
Nguyen Viet, Cuong and Van der Weide, Roy and Tran, Ngoc Truong

15 December 2007

Online at https://mpra.ub.uni-muenchen.de/25762/
MPRA Paper No. 25762, posted 11 Oct 2010 02:56 UTC
Poverty maps is an important for poverty targeting in developing countries. In this study, we combine the Vietnam Household Living Standard Survey (VHLSS) in 2002 and the Population Census in 1999 to estimate poverty and inequality indexes of all provinces and districts of Vietnam in the year 2002.

JEL classification: I31, I32, O15

Keywords: Poverty measurement, poverty mapping, agricultural census, household survey, Vietnam.
1. INTRODUCTION

Elbers et al. (2003) proposes a method to combine a household survey and a census to estimate poverty and inequality at the small areas. Ideally, the survey and the census should be conducted in the same year. Using Vietnam Living Standard Survey (VLSS) 1998 and Population Census 1999, Minot et al. (2003) estimate poverty and inequality at the provincial and district levels. In this study, we combine the Vietnam Household Living Standard Survey (VHLSS) in 2002 and the Population Census in 1999 to estimate poverty and inequality indexes of all provinces and districts of Vietnam for the year 2002.

The research is structured into 6 sections as follows. The second section describes data sources. The third section presents the method of small area estimation of Elbers et al. (2003). The fourth section discusses the selection of common explanatory variables used to construct the expenditure models. The fifth section reports the estimation results of the expenditure models and the estimates of poverty and inequality in 2002. Finally some conclusions are drawn in the sixth section.

2. DATA SOURCES

The poverty mapping in this study relies on two data sources to estimate poverty rates at province, district and commune levels. The first is Vietnam Living Standard Survey (VHLSS) conducted by the General Statistical Office of Vietnam (GSO) in the year 2002. The survey collects information on household characteristics including basic demography, employment and labor force participation, education, health, income, expenditure, housing, fixed assets and durable goods, the participation of households in the most important poverty alleviation programs.

The 2002 VHLSS covered 30000 households. The basic sample frame of this sample is obtained from the Population Census conducted in the year 1999. The selection of the sample of 30000 households follows a method of stratified random cluster sampling so that it is representative for national, rural and urban, and regional levels. The sample is divided further into 4 sub-samples. Each one covers 7500 households and is conducted in a quarter in 2002 in order to eliminate information bias due to seasonal effects. However after processed and cleaned the number of households in the sample is reduced to 29412, of which 6876 households are located in urban area, and 22536 ones in rural areas.
The second data set is the Population and Housing Census that was carried out by the GSO in 1999. It was conducted with the financial and technical support of the United Nations Family Planning Agency and the UNDP. The full results of the census are not made available by the GSO, but this study uses a 33 percent sample of the census. The 33 percent sample was selected by GSO using systematic sampling of every third household on the list of households organized by administrative unit. The sample includes 5,553,811 households.

3. METHODOLOGY

The method of “Small area estimation”, which are developed by Elbers et. al. (2003), Hentschel et. al. (2000), combines a household survey and a population census to estimate poverty rate at small area. The main idea is to estimate a expenditure equation from a household survey, and use this equation to predict expenditure for households in a census given these the households’ characteristics. Once predicted expenditures are available, poverty rate can be estimated at small areas.

Basically, the method of small area estimation can be described by three steps:

Step 1: Select common variables in a household survey and a population census. These variables will be used in regression of household income, therefore these should be correlated with income.

Step 2: Run regression of per capita income on selected variables using data of the household survey:

\[ \ln(y_{ch}) = X_{ch}' \beta + \eta_c + \epsilon_{ch} \]  

(1)

where:
-  \( Y_{ch} \) and \( X_{ch} \) are per capita income and observed characteristics of household \( h \) in cluster \( c \), respectively.
-  \( \eta_c \) and \( \epsilon_{ch} \) are unobserved cluster variables and idiosyncratic variables, respectively.

This decomposition allows for correlation of error terms of households within a cluster.

Step 3: Apply this equation into the population census to predict the expected probability of being poor of households, and the poverty rate for an area can be estimated according to Elbers et al (2003):
\[ \bar{\mu} = \frac{1}{N} \sum_{c=1}^{N} \Phi \left[ \ln \frac{z - X_{ch}^c \hat{\beta}}{\sqrt{\hat{\sigma}^2 + \hat{\sigma}_{e,ch}^2}} \right] \] (2)

Where \( N \) is the number of households in the area.

Estimators of other poverty and inequality indexes are presented in Elbers et. al. (2003).

If the years of the survey and the census are the same or very close, there is no problem in interpreting poverty estimates. However, if the year of the survey is far from the year of the census, it is not clear which year the poverty is estimated for. For example, in this study we have the census in the year 1999, while the survey in the time 2002. To construct the poverty estimates for the year 2002, we have to run regression of per capita expenditure in 2002 on explanatory variables in 1999. More specifically, equation (1) is written as follows:

\[ \ln(y_{ch}^{02}) = X_{ch}^{99} \beta^{99-02} + \eta_c + \epsilon_{ch} \] (3)

Since we do not have panel data during the period 1999-2002, we have to use household variables that are time-variant. In addition, cluster variables from the census are also used to estimate model (3).

Once model (3) is estimated, the parameter estimates will be used to estimate the poverty rates for the year 2002 using equation (2).

4. SELECTION OF EXPLANATORY VARIABLES IN EXPENDITURE MODELS

The variables that are used in the expenditure models must be collected in both the census and survey. In addition, these variables should be time-invariant between 1999 and 2002. However, we do not have panel data between this period. Instead, we use the panel data of VHLSS 2002 and 2004 to assess changes in the common variables.

The VHLSS 2004 covers 9000 households. This sample is representative at the regional level. The VHLSS 2004 and 2002 set up panel data of around 4008 household which is representative at the national level.

To assess the change in household variables, we create 4 binary variables as follows:

(i) A binary variable that equals one if there has been no change from 2002 to 2004;

(ii) A binary variable that equals one if the change is positive;
(iii) A binary variable that equals one if the change is a negative one.

(iv) A variable that equals the absolute difference between the 2002 value and the 2004 value.

There are 4008 households to be matched from VLHSS 2002 and VLHSS 2004 datasets.
We have used 18 original variables to compare and find out change of household’ characteristics and assets.

Household’ characteristics include household size, percentage of children and elder, age and education level of household head, education level of household head spouse, household ethnic situation…; Household’ assets include household type, using water resource, toilet type, telephone, television type (color or black), motorbike, house area,… These variables are also collected in the population census 1999.

Table 1 reports the time-invariant assessment of total of 41 new variables. For each variable, sum of no change, positive change and negative change equals 100%.

<table>
<thead>
<tr>
<th>Variable</th>
<th>No change between 2002-2004</th>
<th>Positive change between 2002-2004</th>
<th>Negative change between 2002-2004</th>
<th>Absolute change between 2002-2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Obs</td>
<td>Mean</td>
<td>Obs</td>
<td>Mean</td>
</tr>
<tr>
<td>Household size</td>
<td>4008 0.5981</td>
<td>4008 0.1761</td>
<td>4008 0.2258</td>
<td>4008 0.6569</td>
</tr>
<tr>
<td>Household size (square)</td>
<td>4008 0.5981</td>
<td>4008 0.1761</td>
<td>4008 0.2258</td>
<td>4008 6.5267</td>
</tr>
<tr>
<td>Percentage of male</td>
<td>4008 0.5856</td>
<td>4008 0.2131</td>
<td>4008 0.2013</td>
<td>4008 0.0677</td>
</tr>
<tr>
<td>Percentage of children</td>
<td>4008 0.5492</td>
<td>4008 0.1794</td>
<td>4008 0.2715</td>
<td>4008 0.0854</td>
</tr>
<tr>
<td>Head ethnic minorities</td>
<td>4008 0.9820</td>
<td>4008 0.0102</td>
<td>4008 0.0077</td>
<td>4008 0.0180</td>
</tr>
<tr>
<td>Percentage of elderly</td>
<td>4008 0.8009</td>
<td>4008 0.1140</td>
<td>4008 0.0851</td>
<td>4008 0.0526</td>
</tr>
<tr>
<td>Age of household head</td>
<td>4008 0.0082</td>
<td>4008 0.9286</td>
<td>4008 0.0631</td>
<td>4008 3.4768</td>
</tr>
<tr>
<td><strong>Education of head spouse</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>4008 0.9376</td>
<td>4008 0.0359</td>
<td>4008 0.0264</td>
<td>4008 0.0624</td>
</tr>
<tr>
<td>Lower-secondary school</td>
<td>4008 0.8815</td>
<td>4008 0.0519</td>
<td>4008 0.0666</td>
<td>4008 0.1185</td>
</tr>
<tr>
<td>Upper-secondary school</td>
<td>4008 0.8293</td>
<td>4008 0.0868</td>
<td>4008 0.0838</td>
<td>4008 0.1707</td>
</tr>
<tr>
<td>Post-secondary school</td>
<td>4008 0.8815</td>
<td>4008 0.0529</td>
<td>4008 0.0656</td>
<td>4008 0.1185</td>
</tr>
<tr>
<td><strong>Occupation of head</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leaders/Managers</td>
<td>4008 0.9788</td>
<td>4008 0.0135</td>
<td>4008 0.0077</td>
<td>4008 0.0212</td>
</tr>
<tr>
<td>Professionals/Technicians</td>
<td>4008 0.9775</td>
<td>4008 0.0110</td>
<td>4008 0.0115</td>
<td>4008 0.0225</td>
</tr>
<tr>
<td>Clerks/Service Workers</td>
<td>4008 0.9593</td>
<td>4008 0.0235</td>
<td>4008 0.0172</td>
<td>4008 0.0407</td>
</tr>
<tr>
<td>Agriculture/Forestry/Fishery</td>
<td>4008 0.8066</td>
<td>4008 0.0853</td>
<td>4008 0.1080</td>
<td>4008 0.1934</td>
</tr>
<tr>
<td>Skilled Workers</td>
<td>4008 0.9114</td>
<td>4008 0.0437</td>
<td>4008 0.0449</td>
<td>4008 0.0886</td>
</tr>
<tr>
<td>Unskilled Workers</td>
<td>4008 0.8476</td>
<td>4008 0.0796</td>
<td>4008 0.0729</td>
<td>4008 0.1524</td>
</tr>
<tr>
<td>Not working</td>
<td>4008 0.8960</td>
<td>4008 0.0549</td>
<td>4008 0.0492</td>
<td>4008 0.1040</td>
</tr>
<tr>
<td><strong>House type</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanent house</td>
<td>4008 0.8802</td>
<td>4008 0.0711</td>
<td>4008 0.0487</td>
<td>4008 0.1183</td>
</tr>
<tr>
<td>Semi-Permanent</td>
<td>4008 0.7500</td>
<td>4008 0.1307</td>
<td>4008 0.1193</td>
<td>4008 0.2488</td>
</tr>
<tr>
<td>Variable</td>
<td>No change between 2002-2004</td>
<td>Positive change between 2002-2004</td>
<td>Negative change between 2002-2004</td>
<td>Absolute change between 2002-2004</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>----------------------------------</td>
<td>---------------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td></td>
<td>Obs</td>
<td>Mean</td>
<td>Obs</td>
<td>Mean</td>
</tr>
<tr>
<td>Temporary</td>
<td>4008</td>
<td>0.8436</td>
<td>4008</td>
<td>0.0624</td>
</tr>
<tr>
<td>Water type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tap-water</td>
<td>4008</td>
<td>0.9296</td>
<td>4008</td>
<td>0.0452</td>
</tr>
<tr>
<td>Filtered water</td>
<td>4008</td>
<td>0.7817</td>
<td>4008</td>
<td>0.1335</td>
</tr>
<tr>
<td>others</td>
<td>4008</td>
<td>0.8231</td>
<td>4008</td>
<td>0.0541</td>
</tr>
<tr>
<td>Toilet type</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flush</td>
<td>4008</td>
<td>0.8787</td>
<td>4008</td>
<td>0.0898</td>
</tr>
<tr>
<td>Others</td>
<td>4008</td>
<td>0.7635</td>
<td>4008</td>
<td>0.0978</td>
</tr>
<tr>
<td>toilet</td>
<td>4008</td>
<td>0.8518</td>
<td>4008</td>
<td>0.0654</td>
</tr>
<tr>
<td>Television</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>black television</td>
<td>4008</td>
<td>0.8782</td>
<td>4008</td>
<td>0.0374</td>
</tr>
<tr>
<td>color television</td>
<td>4008</td>
<td>0.7892</td>
<td>4008</td>
<td>0.1669</td>
</tr>
<tr>
<td>telephone</td>
<td>4008</td>
<td>0.8787</td>
<td>4008</td>
<td>0.0946</td>
</tr>
<tr>
<td>Computer</td>
<td>4008</td>
<td>0.9563</td>
<td>4008</td>
<td>0.0292</td>
</tr>
<tr>
<td>motorbike</td>
<td>4008</td>
<td>0.8051</td>
<td>4008</td>
<td>0.1457</td>
</tr>
<tr>
<td>Logarithm of living area</td>
<td>4008</td>
<td>0.1250</td>
<td>4008</td>
<td>0.5195</td>
</tr>
<tr>
<td>% agricultural working</td>
<td>4008</td>
<td>0.6544</td>
<td>4008</td>
<td>0.1385</td>
</tr>
</tbody>
</table>

Based on the comparison, the time-invariant variables selected include:

- Age and sex of head
- Ethnicity
- Education:
  - less than primary
  - Technical degree
  - Post upper-secondary
- Head occupation:
  - Leaders/Managers
  - Professionals/Technicians
  - Clerks/Service Workers
- Permanent house
- No toilet
- Tap water
- Working in agriculture or not.
In addition, the cluster variables from the census are merged to the survey to construct the consumption model. The list of all variables used in the expenditure model is presented in Table 2.

Table 2: Cluster variable in expenditure models (in VHLSS 2002)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Meaning</th>
<th>Obs</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>housetp1_c</td>
<td>Ratio of households with permanent house</td>
<td>28215</td>
<td>0.128</td>
<td>0.164</td>
</tr>
<tr>
<td>housetp2_c</td>
<td>Ratio of households with semi-permanent house</td>
<td>28215</td>
<td>0.504</td>
<td>0.264</td>
</tr>
<tr>
<td>housetp3_c</td>
<td>Ratio of households with temporary house</td>
<td>28215</td>
<td>0.367</td>
<td>0.318</td>
</tr>
<tr>
<td>toiletp1_c</td>
<td>Ratio of households with flush toilet</td>
<td>28215</td>
<td>0.161</td>
<td>0.272</td>
</tr>
<tr>
<td>toiletp2_c</td>
<td>Ratio of households with other toilet</td>
<td>28215</td>
<td>0.677</td>
<td>0.319</td>
</tr>
<tr>
<td>toiletp3_c</td>
<td>Ratio of households with no toilet</td>
<td>28215</td>
<td>0.162</td>
<td>0.232</td>
</tr>
<tr>
<td>waterp1_c</td>
<td>Ratio of households with tap water</td>
<td>28215</td>
<td>0.133</td>
<td>0.274</td>
</tr>
<tr>
<td>waterp2_c</td>
<td>Ratio of households with clean water</td>
<td>28215</td>
<td>0.648</td>
<td>0.350</td>
</tr>
<tr>
<td>waterp3_c</td>
<td>Ratio of households with other water</td>
<td>28215</td>
<td>0.218</td>
<td>0.295</td>
</tr>
<tr>
<td>headedu1_c</td>
<td>Ratio of heads with primary school</td>
<td>28215</td>
<td>0.392</td>
<td>0.214</td>
</tr>
<tr>
<td>headedu2_c</td>
<td>Ratio of heads with lower-secondary school</td>
<td>28215</td>
<td>0.399</td>
<td>0.157</td>
</tr>
<tr>
<td>headedu3_c</td>
<td>Ratio of heads with upper-secondary school</td>
<td>28215</td>
<td>0.170</td>
<td>0.098</td>
</tr>
<tr>
<td>headedu4_c</td>
<td>Ratio of heads with post-secondary school</td>
<td>28215</td>
<td>0.040</td>
<td>0.064</td>
</tr>
<tr>
<td>spouseedu1_c</td>
<td>Ratio of no spouse</td>
<td>28215</td>
<td>0.238</td>
<td>0.084</td>
</tr>
<tr>
<td>spouseedu2_c</td>
<td>Ratio of spouse with primary school</td>
<td>28215</td>
<td>0.318</td>
<td>0.201</td>
</tr>
<tr>
<td>spouseedu3_c</td>
<td>Ratio of spouse with lower-secondary school</td>
<td>28215</td>
<td>0.319</td>
<td>0.160</td>
</tr>
<tr>
<td>spouseedu4_c</td>
<td>Ratio of spouse with upper-secondary school</td>
<td>28215</td>
<td>0.103</td>
<td>0.078</td>
</tr>
<tr>
<td>spouseedu5_c</td>
<td>Ratio of spouse with post-secondary school</td>
<td>28215</td>
<td>0.021</td>
<td>0.033</td>
</tr>
<tr>
<td>headoc1_c</td>
<td>Ratio of head Leaders/Managers</td>
<td>28215</td>
<td>0.008</td>
<td>0.009</td>
</tr>
<tr>
<td>headoc2_c</td>
<td>Ratio of head Professionals/Technicians</td>
<td>28215</td>
<td>0.041</td>
<td>0.051</td>
</tr>
<tr>
<td>headoc3_c</td>
<td>Ratio of head Clerks/Service Workers</td>
<td>28215</td>
<td>0.061</td>
<td>0.061</td>
</tr>
<tr>
<td>headoc4_c</td>
<td>Ratio of head Agriculture/Forestry/Fishery</td>
<td>28215</td>
<td>0.555</td>
<td>0.279</td>
</tr>
<tr>
<td>headoc5_c</td>
<td>Ratio of head Skilled Workers</td>
<td>28215</td>
<td>0.084</td>
<td>0.082</td>
</tr>
<tr>
<td>headoc6_c</td>
<td>Ratio of head Unskilled Workers</td>
<td>28215</td>
<td>0.027</td>
<td>0.033</td>
</tr>
<tr>
<td>headoc7_c</td>
<td>Ratio of head Not working</td>
<td>28215</td>
<td>0.223</td>
<td>0.110</td>
</tr>
<tr>
<td>spouseoc1_c</td>
<td>Ratio of no spouse</td>
<td>28215</td>
<td>0.238</td>
<td>0.084</td>
</tr>
<tr>
<td>spouseoc2_c</td>
<td>Ratio of spouse Leaders/Managers</td>
<td>28215</td>
<td>0.002</td>
<td>0.004</td>
</tr>
<tr>
<td>spouseoc3_c</td>
<td>Ratio of spouse Professionals/Technicians</td>
<td>28215</td>
<td>0.030</td>
<td>0.032</td>
</tr>
<tr>
<td>spouseoc4_c</td>
<td>Ratio of spouse Clerks/Service Workers</td>
<td>28215</td>
<td>0.052</td>
<td>0.055</td>
</tr>
<tr>
<td>spouseoc5_c</td>
<td>Ratio of spouse Agriculture/Forestry/Fishery</td>
<td>28215</td>
<td>0.432</td>
<td>0.265</td>
</tr>
<tr>
<td>spouseoc6_c</td>
<td>Ratio of spouse Skilled Workers</td>
<td>28215</td>
<td>0.033</td>
<td>0.046</td>
</tr>
<tr>
<td>spouseoc7_c</td>
<td>Ratio of spouse Unskilled Workers</td>
<td>28215</td>
<td>0.017</td>
<td>0.027</td>
</tr>
<tr>
<td>spouseoc8_c</td>
<td>Ratio of spouse Not working</td>
<td>28215</td>
<td>0.195</td>
<td>0.130</td>
</tr>
<tr>
<td>tv_c</td>
<td>Ratio of households with tv</td>
<td>28215</td>
<td>0.541</td>
<td>0.204</td>
</tr>
<tr>
<td>radio_c</td>
<td>Ratio of households with radio</td>
<td>28215</td>
<td>0.452</td>
<td>0.134</td>
</tr>
<tr>
<td>reduc1_c</td>
<td>Ratio of people with primary school</td>
<td>28215</td>
<td>0.526</td>
<td>0.162</td>
</tr>
<tr>
<td>reduc2_c</td>
<td>Ratio of people with lower-secondary school</td>
<td>28215</td>
<td>0.320</td>
<td>0.100</td>
</tr>
<tr>
<td>reduc3_c</td>
<td>Ratio of people with upper-secondary school</td>
<td>28215</td>
<td>0.125</td>
<td>0.082</td>
</tr>
<tr>
<td>reduc4_c</td>
<td>Ratio of people with post-secondary school</td>
<td>28215</td>
<td>0.030</td>
<td>0.051</td>
</tr>
<tr>
<td>rwork_c</td>
<td>Ratio of working people</td>
<td>28215</td>
<td>0.457</td>
<td>0.051</td>
</tr>
<tr>
<td>ragri_c</td>
<td>Ratio of people working in agriculture</td>
<td>28215</td>
<td>0.613</td>
<td>0.302</td>
</tr>
<tr>
<td>rindustry_c</td>
<td>Ratio of people working in industrial sector</td>
<td>28215</td>
<td>0.110</td>
<td>0.124</td>
</tr>
<tr>
<td>rservice_c</td>
<td>Ratio of people working in service sector</td>
<td>28215</td>
<td>0.197</td>
<td>0.185</td>
</tr>
<tr>
<td>lc_natfor</td>
<td>% natural land</td>
<td>28215</td>
<td>8.997</td>
<td>17.179</td>
</tr>
</tbody>
</table>
5. EXPENDITURE MODELS AND WELFARE ESTIMATES

The first step in estimating the poverty and inequality is to construct the expenditure models. There are 8 geographical regions in Vietnam. To allow for geographical heterogeneity, we estimate separate expenditure models for each region. Interaction terms between explanatory variables with urban dummy variables are also included.

To examine the sensitivity of the poverty estimates to model specifications, for each region, we compare 3 different models, which mostly vary in the number of explanatory variables they included. Models 1, 2 and 3 refer to a large, medium, and a relatively small specification. In total, there are 24 expenditure regressions. The full regression results are reported in separate files. In this paper, regression results of the medium model (Model 2) are presented in Tables 5 to 13 of Appendix.

It should be noted that we used the latest version of the PovMap program to estimate poverty and inequality (updated on December 13, 2007). Districts are specified as cluster in modeling location effect. The estimates of poverty are similar when communes are selected as clusters.

---

2 The program is developed by researchers of WB. [http://iresearch.worldbank.org/PovMap/PovMap2/PovMap2Main.asp](http://iresearch.worldbank.org/PovMap/PovMap2/PovMap2Main.asp)
Figure 1 graphs the estimates of the headcount index of 61 provinces in Vietnam. The blue line is the poverty ratio that is estimated directly from VHLSS 2002. It shows that estimates from three models are quite close, especially Model 1 and 2. However, these estimates are rather different from those based on the 2002 VHLSS for some provinces.

Figure 1: Poverty estimates at the provincial level

![Graph showing poverty estimates at the provincial level.]

Figure 2 graphs the standard errors of headcount index estimates in the three models. Model 3 results in highest standard errors, while Model 1 has lowest standard errors.

Figure 2: Standard errors of headcount index estimates

![Graph showing standard errors of headcount index estimates at the provincial level.]

Figure 2: Standard errors of headcount index estimates
errors. However, we prefer Model 2 to avoid the over-fitting problem when we use a large number of cluster variables.

Although, the 2002 VHLSS is not representative at the provincial level, its sample size is very large and can be used for comparison. The representativeness of VHLSS 2002 is assessed by comparing the percentage of urban population between this survey and the census 1999. Figure 3 shows that two data sets give very close estimates of urban share at the provincial level.

Figure 3: The percentage of urban population of provinces in Census 1999 and VHLSS 2002

Since the 2002 VHLSS is representative at the regional level, we compare the estimates of regional poverty rate between the mapping method and the 2002 VHLSS. Figure 4 shows that poverty estimates of poverty mapping method are lower than those based on the survey.

Figure 5 presents the estimates of poverty headcount index for the years 1999 and 2002 at the provincial level. It shows that most of provinces experienced a reduction in poverty rate. However, it is not a clear trend that the poverty reduction is higher for the provinces with high poverty in 1999. In addition, poverty estimates increased for several provinces. Figure 6 presents the poverty maps of these years.
Figure 4: Poverty estimates of regions

Figure 5: Estimates of poverty headcount index in 1999 and 2002
Figure 6: Poverty Map in 1999 and 2002

Figure 7: Poverty estimates of districts
Poverty estimates at the district level are graphed in Figure 7. It shows that differences in poverty estimates among three models at the district level are much larger than at the provincial level (Figure 1).

Finally, Table 3 presents the estimates of poverty depth and severity indexes (P1 and P2), and Gini index from Model 2.

Table 3: Estimates of poverty depth and severity indexes and Gini index

<table>
<thead>
<tr>
<th>Provinces</th>
<th>P0</th>
<th>P1</th>
<th>P2</th>
<th>Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>101</td>
<td>0.0488</td>
<td>0.0121</td>
<td>0.0084</td>
<td>0.0025</td>
</tr>
<tr>
<td>103</td>
<td>0.1755</td>
<td>0.0269</td>
<td>0.0342</td>
<td>0.0071</td>
</tr>
<tr>
<td>105</td>
<td>0.2680</td>
<td>0.0328</td>
<td>0.0538</td>
<td>0.0089</td>
</tr>
<tr>
<td>107</td>
<td>0.1706</td>
<td>0.0297</td>
<td>0.0306</td>
<td>0.0066</td>
</tr>
<tr>
<td>109</td>
<td>0.2413</td>
<td>0.0423</td>
<td>0.0459</td>
<td>0.0103</td>
</tr>
<tr>
<td>111</td>
<td>0.3151</td>
<td>0.0574</td>
<td>0.0656</td>
<td>0.0175</td>
</tr>
<tr>
<td>113</td>
<td>0.3211</td>
<td>0.0445</td>
<td>0.0682</td>
<td>0.0131</td>
</tr>
<tr>
<td>115</td>
<td>0.3010</td>
<td>0.0403</td>
<td>0.0616</td>
<td>0.0116</td>
</tr>
<tr>
<td>117</td>
<td>0.3145</td>
<td>0.0464</td>
<td>0.0666</td>
<td>0.0136</td>
</tr>
<tr>
<td>201</td>
<td>0.5671</td>
<td>0.0460</td>
<td>0.1496</td>
<td>0.0206</td>
</tr>
<tr>
<td>203</td>
<td>0.4232</td>
<td>0.0455</td>
<td>0.0998</td>
<td>0.0165</td>
</tr>
<tr>
<td>205</td>
<td>0.5228</td>
<td>0.0328</td>
<td>0.1443</td>
<td>0.0160</td>
</tr>
<tr>
<td>207</td>
<td>0.4272</td>
<td>0.0440</td>
<td>0.1060</td>
<td>0.0170</td>
</tr>
<tr>
<td>209</td>
<td>0.3735</td>
<td>0.0421</td>
<td>0.0852</td>
<td>0.0137</td>
</tr>
<tr>
<td>211</td>
<td>0.3923</td>
<td>0.0483</td>
<td>0.0930</td>
<td>0.0169</td>
</tr>
<tr>
<td>213</td>
<td>0.4113</td>
<td>0.0386</td>
<td>0.1035</td>
<td>0.0147</td>
</tr>
<tr>
<td>215</td>
<td>0.2597</td>
<td>0.0303</td>
<td>0.0541</td>
<td>0.0086</td>
</tr>
<tr>
<td>217</td>
<td>0.2842</td>
<td>0.0352</td>
<td>0.0577</td>
<td>0.0102</td>
</tr>
<tr>
<td>219</td>
<td>0.2826</td>
<td>0.0428</td>
<td>0.0552</td>
<td>0.0117</td>
</tr>
<tr>
<td>221</td>
<td>0.2618</td>
<td>0.0313</td>
<td>0.0513</td>
<td>0.0082</td>
</tr>
<tr>
<td>223</td>
<td>0.2069</td>
<td>0.0312</td>
<td>0.0397</td>
<td>0.0077</td>
</tr>
<tr>
<td>225</td>
<td>0.1141</td>
<td>0.0164</td>
<td>0.0211</td>
<td>0.0036</td>
</tr>
<tr>
<td>301</td>
<td>0.7630</td>
<td>0.0246</td>
<td>0.3201</td>
<td>0.0203</td>
</tr>
<tr>
<td>303</td>
<td>0.6982</td>
<td>0.0280</td>
<td>0.2333</td>
<td>0.0200</td>
</tr>
<tr>
<td>305</td>
<td>0.6100</td>
<td>0.0346</td>
<td>0.1869</td>
<td>0.0206</td>
</tr>
<tr>
<td>401</td>
<td>0.4439</td>
<td>0.0290</td>
<td>0.1119</td>
<td>0.0107</td>
</tr>
<tr>
<td>403</td>
<td>0.4389</td>
<td>0.0290</td>
<td>0.1144</td>
<td>0.0108</td>
</tr>
<tr>
<td>405</td>
<td>0.4263</td>
<td>0.0327</td>
<td>0.1080</td>
<td>0.0125</td>
</tr>
<tr>
<td>407</td>
<td>0.3580</td>
<td>0.0397</td>
<td>0.0855</td>
<td>0.0133</td>
</tr>
<tr>
<td>409</td>
<td>0.3862</td>
<td>0.0371</td>
<td>0.1030</td>
<td>0.0133</td>
</tr>
<tr>
<td>411</td>
<td>0.3246</td>
<td>0.0347</td>
<td>0.0831</td>
<td>0.0129</td>
</tr>
<tr>
<td>501</td>
<td>0.0853</td>
<td>0.0195</td>
<td>0.0180</td>
<td>0.0051</td>
</tr>
<tr>
<td>503</td>
<td>0.3319</td>
<td>0.0382</td>
<td>0.0821</td>
<td>0.0115</td>
</tr>
<tr>
<td>505</td>
<td>0.3547</td>
<td>0.0355</td>
<td>0.0916</td>
<td>0.0106</td>
</tr>
<tr>
<td>507</td>
<td>0.2282</td>
<td>0.0363</td>
<td>0.0467</td>
<td>0.0095</td>
</tr>
<tr>
<td>509</td>
<td>0.2184</td>
<td>0.0387</td>
<td>0.0461</td>
<td>0.0100</td>
</tr>
<tr>
<td>511</td>
<td>0.1214</td>
<td>0.0260</td>
<td>0.0245</td>
<td>0.0061</td>
</tr>
<tr>
<td>601</td>
<td>0.4289</td>
<td>0.0240</td>
<td>0.1236</td>
<td>0.0105</td>
</tr>
</tbody>
</table>
## 6. CONCLUSION

The present study is to combine Population Census 1999 and VHLSS 2002 to estimate poverty and inequality for the year 2002 using the poverty mapping method of Elbers et al. (2003). Although the estimates from this method are rather close to those based on the 2002 VHLSS at the regional level, they are not very close at the provincial level. One possible reason is that there could be population changes between the districts and provinces during the period 1999-2002. In addition, the population growth can be very different between districts and provinces. The modeling of these population changes should be taken into account in the future studies to produce more accurate estimates of welfares.

<table>
<thead>
<tr>
<th>Provinces</th>
<th>P0</th>
<th>Std. Err.</th>
<th>P1</th>
<th>Std. Err.</th>
<th>P2</th>
<th>Std. Err.</th>
<th>Gini</th>
</tr>
</thead>
<tbody>
<tr>
<td>603</td>
<td>0.5540</td>
<td>0.0140</td>
<td>0.2101</td>
<td>0.0084</td>
<td>0.1020</td>
<td>0.0056</td>
<td>0.3893</td>
</tr>
<tr>
<td>605</td>
<td>0.4474</td>
<td>0.0183</td>
<td>0.1280</td>
<td>0.0078</td>
<td>0.0512</td>
<td>0.0040</td>
<td>0.3073</td>
</tr>
<tr>
<td>701</td>
<td>0.0063</td>
<td>0.0020</td>
<td>0.0009</td>
<td>0.0004</td>
<td>0.0002</td>
<td>0.0001</td>
<td>0.3021</td>
</tr>
<tr>
<td>703</td>
<td>0.2668</td>
<td>0.0393</td>
<td>0.0705</td>
<td>0.0142</td>
<td>0.0267</td>
<td>0.0065</td>
<td>0.3297</td>
</tr>
<tr>
<td>705</td>
<td>0.3864</td>
<td>0.0613</td>
<td>0.1072</td>
<td>0.0251</td>
<td>0.0416</td>
<td>0.0121</td>
<td>0.3607</td>
</tr>
<tr>
<td>707</td>
<td>0.2377</td>
<td>0.0550</td>
<td>0.0557</td>
<td>0.0172</td>
<td>0.0192</td>
<td>0.0071</td>
<td>0.2770</td>
</tr>
<tr>
<td>709</td>
<td>0.1023</td>
<td>0.0253</td>
<td>0.0185</td>
<td>0.0058</td>
<td>0.0053</td>
<td>0.0020</td>
<td>0.2675</td>
</tr>
<tr>
<td>711</td>
<td>0.0493</td>
<td>0.0160</td>
<td>0.0084</td>
<td>0.0035</td>
<td>0.0023</td>
<td>0.0011</td>
<td>0.2804</td>
</tr>
<tr>
<td>713</td>
<td>0.0771</td>
<td>0.0168</td>
<td>0.0137</td>
<td>0.0037</td>
<td>0.0038</td>
<td>0.0012</td>
<td>0.2825</td>
</tr>
<tr>
<td>715</td>
<td>0.2806</td>
<td>0.0405</td>
<td>0.0662</td>
<td>0.0132</td>
<td>0.0229</td>
<td>0.0056</td>
<td>0.3369</td>
</tr>
<tr>
<td>717</td>
<td>0.0780</td>
<td>0.0234</td>
<td>0.0135</td>
<td>0.0050</td>
<td>0.0037</td>
<td>0.0016</td>
<td>0.2851</td>
</tr>
<tr>
<td>801</td>
<td>0.1904</td>
<td>0.0299</td>
<td>0.0393</td>
<td>0.0081</td>
<td>0.0122</td>
<td>0.0030</td>
<td>0.2884</td>
</tr>
<tr>
<td>803</td>
<td>0.1842</td>
<td>0.0279</td>
<td>0.0354</td>
<td>0.0070</td>
<td>0.0104</td>
<td>0.0025</td>
<td>0.2667</td>
</tr>
<tr>
<td>805</td>
<td>0.1507</td>
<td>0.0303</td>
<td>0.0294</td>
<td>0.0075</td>
<td>0.0087</td>
<td>0.0027</td>
<td>0.2862</td>
</tr>
<tr>
<td>807</td>
<td>0.1507</td>
<td>0.0333</td>
<td>0.0296</td>
<td>0.0081</td>
<td>0.0089</td>
<td>0.0028</td>
<td>0.2833</td>
</tr>
<tr>
<td>809</td>
<td>0.1726</td>
<td>0.0346</td>
<td>0.0332</td>
<td>0.0084</td>
<td>0.0097</td>
<td>0.0029</td>
<td>0.2717</td>
</tr>
<tr>
<td>811</td>
<td>0.1703</td>
<td>0.0338</td>
<td>0.0325</td>
<td>0.0081</td>
<td>0.0095</td>
<td>0.0027</td>
<td>0.2605</td>
</tr>
<tr>
<td>813</td>
<td>0.2476</td>
<td>0.0316</td>
<td>0.0551</td>
<td>0.0097</td>
<td>0.0180</td>
<td>0.0039</td>
<td>0.3224</td>
</tr>
<tr>
<td>815</td>
<td>0.1657</td>
<td>0.0341</td>
<td>0.0329</td>
<td>0.0088</td>
<td>0.0099</td>
<td>0.0032</td>
<td>0.2932</td>
</tr>
<tr>
<td>817</td>
<td>0.3165</td>
<td>0.0467</td>
<td>0.0728</td>
<td>0.0151</td>
<td>0.0243</td>
<td>0.0062</td>
<td>0.2794</td>
</tr>
<tr>
<td>819</td>
<td>0.3033</td>
<td>0.0431</td>
<td>0.0698</td>
<td>0.0137</td>
<td>0.0233</td>
<td>0.0055</td>
<td>0.2868</td>
</tr>
<tr>
<td>821</td>
<td>0.2168</td>
<td>0.0509</td>
<td>0.0465</td>
<td>0.0143</td>
<td>0.0149</td>
<td>0.0054</td>
<td>0.2806</td>
</tr>
<tr>
<td>823</td>
<td>0.2069</td>
<td>0.0412</td>
<td>0.0438</td>
<td>0.0114</td>
<td>0.0139</td>
<td>0.0044</td>
<td>0.2882</td>
</tr>
</tbody>
</table>
REFERENCE


## APPENDIX: REGRESSION RESULTS OF MODEL 2

Table 4: Name and meaning of explanatory variables in expenditure model

<table>
<thead>
<tr>
<th>Variable name</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td>Head age</td>
</tr>
<tr>
<td>AGESQUARED</td>
<td>Head age squared</td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>Member working in agriculture</td>
</tr>
<tr>
<td>ETHNIC_1</td>
<td>Head ethnic minorities</td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>Head primary school</td>
</tr>
<tr>
<td>HEADEDU4_1</td>
<td>Head post secondary school</td>
</tr>
<tr>
<td>HEADC1_1</td>
<td>Head Leaders/Managers</td>
</tr>
<tr>
<td>HEADC2_1</td>
<td>Head Professionals/Technicians</td>
</tr>
<tr>
<td>HEADC3_1</td>
<td>Head Clerks/Service Workers</td>
</tr>
<tr>
<td>HOUSETP1_1</td>
<td>Permanent house</td>
</tr>
<tr>
<td>LC_ARABLE</td>
<td>% arable land</td>
</tr>
<tr>
<td>LNAGE</td>
<td>Log of head age</td>
</tr>
<tr>
<td>RWORK_C</td>
<td>Commune ratio of working people</td>
</tr>
<tr>
<td>HEADEDU2_C</td>
<td>Commune ratio of head post secondary</td>
</tr>
<tr>
<td>MKTPERCOM</td>
<td>Number of markets per commune</td>
</tr>
<tr>
<td>MAINROAD_DEN</td>
<td>Main road density</td>
</tr>
<tr>
<td>MINROAD_DEN</td>
<td>Minor road density</td>
</tr>
<tr>
<td>MKTPAYM</td>
<td>Market payment to State</td>
</tr>
<tr>
<td>LC_NATFOR</td>
<td>% natural land</td>
</tr>
<tr>
<td>LC_PLANTFOR</td>
<td>% planted land</td>
</tr>
<tr>
<td>PREC_ANNUAL</td>
<td>Annual rainfall</td>
</tr>
<tr>
<td>HEADEDU1_C</td>
<td>Commune ratio of head primary school</td>
</tr>
<tr>
<td>HEADEDU3_C</td>
<td>Commune ratio of head upper-sec school</td>
</tr>
<tr>
<td>HEADEDU4_C</td>
<td>Commune ratio of head post secondary</td>
</tr>
<tr>
<td>REDUC1_C</td>
<td>Commune ratio of people with primary school</td>
</tr>
<tr>
<td>REDUC2_C</td>
<td>Commune ratio of people with lower-secondary</td>
</tr>
<tr>
<td>HEADC3_C</td>
<td>Commune ratio of head clerks/services</td>
</tr>
<tr>
<td>HEADC4_C</td>
<td>Commune ratio of head agriculture</td>
</tr>
<tr>
<td>HEADC6_C</td>
<td>Commune ratio of head Unskilled Workers</td>
</tr>
<tr>
<td>HEADC7_C</td>
<td>Commune ratio of head not working</td>
</tr>
<tr>
<td>SPOUSEEDU2_1</td>
<td>Spouse primary school</td>
</tr>
<tr>
<td>SPOUSEEDU3_C</td>
<td>Commune ratio of spouse lower-sec school</td>
</tr>
<tr>
<td>SPOUSEEDU4_C</td>
<td>Commune ratio of spouse upper-sec secondary</td>
</tr>
<tr>
<td>SPOUSEOC2_1</td>
<td>Ratio of spouse leaders/managers</td>
</tr>
<tr>
<td>SPOUSEOC3_1</td>
<td>Spouse professionals/technicians</td>
</tr>
<tr>
<td>SPOUSEOC4_1</td>
<td>Spouse clerks/service workers</td>
</tr>
<tr>
<td>SPOUSEOC2_C</td>
<td>Commune ratio of spouse leaders</td>
</tr>
<tr>
<td>SPOUSEOC3_C</td>
<td>Commune ratio of spouse professionals/technicians</td>
</tr>
<tr>
<td>SPOUSEOC4_C</td>
<td>Commune ratio of spouse clerk/services</td>
</tr>
<tr>
<td>SPOUSEOC5_C</td>
<td>Commune ratio of spouse agri.</td>
</tr>
<tr>
<td>SPOUSEOC8_C</td>
<td>Commune ratio of spouse not working</td>
</tr>
<tr>
<td>RAGRI_C</td>
<td>Commune ratio of agr. workers</td>
</tr>
<tr>
<td>TOILETTP1_C</td>
<td>Commune ratio of flush toilet</td>
</tr>
<tr>
<td>TOILETTP2_C</td>
<td>Commune ratio of other toilet</td>
</tr>
<tr>
<td>TOILETTP3_C</td>
<td>Commune ratio of no toilet</td>
</tr>
<tr>
<td>Variable name</td>
<td>Meaning</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>Have no toilet</td>
</tr>
<tr>
<td>TV_C</td>
<td>Commune ratio of having TV</td>
</tr>
<tr>
<td>RADIO_C</td>
<td>Commune ratio of having radio</td>
</tr>
<tr>
<td>WATERTP1_C</td>
<td>Commune ratio of tap water</td>
</tr>
<tr>
<td>WATERTP2_C</td>
<td>Commune ratio of clean water</td>
</tr>
<tr>
<td>WATERTP3_C</td>
<td>Commune ratio of unclean water</td>
</tr>
<tr>
<td>WATERTP1_1</td>
<td>Tap water</td>
</tr>
<tr>
<td>HOUSETP1_C</td>
<td>Commune ratio of permanent house</td>
</tr>
<tr>
<td>HOUSETP3_C</td>
<td>Commune ratio of temporary house</td>
</tr>
<tr>
<td>PCTSLOPE1</td>
<td>Pct 0-4% slope</td>
</tr>
<tr>
<td>ROAD_KM</td>
<td>Length of roads</td>
</tr>
<tr>
<td>TRACKS_DENS</td>
<td>Track density</td>
</tr>
<tr>
<td>TEMP_AVG</td>
<td>Average temperature</td>
</tr>
<tr>
<td>HUM_AVG</td>
<td>Average humidity</td>
</tr>
<tr>
<td>SUN_ANNUAL</td>
<td>Annual sunshine duration</td>
</tr>
<tr>
<td>_URBAN$AGESQUARED</td>
<td>Urban * Head age squared</td>
</tr>
<tr>
<td>_URBAN$TOILETTP1_C</td>
<td>Urban * Commune ratio of flush toilet</td>
</tr>
<tr>
<td>_URBAN$HOUSETP1_C</td>
<td>Urban * Commune ratio of permanent house</td>
</tr>
<tr>
<td>_URBAN$HOUSETP2_C</td>
<td>Urban * Commune ratio of semi-permanent house</td>
</tr>
<tr>
<td>_URBAN$HOUSETP3_C</td>
<td>Urban * Commune ratio of temporary house</td>
</tr>
<tr>
<td>_URBAN$MAINROAD_DEN</td>
<td>Urban * Main road density</td>
</tr>
<tr>
<td>_URBAN$MINROAD_DEN</td>
<td>Urban * Minor road density</td>
</tr>
<tr>
<td>_URBAN$HEADEDU1#1</td>
<td>Urban * Head primary school</td>
</tr>
<tr>
<td>_URBAN$HEADEDU3_C</td>
<td>Urban * Head upper-secondary</td>
</tr>
<tr>
<td>_URBAN$REDC4_C</td>
<td>Urban * Commune ratio of post secondary</td>
</tr>
<tr>
<td>_URBAN$SPouseEDU5_C</td>
<td>Urban * Commune ratio of spouse post secondary</td>
</tr>
<tr>
<td>_URBAN$SPouseOC2#1</td>
<td>Urban * Spouse leaders/managers</td>
</tr>
<tr>
<td>_URBAN$SPouseOC4#1</td>
<td>Urban * Spouse clerks/service workers</td>
</tr>
<tr>
<td>_URBAN$SPouseOC8_C</td>
<td>Urban * Spouse not working</td>
</tr>
<tr>
<td>_URBAN$WATERTP1#1</td>
<td>Urban * Tap water</td>
</tr>
<tr>
<td>_URBAN$WATERTP2_C</td>
<td>Urban * Commune ratio of clean water</td>
</tr>
<tr>
<td>_URBAN$TOILETTP3#1</td>
<td>Urban * No toilet</td>
</tr>
<tr>
<td>_URBAN$TOILETTP3_C</td>
<td>Urban * Commune ratio of no toilet</td>
</tr>
<tr>
<td>_URBAN$HOUSETP1#1</td>
<td>Urban * Permanent house</td>
</tr>
<tr>
<td>_URBAN$DAGRI#1</td>
<td>Urban * Agr. Worker</td>
</tr>
<tr>
<td>_URBAN$ETHNIC#1</td>
<td>Urban * Head ethnic minorities</td>
</tr>
<tr>
<td>_URBAN$LC_BAREROCKY</td>
<td>Urban * % bare land</td>
</tr>
<tr>
<td>_URBAN$LC_PLANTFOR</td>
<td>Urban * % planted forest</td>
</tr>
<tr>
<td>_URBAN$LC_NATFOR</td>
<td>Urban * % natural forest</td>
</tr>
<tr>
<td>_URBAN$SPouseEDU2#1</td>
<td>Urban * Spouse primary school</td>
</tr>
<tr>
<td>_URBAN$SPouseOC3#1</td>
<td>Urban * Spouse clerks/service workers</td>
</tr>
<tr>
<td>_URBAN$MKTPAYM</td>
<td>Urban * Market payment to State</td>
</tr>
<tr>
<td>_URBAN$MKTPERCOM</td>
<td>Urban * Number of market per commune</td>
</tr>
<tr>
<td>_URBAN$SRWORK_C</td>
<td>Urban * Commune ratio of working people</td>
</tr>
<tr>
<td>_URBAN$TRACKS_DENS</td>
<td>Urban * Track density</td>
</tr>
</tbody>
</table>
Table 5: Expenditure model of Region 1 “Red River Delta”

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>11.8408</td>
<td>0.9792</td>
<td>12.0922</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>0.1098</td>
<td>0.0185</td>
<td>5.9377</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGESQUARED</td>
<td>-0.0007</td>
<td>0.0001</td>
<td>-6.8662</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.1940</td>
<td>0.0136</td>
<td>-14.2510</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.2134</td>
<td>0.0181</td>
<td>-11.8091</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU4_1</td>
<td>0.1795</td>
<td>0.0282</td>
<td>6.3603</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC1_1</td>
<td>0.2759</td>
<td>0.0398</td>
<td>6.9302</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC2_1</td>
<td>0.1909</td>
<td>0.0294</td>
<td>6.4950</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC3_1</td>
<td>0.1650</td>
<td>0.0285</td>
<td>5.7813</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HOUSETP1_1</td>
<td>0.1557</td>
<td>0.0125</td>
<td>12.4516</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LC_ARABLE</td>
<td>-0.3426</td>
<td>0.0486</td>
<td>-7.0480</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LNAGE</td>
<td>-1.8261</td>
<td>0.4217</td>
<td>-4.3303</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>PREC_ANNUAL</td>
<td>-0.0006</td>
<td>0.0001</td>
<td>-8.4803</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>REDUC1_C</td>
<td>1.0914</td>
<td>0.1574</td>
<td>6.9345</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEEDU2_1</td>
<td>-0.1021</td>
<td>0.0191</td>
<td>-5.3403</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEOC3_1</td>
<td>0.1925</td>
<td>0.0283</td>
<td>6.7905</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TOILETTP1_C</td>
<td>0.4848</td>
<td>0.0498</td>
<td>9.7317</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TV_C</td>
<td>0.7607</td>
<td>0.0637</td>
<td>11.9323</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$REDUC4_C</td>
<td>3.5940</td>
<td>0.2485</td>
<td>14.4601</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$SPOUSEEDU5_C</td>
<td>-4.9644</td>
<td>0.4331</td>
<td>-11.4625</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 5240
Number of regressors 159
Number of regressors in model 20
Adjusted R squared 0.6102
Number of clusters in survey 91
Number of clusters in census 93

\[
\frac{\hat{\sigma}^2}{\sigma^2} = 0.085
\]
Table 6: Expenditure model of Region 2 “North East”

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>18.7310</td>
<td>1.0360</td>
<td>18.0797</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>0.1265</td>
<td>0.0180</td>
<td>7.0464</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGESQUARED</td>
<td>-0.0008</td>
<td>0.0001</td>
<td>-7.7514</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.2321</td>
<td>0.0159</td>
<td>-14.5652</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>ETHNIC_1</td>
<td>-0.1561</td>
<td>0.0163</td>
<td>-9.5626</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.1561</td>
<td>0.0159</td>
<td>-9.8101</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU2_C</td>
<td>-0.5301</td>
<td>0.0514</td>
<td>-10.3137</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU4_1</td>
<td>0.1858</td>
<td>0.0347</td>
<td>5.3511</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC2_1</td>
<td>0.2045</td>
<td>0.0335</td>
<td>6.0981</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC3_1</td>
<td>0.1304</td>
<td>0.0282</td>
<td>4.6218</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HOUSEDP1_1</td>
<td>0.2093</td>
<td>0.0153</td>
<td>13.6654</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HUM_AVG</td>
<td>-0.0749</td>
<td>0.0076</td>
<td>-9.8492</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LNAGE</td>
<td>-2.2030</td>
<td>0.3813</td>
<td>-5.7779</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEEDU2_1</td>
<td>-0.1026</td>
<td>0.0164</td>
<td>-6.2456</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEOC3_1</td>
<td>0.2119</td>
<td>0.0273</td>
<td>7.7710</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEOC5_C</td>
<td>-0.0484</td>
<td>0.0492</td>
<td>-0.9852</td>
<td>0.3246</td>
<td></td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>-0.1717</td>
<td>0.0190</td>
<td>-9.0287</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TV_C</td>
<td>0.4720</td>
<td>0.0535</td>
<td>8.8202</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBANSPOUSEOC2#1 0.5271</td>
<td>0.1298 4.0612</td>
<td>0.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>_URBAN$WATERTP3_C 0.3606</td>
<td>0.0787 4.5791</td>
<td>0.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 4816
Number of regressors 159
Number of regressors in model 20
Adjusted R squared 0.5141
Number of clusters in survey 116
Number of clusters in census 129

\[
\frac{\hat{\sigma}_e^2}{\hat{\sigma}_u^2} = 0.088
\]
Table 7: Expenditure model of Region 3 “North West”

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>4.1493</td>
<td>0.5792</td>
<td>7.1640</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGESQUARED</td>
<td>0.0000</td>
<td>0.0000</td>
<td>3.8057</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.1887</td>
<td>0.0478</td>
<td>-3.9508</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>ETHNIC_1</td>
<td>-0.1825</td>
<td>0.0368</td>
<td>-4.9664</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.1678</td>
<td>0.0332</td>
<td>-5.0510</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC1_1</td>
<td>0.3431</td>
<td>0.0652</td>
<td>5.2593</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC7_C</td>
<td>-1.4456</td>
<td>0.3211</td>
<td>-4.5014</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>MINRROAD_DEN</td>
<td>-0.1232</td>
<td>0.0406</td>
<td>-3.0361</td>
<td>0.0025</td>
<td></td>
</tr>
<tr>
<td>PCTSLOPE1</td>
<td>0.0098</td>
<td>0.0015</td>
<td>6.4098</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>REDUC2_C</td>
<td>1.3127</td>
<td>0.3690</td>
<td>3.5570</td>
<td>0.0004</td>
<td></td>
</tr>
<tr>
<td>RINDUSTRY_C</td>
<td>1.0516</td>
<td>0.3201</td>
<td>3.2854</td>
<td>0.0011</td>
<td></td>
</tr>
<tr>
<td>ROAD_DENS</td>
<td>-0.0568</td>
<td>0.0096</td>
<td>-5.9068</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPouseEDU2_1</td>
<td>-0.1134</td>
<td>0.0335</td>
<td>-3.3848</td>
<td>0.0007</td>
<td></td>
</tr>
<tr>
<td>SPouseEDU3_C</td>
<td>-1.7110</td>
<td>0.2322</td>
<td>-7.3692</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPouseOC3_1</td>
<td>0.2942</td>
<td>0.0606</td>
<td>4.8523</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TEMP_AVG</td>
<td>0.1862</td>
<td>0.0275</td>
<td>6.7581</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>-0.1152</td>
<td>0.0361</td>
<td>-3.1875</td>
<td>0.0015</td>
<td></td>
</tr>
<tr>
<td>TV_C</td>
<td>0.8651</td>
<td>0.1154</td>
<td>7.4965</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>WATERTP2_C</td>
<td>-0.2134</td>
<td>0.0613</td>
<td>-3.4782</td>
<td>0.0005</td>
<td></td>
</tr>
<tr>
<td>_URBANSLLC_BAREROCKY</td>
<td>0.0186</td>
<td>0.0038</td>
<td>4.8692</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 938  
Number of regressors 154  
Number of regressors in model 20  
Adjusted R squared 0.6356  
Number of clusters in survey 28  
Number of clusters in census 30
Table 8: Expenditure model of Region 4 “North Central Coast”

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>8.0166</td>
<td>1.1809</td>
<td>6.7887</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGE</td>
<td>0.0946</td>
<td>0.0217</td>
<td>4.3703</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>AGESQUARED</td>
<td>-0.0006</td>
<td>0.0001</td>
<td>-4.8994</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.2505</td>
<td>0.0210</td>
<td>-11.9039</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.1239</td>
<td>0.0205</td>
<td>-6.0432</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC1_1</td>
<td>0.3153</td>
<td>0.0474</td>
<td>6.6562</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC2_1</td>
<td>0.3436</td>
<td>0.0399</td>
<td>8.6096</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC3_1</td>
<td>0.2042</td>
<td>0.0553</td>
<td>3.6952</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>HEADOC4_C</td>
<td>-0.2056</td>
<td>0.0689</td>
<td>-2.9857</td>
<td>0.0029</td>
<td></td>
</tr>
<tr>
<td>HOUSSETP1_1</td>
<td>0.1792</td>
<td>0.0236</td>
<td>7.6011</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LNAGE</td>
<td>-1.6264</td>
<td>0.4819</td>
<td>-3.3750</td>
<td>0.0007</td>
<td></td>
</tr>
<tr>
<td>SPOUSEEDU2_1</td>
<td>-0.1300</td>
<td>0.0202</td>
<td>-6.4498</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEOC3_1</td>
<td>0.2403</td>
<td>0.0370</td>
<td>6.4884</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TEMP_AVG</td>
<td>0.1268</td>
<td>0.0181</td>
<td>7.0218</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>-0.1340</td>
<td>0.0241</td>
<td>-5.5642</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TRACKS_DENS</td>
<td>-0.0193</td>
<td>0.0040</td>
<td>-4.8204</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TV_C</td>
<td>0.5985</td>
<td>0.0592</td>
<td>10.1150</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$DAGRI#1</td>
<td>0.1629</td>
<td>0.0443</td>
<td>3.6779</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>_URBAN$RINDUSTRY_C</td>
<td>-0.9377</td>
<td>0.1911</td>
<td>-4.9055</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$WATERTP1#1</td>
<td>0.2806</td>
<td>0.0432</td>
<td>6.4939</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 3272
Number of regressors 159
Number of regressors in model 20
Adjusted R squared 0.4533
Number of clusters in survey 77
Number of clusters in census 81

\[
\frac{\hat{\sigma}_u^2}{\hat{\sigma}_\epsilon^2} = 0.076
\]
Table 9: Expenditure model of Region 5 “South Central Coast”

| Variable               | Coefficient | Std. Err. | t     | Prob>|t| |
|------------------------|-------------|-----------|-------|-----|---|
| _intercept_            | 6.8041      | 0.2597    | 26.1972 | 0.0000 |
| AGESQARED              | -0.0001     | 0.0000    | -4.2540 | 0.0000 |
| DAGRI_1                | -0.1346     | 0.0178    | -7.5609 | 0.0000 |
| ETHNIC_1               | -0.4141     | 0.0756    | -5.4760 | 0.0000 |
| HEADEDU1_1             | -0.1606     | 0.0200    | -8.0233 | 0.0000 |
| HEADEDU4_1             | 0.1484      | 0.0421    | 3.5232  | 0.0004 |
| HEADOC2_1              | 0.1382      | 0.0404    | 3.4198  | 0.0006 |
| HOUSETP1_1             | 0.3044      | 0.0306    | 9.9558  | 0.0000 |
| HOUSETP3_C             | -0.3045     | 0.0620    | -4.9123 | 0.0000 |
| LNAGE                  | 0.4344      | 0.0746    | 5.8210  | 0.0000 |
| MINRROAD_DEN           | 0.0186      | 0.0033    | 5.5888  | 0.0000 |
| PREC_ANNUAL            | -0.0001     | 0.0000    | -7.3523 | 0.0000 |
| REDUC1_C               | 0.4810      | 0.1469    | 3.2737  | 0.0011 |
| ROAD_KM                | 0.0000      | 0.0000    | -5.1179 | 0.0000 |
| SPouseOC3_1            | 0.1845      | 0.0432    | 4.2692  | 0.0000 |
| TOILETTP1_C            | 0.2620      | 0.0632    | 4.1448  | 0.0000 |
| TOILETTP3_1            | -0.1931     | 0.0177    | -10.8999 | 0.0000 |
| WATERTP1_1             | 0.1792      | 0.0294    | 6.0863  | 0.0000 |
| WATERTP1_C             | -0.3346     | 0.0940    | -3.5591 | 0.0004 |
| _URBAN$MKTPAYM         | 0.0000      | 0.0000    | 5.7095  | 0.0000 |

Number of obs. 2600
Number of regressors 160
Number of regressors in model 20
Adjusted R squared 0.5349
Number of clusters in survey 49
Number of clusters in census 58

\[
\frac{\hat{\sigma}_u^2}{\hat{\sigma}_\varepsilon^2} = 0.0744
\]
Table 10: Expenditure model of Region 6 “Central Highland”

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>9.2504</td>
<td>0.4490</td>
<td>20.6026</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.1621</td>
<td>0.0403</td>
<td>-4.0249</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>ETHNIC_1</td>
<td>-0.3055</td>
<td>0.0312</td>
<td>-9.7793</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.1830</td>
<td>0.0304</td>
<td>-6.0248</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC1_1</td>
<td>0.5780</td>
<td>0.1067</td>
<td>5.4150</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADOC2_1</td>
<td>0.3709</td>
<td>0.0761</td>
<td>4.8765</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HOUSSETP1_1</td>
<td>0.1949</td>
<td>0.0582</td>
<td>3.514</td>
<td>0.0008</td>
<td></td>
</tr>
<tr>
<td>LC_ARABLE</td>
<td>0.5695</td>
<td>0.1119</td>
<td>5.0875</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LC_NATFOR</td>
<td>0.0053</td>
<td>0.0009</td>
<td>5.7917</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LNAGE</td>
<td>0.1612</td>
<td>0.0431</td>
<td>3.7368</td>
<td>0.0002</td>
<td></td>
</tr>
<tr>
<td>REDUC3_C</td>
<td>2.6159</td>
<td>0.6300</td>
<td>4.1520</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>SPOUSEEDU5_C</td>
<td>8.2310</td>
<td>2.0783</td>
<td>3.9605</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SPOUSEOC5_C</td>
<td>0.5383</td>
<td>0.1367</td>
<td>3.9368</td>
<td>0.0001</td>
<td></td>
</tr>
<tr>
<td>SUN_ANNUAL</td>
<td>-0.0013</td>
<td>0.0002</td>
<td>-6.8744</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>-0.1010</td>
<td>0.0305</td>
<td>-3.3109</td>
<td>0.0010</td>
<td></td>
</tr>
<tr>
<td>WATERTP1_1</td>
<td>0.1461</td>
<td>0.0563</td>
<td>2.5935</td>
<td>0.0096</td>
<td></td>
</tr>
<tr>
<td>_URBAN$HEADEDU4#1</td>
<td>0.2838</td>
<td>0.0983</td>
<td>2.8864</td>
<td>0.0040</td>
<td></td>
</tr>
<tr>
<td>_URBAN$HOUSETP1#1</td>
<td>0.2734</td>
<td>0.0843</td>
<td>3.2441</td>
<td>0.0012</td>
<td></td>
</tr>
<tr>
<td>_URBAN$HOUSETP2_C</td>
<td>0.5362</td>
<td>0.1010</td>
<td>5.3086</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$REDUC4_C</td>
<td>-7.0019</td>
<td>1.1740</td>
<td>-5.9641</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 1114
Number of regressors 157
Number of regressors in model 20
Adjusted R squared 0.5769
Number of clusters in survey 32
Number of clusters in census 37

\[
\frac{\hat{\sigma}_\eta^2}{\hat{\sigma}_u^2} = 0.027
\]
Table 11: Expenditure model of Region 7 “North East South”

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Std. Err.</th>
<th>t</th>
<th>Prob&gt;</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>intercept</em></td>
<td>7.5747</td>
<td>0.0623</td>
<td>121.5565</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>DAGRI_1</td>
<td>-0.1503</td>
<td>0.0194</td>
<td>-7.7584</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>ETHNIC_1</td>
<td>-0.2755</td>
<td>0.0383</td>
<td>-7.1876</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU1_1</td>
<td>-0.0801</td>
<td>0.0164</td>
<td>-4.8953</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HEADEDU4_1</td>
<td>0.3071</td>
<td>0.0355</td>
<td>8.6418</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>HOUSETP1_1</td>
<td>0.2676</td>
<td>0.0222</td>
<td>12.0608</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>LC_NATFOR</td>
<td>0.0024</td>
<td>0.0003</td>
<td>6.9676</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>PCTSLOPE1</td>
<td>0.0036</td>
<td>0.0005</td>
<td>7.7613</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>RINDUSTRY_C</td>
<td>0.6390</td>
<td>0.0703</td>
<td>9.0874</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>ROAD_DENS</td>
<td>-0.0279</td>
<td>0.0026</td>
<td>-10.5697</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>ROAD_KM</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-6.2367</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TOILETTP3_1</td>
<td>-0.1842</td>
<td>0.0227</td>
<td>-8.1005</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TRACKS_DENS</td>
<td>0.0454</td>
<td>0.0041</td>
<td>11.0395</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>TV_C</td>
<td>0.4446</td>
<td>0.0753</td>
<td>5.9083</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$AGESQUARED</td>
<td>0.0000</td>
<td>0.0000</td>
<td>-5.1074</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$MKTPERCOM</td>
<td>-0.1806</td>
<td>0.0207</td>
<td>-8.7337</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$ROAD_DENS</td>
<td>0.0369</td>
<td>0.0026</td>
<td>14.0487</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$SPOUSEEDU5_C</td>
<td>2.6291</td>
<td>0.3642</td>
<td>7.2189</td>
<td>0.0000</td>
<td></td>
</tr>
<tr>
<td>_URBAN$WATERTP1#1</td>
<td>0.2816</td>
<td>0.0250</td>
<td>11.2494</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>

Number of obs. 3806
Number of regressors 159
Number of regressors in model 19
Adjusted R squared 0.6307
Number of clusters in survey 81
Number of clusters in census 84

$$\hat{\sigma}_\eta^2 / \hat{\sigma}_\epsilon^2 = 0.096$$
Table 12: Expenditure model of Region 8 “Mekong River Delta”

|                       | Coefficient | Std. Err. | t     | |Prob>|t|     |
|-----------------------|-------------|-----------|-------|------|------|-------|
| _intercept_           | 7.4917      | 0.1081    | 69.3175 | 0.0000 |
| DAGRI_1               | -0.1051     | 0.0144    | -7.2861 | 0.0000 |
| ELEV_MEAN             | 0.0058      | 0.0008    | 7.4368 | 0.0000 |
| ETHNIC_1              | -0.1543     | 0.0246    | -6.2819 | 0.0000 |
| HEADEDU1_1            | -0.1515     | 0.0130    | -11.6329 | 0.0000 |
| HEADOC2_1             | 0.2560      | 0.0397    | 6.4519 | 0.0000 |
| HOUSETP1_1            | 0.3343      | 0.0250    | 13.3575 | 0.0000 |
| HOUSETP1_C            | -2.5688     | 0.3244    | -7.9173 | 0.0000 |
| HOUSETP3_C            | -0.5148     | 0.0548    | -9.3874 | 0.0000 |
| LNAGE                 | 0.1845      | 0.0206    | 8.9445 | 0.0000 |
| MKTPERCOM             | 0.0753      | 0.0102    | 7.3531 | 0.0000 |
| RADIO_C               | 0.4232      | 0.0826    | 5.1241 | 0.0000 |
| SPOUSEEDU2_1          | -0.1234     | 0.0125    | -9.8540 | 0.0000 |
| SPOUSEOC2_C           | 18.5993     | 3.9339    | 4.7279 | 0.0000 |
| SPOUSEOC8_C           | 0.2681      | 0.0428    | 6.2613 | 0.0000 |
| TOILETTP3_1           | -0.1104     | 0.0151    | -7.3284 | 0.0000 |
| WATERTP1_1            | 0.1398      | 0.0174    | 8.0260 | 0.0000 |
| _URBAN$AGESQUARED     | -0.0001     | 0.0000    | -7.2447 | 0.0000 |
| _URBAN$HEADOC3#1      | 0.1782      | 0.0441    | 4.0422 | 0.0001 |
| _URBAN$HOUSETP1_C     | 2.1786      | 0.3441    | 6.3315 | 0.0000 |
| _URBAN$SPOUSEEDU5#1   | 0.2965      | 0.0712    | 4.1625 | 0.0000 |
| _URBAN$TOILETTP3_C    | 0.3495      | 0.0632    | 5.5284 | 0.0000 |

Number of obs. 5908
Number of regressors 159
Number of regressors in model 22
Adjusted R squared 0.3364
Number of clusters in survey 102
Number of clusters in census 107

\[ \frac{\sigma^2_{\eta}}{\sigma^2_{\epsilon}} = 0.101 \]