but increases with income per capita, total workers; and employment in agriculture sector.

**Hypothesis 3:** The household's transportation expenditure share decreases with proximity to the EWEC but increases with income per capita; total workers; share of service or industrial income, and employment in service or hired labour status.

**Hypothesis 4:** The household's non-food items expenditure share increases with proximity to the EWEC, income per capita, total workers, living space per capita, share of non-agricultural income, and employment in service or commercial sectors.

In testing the above hypotheses, we shall also seek to determine whether the age of household head, total years of education of all family members, gender of household head, living in rural or urban vs. semi-urban areas offer further significant determinants of expenditure shares. For all four hypotheses we shall use the econometric model 'seemingly unrelated regression' to identify the significance of the determinants of food, health transportation and non-food items expenditures.

In econometrics, the seemingly unrelated regression equations (SURE) model is a generalization of a linear regression model that explains the variation of not just one dependent variable -- as in the univariate multiple regression models -- but the variation of a set of  $m$  dependent variables. Each equation is a valid linear regression on its own and can be estimated separately, which is why the system is called seemingly unrelated. The OLS estimates are employed in our analysis to explain the dependent variables while ignoring any correlation between the error terms of all equations. If the error

terms are not highly correlated, the separate OLS estimates may be employed independently. If, however, the error terms are reasonably correlated, separate analysis of single equations might lead to an inefficient estimate result in the covariate effect. In this latter case, the seemingly unrelated regression estimator is used to explain a set of dependent variables that leads to efficient parameter estimates (Cadavez & Henningsen, 2011). Moon and Perron (2006) summarized the motivations for the use of Seemingly Unrelated Regression as follow: “*The first reason is to gain efficiency in estimation by combining information on different equations. Second is to impose and/or test restrictions that involve parameters in different equations*” (Moon & Perron, 2006).

The description of dependent variables and the explanatory variable in our equations have been shown in the table 1 and the descriptive statistics of all variable have been shown in the table 2.

TABLE 1: Variables description

<b>Dependent variable</b>	<b>Variable description</b>
FOOD_EXP	Food expenditures as a share of total expenditures
HEALTH_EXP	Healthcare expenditures as a share of total expenditures
TRANS_EXP	Transportation expenditures as a share of total expenditures
NONFOOD_EXP	Non-food items expenditures as a share of total expenditures, including clothing, housing, and miscellaneous items
<b>Explanatory variable</b>	
Y	Income per capita in Lao Kip
AGE	Age of household head
DISTANCE	Distance from the EWEC (km)
EDU	Total year of education of all family members
HHSIZE	Number of household members
LAND	Total agriculture land holding per capita
SPACE	Living space per capita (square meter)
TOTAL_WORKER	Total household worker
SHARE_AGRI	Percent share of income from agriculture based
SHARE_BUSINESS	Percent share of income from business sales
SHARE_FIN	Percent share of income from interest income from financial institution
SHARE_HHINDUS	Percent share of income from household level small industry
SHARE_SERVICE	Percent share of income from service sector
FEMALE	Gender of household head (female=1, other=0)
URBAN	Urban=1, other=0
RURAL	Rural=1, other=0
EM_AGRI	Working in agriculture based (1,0)
EM_COMMERCE	Working in commerce sector (1,0)
EM_HHINDUS	Working in small household industry (1,0)
EM_HIRED	Hired labor (1,0)
EM_SERVICE	Working in service sector (1,0)

TABLE 2: Descriptive statistics

	Mean	Maximum	Minimum	Std. Dev.
Y	18.7 million	810.million	0	65.7 million
AGE	42.8642	65	24	7.0730
DISTANCE	4.9218	45	0	7.6918
EDU	33.1482	94	0	16.1893
TOTAL_WORKER	2.2099	8	0	2.0290
HHSIZE	4.1193	10	1	1.5475
LAND	0.3190	16.6667	0	1.2582
SPACE	62.7814	640	0	98.1362
FEMALE	0.5144	1	0	0.5008
RURAL	0.1111	1	0	0.3149
SEMI	0.3128	1	0	0.4646
URBAN	0.5761	1	0	0.4952
EM_AGRI	0.2716	1	0	0.4457
EM_COMMERCE	0.0782	1	0	0.2690
EM_HHINDUS	0.0329	1	0	0.1788
EM_HIRED	0.2058	1	0	0.4051
EM_SERVICE	0.0412	1	0	0.1991
SHARE_AGRI	0.2266	1	0	0.4026
SHARE_BUSINESS	0.0521	1	0	0.2133
SHARE_FIN	0.1220	1	0	0.3091
SHARE_HHINDUS	0.0474	1	0	0.2003
SHARE_SERVICE	0.1516	1	0	0.3477
FOOD_EXP	0.4273	1	0	0.2793
NONFOOD_EXP	0.1623	1	0	0.1674
HEALTH_EXP	0.0271	0.2096	0	0.0374
TRANS_EXP	0.3713	0.9992	0	0.3303

### Dependent variable

Expenditures are key factors to be considered for measurement and evaluation of welfare and to explain inequalities and living standards of households. Expenditures are usually considered to be a better proxy than household income as a development indicator.

Our dependent variables are computed as percentage share expenditures of total expenditure as measures of the living standards of Savannakhet households. In this paper, we estimate equations for four such share expenditures: food, healthcare, transportation, and other non-food items. This last is composed of *clothing* (diapers, shirts, pants, dresses, suits, and footwear), *housing* (shelter, utilities, house furnishings and equipment), *fixtures*, and *miscellaneous* items (personal care items, entertainment, and reading materials)

## Independent variables

Our explanatory variables in the models are household socio-economic variables, demographic variables, location variables and percent share of income variables from many sources. These explanatory variables will be tested to see to what extent they capture household expenditures pattern and the poverty level of vulnerable households. The description of most variables is apparent from table 1.

## 7. Empirical result

First of all, we employed the Ordinary least squares regression to see the household expenditure pattern on each expenditure while ignoring any correlation between the error terms of all four equations. Twenty variables were assumed to determine the share expenditure of food, health care, transportation and non-food items. In this step, we focused only on the absolute variables (income per capita, age of household head, distance of EWEC, total years of education of all members, household size, landholding per capita, living space per capita and total worker) and ignored dummy variables and share of income by source in order to reflect any significant impact on household expenditures. Moreover, we assumed the distance of EWEC played an important role in determining households' food, health, transportation, and non-food item expenditures.

TABLE 3: The ordinary least square regression results for household expenditures.

Variable	Independent variable			
dependent variable	FOOD_EXP	HEALTH_EXP	TEANS_EXP	NON FOOD_EXP
C	<b>0.59***</b> (0.14)	<b>0.03*</b> (0.09)	<b>0.27*</b> (0.16)	0.10 (0.08)
Y	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
AGE	-0.001 (0.003)	0.000 (0.000)	0.002 (0.003)	-0.001 (0.008)
DISTANCE	<b>-0.007**</b> (0.003)	-0.000 (0.001)	0.004 (0.004)	<b>0.004*</b> (0.002)
EDU	0.000 (0.001)	0.000 (0.000)	-0.000 (0.002)	0.001 (0.001)
HHSIZE	<b>-0.04**</b> (0.07)	<b>-0.006**</b> (0.002)	<b>0.05***</b> (0.02)	-0.01 (0.01)
LAND	0.01 (0.01)	-0.003 (0.002)	-0.01 (0.02)	0.001 (0.009)
SPACE	0.000 (0.195)	0.000 (0.000)	-0.000 (0.000)	<b>0.000**</b> (0.000)
TOTAL_WORKER	0.02 (0.01)	<b>0.003*</b> (0.002)	<b>-0.03**</b> (0.01)	<b>0.02**</b> (0.01)
SHARE_AGRI	0.03 (0.05)	-0.004 (0.008)	-0.009 (0.064)	-0.007 (0.034)
SHARE_BUSINESS	0.04 (0.10)	-0.006 (0.014)	-0.10 (0.12)	0.08 (0.06)

SHARE_FIN	-0.07 (0.06)	<b>0.03***</b> <b>(0.01)</b>	0.002 (0.07)	0.04 (0.04)
SHARE_HHINDUS	-0.02 (0.09)	-0.009 (0.013)	-0.07 (0.11)	<b>0.12**</b> <b>(0.06)</b>
SHARE_SERVICE	<b>0.12*</b> <b>(0.06)</b>	0.005 (0.009)	<b>-0.19**</b> <b>(0.07)</b>	0.06 (0.04)
FEMALE	0.01 (0.04)	0.005 (0.005)	-0.05 (0.04)	<b>0.04*</b> <b>(0.02)</b>
URBAN	-0.04 (0.04)	0.006 (0.006)	0.02 (0.05)	0.01 (0.03)
RURAL	<b>0.21*** (0.08)</b>	0.009 (0.010)	<b>-0.24***</b> <b>(0.09)</b>	0.02 (0.05)
EM_AGRI	0.03 (0.05)	0.004 (0.007)	-0.05 (0.06)	0.01 (0.03)
EM_COMMERCE	-0.03 (0.08)	-0.004 (0.010)	0.10 (0.01)	-0.07 (0.05)
EM_HHINDUS	<b>0.24**</b> <b>(0.12)</b>	0.001 (0.068)	<b>-0.34**</b> <b>(0.14)</b>	0.10 (0.07)
EM_HIRED	<b>0.13**</b> <b>(0.06)</b>	-0.01 (0.01)	-0.10 (0.07)	-0.04 (0.03)
EM_SERVICE	0.002 (0.092)	<b>-0.02*</b> <b>(0.01)</b>	0.06 (0.11)	-0.02 (0.06)
R-squared	0.18	0.15	0.19	0.14
Adjusted R-squared	0.10	0.07	0.11	0.06
S.E. of regression	0.26	0.04	0.31	0.16
Akaike info criterion	0.27	-3.72	0.59	-0.71
Schwarz criterion	0.59	-3.40	0.92	-0.39

Note: (1) the result show the coefficient and the standard error is in the parenthesis. (2) \*significant at 1%, \*\*significant at 5%, \*\*\*significant at 10%.

Table 3 shows the ordinary least square regression results of all expenditures. The variables that “significantly affect food expenditure” are the distance from the EWEC and household size. Healthcare expenditures show that household size and total workers “significantly affect healthcare expenditure”. The transportation expenditures show the same significant variables as for healthcare expenditures. And the distance from the EWEC, living space per capita and total workers are “significant in determine non-food items expenditure.”

As the next step, we used the Wald coefficient test to determine whether or not those variables that were not significant in the models should be taken out of the model. This test enables us to add a set of variables to an existing equation and to ask whether the set makes a significant contribution to explaining the variation in the dependent variable. We set up the coefficient of those insignificant variables equal to zero. The null hypothesis was that the additional set of regressors was not jointly significant; which means the coefficients would be equal zero. Whenever those variables are not jointly significant (Quantitative Micro Software, LLC, 2004), we may omit them from each model. The results of the Wald coefficient test are shown in table 4.

TABLE 4: Wald coefficient test result.

Wald Test:	Test Statistic	Value	df	Probability
Equation: FOOD_EXP	F-statistic	0.75	(6, 216)	0.61
	Chi-square	4.47	6	0.61
Equation: HEALTH_EXP	F-statistic	0.33	(6, 216)	0.92
	Chi-square	2.01	6	0.92
Equation: TRANS_EXP	F-statistic	0.95	(6, 216)	0.46
	Chi-square	5.73	6	0.45
Equation: NONFOOD_EXP	F-statistic	0.23	(5, 216)	0.95
	Chi-square	1.14	5	0.95

The Wald coefficient test results showed a high level of probability that prevented us from rejecting the null hypothesis that the insignificant variables were indeed equal to zero. The probabilities of the F-statistic and Chi-squared were not significant at the 5% level. As a result, we cannot reject the null hypothesis that the additional set of regressors is not jointly significant. Thus, we can omit those variables which are not significant in the models.

After putting the restriction by use of the Wald coefficient test, we again employed Ordinary least squares regression to reveal the real pattern of household expenditures, which now included the dummy variables and income shares. The restricted ordinary least square regression results are shown in table 5.

TABLE 5: The restricted ordinary least square regression results.

Variable	Independent variable			
	FOOD_EXP	HEALTH_EXP	TEANS_EXP	NON FOOD_EXP
dependent variable				
C	<b>0.51***</b> (0.08)	<b>0.03***</b> (0.01)	<b>0.36***</b> (0.09)	0.05 (0.03)
DISTANCE	<b>-0.008**</b> (0.003)	-	-	<b>0.004*</b> (0.002)
SPACE	-	-	-	<b>0.000**</b> (0.000)
HHSIZE	<b>-0.03**</b> (0.01)	<b>-0.005***</b> (0.002)	<b>0.048***</b> (0.02)	-
TOTAL_WORKER	-	<b>0.003*</b> (0.002)	<b>-0.03**</b> (0.01)	<b>0.02**</b> (0.01)
SHARE_AGRI	0.03 (0.05)	-0.005 (0.007)	-0.009 (0.063)	-0.009 (0.033)
SHARE_BUSINESS	-0.02 (0.09)	-0.008 (0.012)	-0.04 (0.11)	0.08 (0.06)
SHARE_FIN	-0.07 (0.06)	<b>0.08***</b> (0.01)	0.02 (0.07)	0.04 (0.04)

Variable	Independent variable			
	FOOD_EXP	HEALTH_EXP	TEANS_EXP	NON FOOD_EXP
SHARE_HHINDUS	-0.03 (0.09)	-0.009 (0.012)	-0.08 (0.11)	<b>0.12**</b> <b>(0.06)</b>
SHARE_SERVICE	0.10 (0.06)	0.005 (0.008)	<b>-0.16**</b> <b>(0.07)</b>	<b>0.06*</b> <b>(0.04)</b>
FEMALE	0.0123 (0.04)	0.005 (0.005)	-0.06 (0.04)	<b>0.05**</b> <b>(0.02)</b>
URBAN	-0.04 (0.04)	0.006 (0.006)	0.001 (0.049)	0.02 (0.03)
RURAL	<b>0.21***</b> <b>(0.08)</b>	0.009 (0.009)	<b>-0.20***</b> <b>(0.08)</b>	0.01 (0.05)
EM_AGRI	0.06 (0.05)	0.003 (0.007)	-0.05 (0.06)	0.005 (0.031)
EM_COMMERCE	-0.02 (0.08)	-0.004 (0.010)	0.09 (0.09)	<b>-0.08*</b> <b>(0.05)</b>
EM_HHINDUS	<b>0.25**</b> <b>(0.11)</b>	0.003 (0.02)	<b>-0.34**</b> <b>(0.13)</b>	0.09 (0.07)
EM_HIRED	<b>0.13**</b> <b>(0.05)</b>	-0.01 (0.01)	-0.08 (0.06)	-0.04 (0.03)
EM_SERVICE	0.001 (0.091)	<b>-0.02*</b> <b>(0.01)</b>	0.07 (0.11)	-0.03 (0.06)
R-squared	0.16	0.12	0.17	0.14
Adjusted R-squared	0.11	0.06	0.11	0.08
S.E. of regression	0.26	0.04	0.31	0.16
Akaike info criterion	0.24	-3.78	0.57	-0.75
Schwarz criterion	0.47	-3.56	0.80	-0.50

Note: (1) the result show the coefficient, the standard error is in the parenthesis. (2) \*significant at 1%, \*\*significant at 5%, \*\*\*significant at 10%.

Table 5 shows the restricted ordinary least square regression results. Household's food expenditure depends negatively on the distance from the EWEC and household size as expected and depends positively on living in a rural area, employment in small-scale household industry and hired labor status; which sign is unexpected. This could be households are obliged to take care workers by providing food and beverage. In the case of healthcare expenditures depends positively on total worker as expected and the share of interest income from financial institutions, and also depends negatively on household size as expected and employment in the service sector. Transportation expenditures depends positively on household size and negatively on total workers, share of service sector income, living in a rural area, and employment in small household industry. However, total worker and share of service sector income are unexpected sign from the hypothesis test which could be employers/workers may travel together on the same vehicle and the share of income from service are saves the share of transportation costs.

And non-food item expenditures depends positively on distance from EWEC, living space per capita, total workers, share of income on small household industry and service as expected and female household head. Moreover, employment in the commercial sector is negatively as unexpected.

The dummy variables and shares of incomes that we included in the equations to reflect any significant impact of household expenditures in the models may lead to exact collinearity. The correlation among the equations could come from several sources. Although such estimates are consistent, the estimated results are not efficient as under the SURE method. Thus, Seemingly Unrelated Regression models are appropriate for multivariate regression analysis when error terms are assumed to be correlated.

TABLE 6: the Seemingly Unrelated Regression results

Variable	Independent variable			
dependent variable	FOOD_EXP	HEALTH_EXP	TRANS_EXP	NON FOOD_EXP
C	<b>0.50***</b> (0.07)	<b>0.04***</b> (0.01)	<b>0.39***</b> (0.08)	<b>0.06**</b> (0.03)
DISTANCE	<b>-0.004**</b> (0.002)	-	-	<b>0.004**</b> (0.002)
SPACE	-	-	-	0.000 (0.000)
HHSIZE	<b>-0.03**</b> (0.01)	<b>-0.005**</b> (0.002)	<b>0.03**</b> (0.01)	-
TOTAL_WORKER	-	0.002 (0.002)	<b>-0.02**</b> (0.01)	<b>0.02***</b> (0.01)
SHARE_AGRI	0.04 (0.05)	-0.005 (0.007)	-0.01 (0.06)	-0.01 (0.03)
SHARE_BUSINESS	-0.008 (0.089)	-0.008 (0.012)	-0.04 (0.11)	0.07 (0.05)
SHARE_FIN	-0.07 (0.06)	<b>0.03***</b> (0.01)	0.02 (0.07)	0.03 (0.04)
SHARE_HHINDUS	-0.02 (0.09)	-0.009 (0.012)	-0.08 (0.10)	<b>0.12**</b> (0.05)
SHARE_SERVICE	<b>0.10*</b> (0.06)	0.005 (0.008)	<b>-0.16**</b> (0.07)	0.05 (0.04)
FEMALE	0.01 (0.03)	0.005 (0.005)	-0.06 (0.04)	<b>0.05**</b> (0.02)
URBAN	-0.03 (0.04)	0.006 (0.005)	-0.003 (0.047)	0.02 (0.02)
RURAL	<b>0.17**</b> (0.07)	0.009 (0.009)	<b>-0.20***</b> (0.07)	0.02 (0.04)
EM_AGRI	0.05 (0.05)	0.003 (0.006)	-0.07 (0.05)	0.007 (0.029)
EM_COMMERCE	-0.02 (0.07)	-0.004 (0.010)	0.10 (0.09)	<b>-0.08*</b> (0.04)

Variable	Independent variable			
	FOOD_EXP	HEALTH_EXP	TRANS_EXP	NON FOOD_EXP
EM_HHINDUS	<b>0.25**</b> (0.11)	0.003 (0.015)	<b>-0.34***</b> (0.13)	0.09 (0.07)
EM_HIRED	<b>0.12**</b> (0.05)	-0.01 (0.01)	-0.07 (0.06)	-0.04 (0.03)
EM_SERVICE	0.004 (0.088)	<b>-0.02*</b> (0.01)	0.07 (0.10)	-0.04 (0.05)
R-squared	0.16	0.11	0.16	0.12
Adjusted R-squared	0.10	0.07	0.10	0.06
S.E. of regression	0.26	0.04	0.31	0.16

Note: (1) the result show the coefficient and the standard error is in the parenthesis. (2) \*significant at 1%, \*\*significant at 5%, \*\*\*significant at 10%.

Table 6 shows the Seemingly Unrelated Regression results. Four multiple equation models were developed to simultaneously predict food, healthcare, transportation and non-food items. The choice of the variables was guided by the specification of the hypotheses to be tested.

The variables that significantly affect food expenditures are the same as in the restricted ordinary least square regression results. But the Seemingly Unrelated Regression method finds a significant impact on food expenditure of the share of income from the service sector. So, food expenditure depends negatively on the distance from the EWEC and household size but positively on share of the income from the service sector, living in a rural area, employment in small-scale household industry, the share of service income, and hired labor status.

Within these results, the distance from the EWEC and household size are significant at the 5% with impacts of -0.004 and -0.029, respectively, on the expenditure share spent on food. That distance from the EWEC negatively affects food expenditure is as expected. Food expenditure share increase directly with proximity to the EWEC, implying that the EWEC gives a better opportunity for households to enter input/output markets to diversify their diets and supplement their subsistence production. Consistent with this finding, Jacoby (1998) showed that poorer households in Nepal get more benefit from road improvement in the remote areas. Stone and Strutt (2009) examined the benefits of the development of economic transport corridors. Their results showed the potential benefits of improving land transport and facilitating trade, particularly intra-regional trade within the Greater Mekong Subregion.

Similarly, the negative coefficient on household size is consistent with Lanjouw and Ravallion (1994), who found an inverse negative correlation between size and consumption expense per capita; i.e., even poor households face economies of size in consumption. Having more members increases the likelihood of being a poor household because the bulk purchases of large members reduce the lower cost per person in living standards as individuals are living together rather than separately (Grounder 2011).

Rural residence has a positive impact of 0.1659 on food expenditure, significant affect at the 5% level. Usually rural households consume their own agriculture goods: if not rural people might have more possibilities to use their 0.1659 share expenditure on more food than the urban and semi-urban households. Typically, poor people have to spend a higher share of their consumption on food (Committee for planning and cooperation national statistical centre, 2011).

In addition, the share of income from service (transportation-related sector) is significant at the 10% and increases the share spent on food expenditure by 0.1028. Employment in both small household industry and as hired labor is significant at the 5% level, with positive impacts of 0.2530 and 0.1176, respectively. Households are obliged to take care of such employers/workers by providing food and beverage.

For healthcare expenditures, the table shows the same variables to be significant as with the restricted ordinary least square model, except that total workers are no longer significant. Thus, healthcare expenditures depend positively on the share of interest income from financial institutions, and negatively on household size and employment in the service sector. Specifically, household size is significant at the 5% with a -0.0048 effect on the share spent on healthcare expenditure. Larger families tend to be poorer and less able to pay the same level of health care costs per person as smaller households. The share of interest income from financial institutions is significant at the 1% level with an impact of +0.0273 on healthcare expenditure. Furthermore, increasing employment in the service sector lessens the share of healthcare expenditure by 0.0212. This may be because the service sector offers a less dangerous and healthier environment than other branches of the economy. Furthermore, alcohol and tobacco consumption as well as medical care of Laos have declined which will make them become much healthier (Committee for planning and cooperation national statistical centre, 2011).

The Seemingly Unrelated Regression results for transportation expenditures show the same variables to be significant as in the corresponding restricted ordinary least squares model of transportation expenditure. Thus, transportation expenditure depends positively on household size and negatively on total workers, share of service sector income, living in a rural area, and employment in small household industry.

More specifically, household size has a positive effect at the 5% level of 0.0335, implying that larger families tend to spend more on the cost of transportation. On the other hand, the total number of workers is negatively correlated at the 5% level; having more workers saves 0.0165 on the cost of transportation since workers may travel together on the same vehicle. Living in a rural area is negatively correlated and significant at the 1% level, with a large effect of 0.2015. This is because poor households generally lie at greater distance, where road networks and hence opportunities for travel are poorly developed. Their travel is on foot or animal back

(cow or buffalo). This finding is consistent with Dalal et al. (2008). Additionally, the share of income from service and employment in small household industry are negatively correlated, saving 0.1623 and 0.3446, respectively, in the share of transportation costs.

And non-food item expenditures show the same variables to be significant as in the corresponding restricted ordinary least squares model of non-food expenditure but except the living space per capita and share of income on service which are insignificant. Then, the non-food expenditures are depends positively on distance from EWEC, total workers, small household industry and female household head and negatively on employment in the commerce.

Specifically, the distance from the EWEC and total worker are significant at the 5% with impacts of 0.0043 and 0.0155, respectively, on the expenditure share spent on non-food. More worker need more non-food items for themselves such as clothing which is strongly correlated with household size and household income and housing which is an effective indicator of household's lifestyle (U.S. Department of Agriculture, 2010). Moreover, female household head are spending more on those non-food items with a positive impact of 0.0485 on non-food expenditure. The distance from the EWEC positively affects non-food expenditure is as expected. Non-food expenditure share decrease directly with proximity to the EWEC, implying that the EWEC gives a better opportunity for households to enter input/output markets, consistent with Jacoby (1998) and Stone and Strutt (2009). In addition, the share of income from small industry is significant at the 5% and increases the share spent on non-food expenditure by 0.1223. Employment in commercial sector is significant with negative impact of 0.0787 at the 10% level. Furthermore, Lao have oriented their consumption more towards goods and services than food (Commitee for planning and cooperation national statistical centre, 2011).

Finally, we may observe that the Seemingly Unrelated Regression model result give us efficient estimates; which is less coefficients and standard errors in comparison with the restricted ordinary least squares regression which is improved by Alaba et.al (2010).

## **8. Conclusion**

We have employed the econometric technique seemingly unrelated regression to explore the conditions of well-being and living standards which determine household expenditures in Savannakhet Province, PDR Lao.

Our hypothesis testing has led to rejection of all four of our research hypotheses. Table 7 provides a convenient summary of those findings, with +’s and -’s noted for all significant independent variables. It is clear that very few of the anticipated results (\*’s in Table 7) actually hold true in the Savannakhet region. This important result implies that the previous literature and broad economic theory are inadequate guides to development policy formulation for the specific context of Savannakhet; and that the type of research reported in this paper is often essential in developing economies.

Table 7: Summary of the hypothesis testing.

Hypothesis:	1	2	3	4
Expenditure share in:	Food	Health	Transportation	Non-food
<i>Rejected (R)?</i>	<i>R</i>	<i>R</i>	<i>R</i>	<i>R</i>
Proximity to EWEC	+			-
Income/capita				
Landholding/capita				
Living space/capita				
Household size	-*	-*	+	
Total workers			-	+
Share agricultural income				
Share non-agricultural income				
Share service income	+		-	
Share industry income				+
Share of financial income		+		
Agricultural employment				
Service employment		-		
Hired labour employment	+			
Household industry employment	+		-	
Commerce employment				+*
Significant dummy variables	+Rural		-Rural	+Female

\* signifies a result consistent in both sign and significance with the original formulation of the hypothesis.

Based on Table 7 and the preceding analysis, we are now in a position to answer the three more general questions posed at outset. The first question was *Do the EWEC and transportation-related sectors significantly affect households’ food, health, transportation and non-food items expenditures?* The answer is: yes. Table 6 has shown that the EWEC is indeed significantly related to the household’s food expenditure levels with negatively affect. Consistent with Engel’s law as described by Engel (1857) and Vernon (2004) who found the impact of food expenditures which were affected by household size and food-related time. The EWEC also related to the non-food items expenditure levels with positively affect. The amounts of non-food consumption in rural households who’s located at greater distance are less than urban households because many items are simply not available (Secretariat of the Pacific Community, 2007). Employment in the transportation-related service sector is positively related to food expenditure and negatively related to healthcare expenditure and a hired labor sector is also positively related to food expenditures. Households are obliged to take care of such employers/workers by providing food/beverage and healthcare service for them.

The second question was *“What are the key policy-operable determinants of the household’s expenditures in Savannakhet province?”* We have determined that these variables distance of the EWEC, rural residence, household size, total workers, share of service income, and service employment. In most cases the signs on these significant

variables change from one expenditure category to the next, which is consistent with the theoretical progression of Engel shares over the course of economic development. Similar finding with Vernon (2004) and Gounder (2011) that food expenditures were affected by household size and Wang, Zhang, and Hsiao (2006) that rural households are unable to increase their income enough to compensate the rising cost of health care. However, rural households suffer urban households from poor, unreliable infrastructure and their travel mode choices are restricted. Then, road accessibility would help them to get a better new household occupations, more urban lifestyles, and greater consumption possibilities (Dalal, Sikder, & Goulias, 2008).

The last question is: *What specific policies could be applied in Savannakhet province to improve household welfare and render consumption patterns more effective?* We recommend, first, ongoing improvements in the road system and infrastructure. The accessibility to road would help households acquire a better education, a minimal standard of healthcare services, entry into markets, and access to loans and investment capital, etc. Most areas it passes through are agricultural lands and forests, so households along the EWEC are still poor because public infrastructure and facilities remains largely lacking in remote areas.

Secondly, family planning programs to reduce the number of family members must remain an important government policy to reduce the poverty and increase the welfare of households.

Finally, the majority of Lao's household primary occupation is agriculture; the households whose primary occupation is agriculture are more likely to be poor. As a result, the shares of income from agriculture and employment in agriculture are not significant in any of the four areas of household expenditures. The causes could be that many of them cannot access to production techniques and markets; or that poor rural households are largely self-sufficient in their food, clothing, fuel, and other consumption needs. In either case, improving the efficiency of household or small producer production, their techniques and their market input/output would be help raise their in-country consumption and export to world markets.

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