Rural Poverty and Inequality Maps in Vietnam: Estimation using Vietnam Household Living Standard Survey 2006 and Rural Agriculture and Fishery Census 2006

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Abstract

The objective of this paper is to estimate poverty and inequality for rural Vietnam at different levels of aggregation by combining the Vietnam Household Living Standard Survey (VHLSS) from 2006 and the Rural Agriculture and Fishery Census from the same year. Using the small area estimation method, we will produce estimates at the region, province at district level, and will consider both expenditure and income based measures. It is found that all provinces across the country have experienced a noticeable reduction in rural poverty during the period 1999-2006. Some of the largest reductions in poverty are observed for provinces with poverty rates close to the national average. Also the poorest provinces are experiencing reductions in poverty, albeit at a more modest pace. Provinces and districts with a larger poverty reduction in the period 1999-2006 tend to have a lower level of inequality in 2006. Results based on expenditure poverty estimates are found to be very similar to those based on income poverty estimates.

JEL classification: I31, I32, O15

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

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1. INTRODUCTION

Vietnam has set up poverty reduction as a major development policy. To achieve this goal, Vietnam has maintained extensive public safety net and launched a large number of poverty reduction programs. Various studies such as Bigman and Fofack (2000) and Elbers *et al.* (2007) shows that impact of budget transferring on poverty is larger when geographic targeting units are smaller such as districts and villages. Poverty map can be an important tool for poverty targeting.

Up to now, several poverty maps have been constructed in Vietnam using the small area estimation technique put forward by Elbers *et al.* (2003) (henceforward ELL). At the national level, Minot (2000) combined the Vietnam Living Standard Survey (VLSS) in 1993 and the Agricultural Census in 1994 to estimate the rural poverty of provinces and districts. Minot *et al.* (2002) and Gian and van der Weide (2007) combined the 1998 VLSS and a 33% sample of a population census in 1999 to construct poverty and inequality of provinces and districts. In addition, in analyzing the effects of Vietnam's access to WTO on poverty, Fujii and Roland-Holst (2008) also applied the small area estimation method to provincial poverty rates using the 1998 VLSS and the 33% sample of the 1999 population census. Nguyen et al. (2007) tried to combine Vietnam Household Living Standard Survey (VHLSS) in 2002 and the 1999 population census to estimate the poverty for 2002. At the provincial level, Nguyen et al. (2005) and Nguyen et al. (2007) produced the district map of poverty and inequality of Ho Chi Minh city for the year 2004. Recently, Tran (2007) made the poverty of 7 provinces using VHLSS in 2004 and the Rural Agriculture and Fishery Census in 2006. However, most of the maps, especially, national maps on provinces and districts are out-of-date.

The objective of this study is to estimate poverty and inequality for rural Vietnam at different levels of aggregation by combining the Vietnam Household Living Standard Survey (VHLSS) from 2006 and the Rural Agriculture and Fishery Census from the same year. We will produce estimates at the region, province at district level, and will consider both expenditure and income based measures. The estimates are obtained by adopting the small area estimation method of ELL, which has since been used to put poverty on the map in over fourty countries worldwide.

The information on all households provided for by the census combined with the detailed information on selected households from the survey makes it possible to estimate poverty at levels of aggregation the survey alone does not allow for. The standard errors of our province level estimates are comparable to the standard errors of the region level estimates based on survey data only. The standard errors of our district level estimates are obviously larger, but still acceptable.

The use of the agricultural census denotes a modest variation on the approach of ELL, which conventionally uses a population census instead. The motivation for appealing to the agricultural census is that the population census is only available once every ten years. In Vietnam, the agricultural census is conducted every five years. This means that by alternating the population census with the agricultural census we are able to triple the frequency of poverty and inequality estimates at the small area level. The latter is important as it makes the small area estimation exercise a more suitable tool to monitor poverty and inequality over time, channel resources when and where they are most needed, and to evaluate poverty reduction initiatives across the different areas in Vietnam.

While replacing the population census with the agricultural census does not require any methodological changes, there are some differences worth noting. Most importantly, the agricultural census only allows us to provide estimates for rural Vietnam, where the population census covers both rural and urban areas. Also, the two different census data sets each have their own specific variables, in addition to a standard set of variables that they have in common. Plausibly, the agricultural census is in comparison more informative of rural livelihoods.

It is found from this study that poverty remains a geographical phenomenon in Vietnam. North West and High Lands have very high poverty, while delta regions such as Red River Delta and South East have much lower poverty. In addition, poverty varies significantly across provinces and districts. It is interesting that income poverty estimates are very similar to the expenditure poverty estimates, at both the provincial and district levels. All the provinces experienced rural poverty reduction during the period 1999-2006. Poverty is reduced remarkably in provinces with the poverty rate around the average poverty level. However, very poor provinces are not very successful in poverty reduction. Compared with the poverty estimates from Minot et al. (2002), our poverty estimates are closer to the MOLISA poverty rates. The spatial pattern of poverty is also similar between the MOLISA poverty and our poverty estimates.

Regarding to expenditure inequality, the Gini estimates of provinces and districts are quite low. As expected, income inequality is higher than expenditure inequality. It is interesting that inequality tends to be higher for the low poverty areas and high poverty areas. Inequality becomes highest in areas with middle poverty rates.

The remainder of this study is structured into seven sections. The second section describes data sources. The third section presents the method of small area estimation of Elbers *et al.* (2003). Section four presents the selected explanatory variables that are available in both the survey and the census, and are considered to be comparable. The poverty and inequality estimates and the models used for respectively the expenditure and income based measures are reported in sections five and six. Section seven compares the

estimates of expenditure based poverty to those based on income, and compares our small area estimates of poverty for 2006 to those obtained earlier for 1999. Finally, concluding remarks are presented in section eight.

2. DATA SOURCES

The two data sources that will be combined are: The Vietnam Household Living Standard Survey (VHLSS) for 2006 and the 50% sample of the Rural Agriculture and Fishery Census (ARFC) for 2006. Both data sets have been collected by the General Statistic Office of Vietnam (GSO).

The VHLSS 2006 includes 9189 households (with 39071 individuals), of which 2250 are urban and 6939 rural households. The collected information on household characteristics includes income, expenditure, employment status, education level, housing condition, fixed assets owned by household. The survey is designed to be representative at the regional level. This means that the survey is not able to guarantee consistent poverty estimates at lower level of aggregation.

The Rural Agriculture and Fishery Census (RAFC) includes all households in rural areas, and is conducted every five years. While the agricultural census and the population census have a range of variables in common (demographics, education, dwelling unit characteristics and asset ownership), there are also some important differences.

Firstly, the agricultural census only covers rural households such that the small area poverty and inequality estimates represent the rural population of Vietnam. Estimates based on the population census represent the entire population.

Secondly, the agricultural census includes a selection of specific variables that are particularly informative of rural livelihoods and which are not available in the population census. These include variables on rice cultivation, aquatic cultivation, household ownership of farming tools and machinery. These variables are important correlates of the household's agricultural activities that will directly affect the household's income.

Data on individual household members, however, is only collected for members aged 15 or older (the population census cover all household members). To ensure consistency between the variables from the census and the survey, household members aged 14 or younger were also dropped from the latter. Also, the head of household is not identified in the agricultural census.

Finally, the codes that identify communes, districts and provinces did not provide a perfect match between the census and the survey. We managed to resolve this problem

by using the names of both the provinces and districts to merge data from different sources.

3. METHODOLOGY

The small area estimation method developed by Elbers, Lanjouw and Lanjouw (2002, 2003) is arguably most popular in the context of poverty analysis. In ELL two data sets, a socio-economic survey and a census are combined through an expenditure model. This combination allows us to obtain small area estimates (SAE) of income or expenditure based poverty and inequality. By using the survey alone, we would only be able to disaggregate at the region level.

Typical indicators considered are average expenditure/income, percentage of poor (with expenditure/income below poverty line), poverty density (number of poor per area) and the Gini coefficient (see subsection 3.2 for formal definitions). We will determine both the point estimates and the standard errors associated with them. The standard errors are important because they make explicit the trade-off between the statistical precision of the poverty and inequality estimates and the level of disaggregation. While the standard errors for smaller geographic areas tend to be larger, the errors for estimates based on a few thousand households (think of a district) are often found small enough to be acceptable.

The census is assumed to enjoy complete coverage (of all rural households), such that sampling error may safely be ignored. The basic idea behind the small area estimation method is to replace a small number of exact observations of expenditure/income (using households from the survey) with a large number of estimates of expenditure/income (using households from the census) to obtain accurate estimates of aggregate poverty and inequality. This means that we will be replacing sampling error with approximation error. As approximation errors cancel out on average, the errors induced by approximation tend to be small when the number of households is large.

The ELL framework

Let us provide a brief review of the ELL methodology. In the standard setup, we consider the following model:

$$\ln(y_{ch}) = x_{ch}^T \beta + \eta_c + \varepsilon_{ch}, \qquad (1)$$

Where $\ln(y_{ch})$ denotes the dependent variable (think of logarithmic per capita expenditure), x_{ch} the vector of explanatory variables, β the vector of regression coefficients, η the cluster-specific random effect and ε the household-specific random effect. The subscript *ch* refers to household *h* living in cluster *c*. The explanatory variables x_{ch} must be available in both census and survey. The household specific errors are assumed to be independent from each other, and independent from the cluster error.

Once all the parameters of interest have been identified, the dependent variable is imputed into the census:

$$\hat{\ln}(y_{ch}) = x_{ch}^T\hat{\beta} + \hat{\eta}_c + \hat{\varepsilon}_{ch}, \qquad (2)$$

where $\hat{\beta}$, $\hat{\eta}_c$ and $\hat{\varepsilon}_{ch}$ denote the estimates for β, η_c and ε_{ch}. Now suppose that we want to estimate poverty for a given district. As an illustrative example, let us consider the head-count index, which measures the percentage of poor households in the district:

$$W = \frac{1}{n}\sum\nolimits_{ch} 1_{(y_{ch}<z)}, \qquad (3)$$

where $1_{(y<z)}$ denotes the indicator function that equals 1 if $y < z$ and 0 otherwise, and where *n* denotes the number of households living in the district. An estimate of W can be obtained by replacing y_{ch} with $\hat{y}_{ch}$ for all households *ch*.

For accurate estimation of the standard error of W, ELL advocate repeated Monte-Carlo simulations. In each round, a simulated regression coefficient $\tilde{\beta}^{(r)}$ is drawn (from its estimated distribution), where r denotes the r-th round of simulation. Further, $\tilde{\eta}_c^{(r)}$ and $\tilde{\varepsilon}_{ch}^{(r)}$ are drawn from their estimated distributions, which means we will have a simulated cluster error for each cluster and a simulated household error for each household in the census. The imputed dependent variable for household h in cluster c, in the r-th round, is therefore given by:

$$\tilde{\ln}(y_{ch})^{(r)} = x_{ch}^T\tilde{\beta}^{(r)} + \tilde{\eta}_c^{(r)} + \tilde{\varepsilon}_{ch}^{(r)}, \qquad (4)$$

Each round of simulation yields a new estimate $\tilde{W}^{(r)}$. By taking the average and standard deviation over the R different simulated values of $\tilde{W}^{(r)}$, we obtain both the point estimate and the corresponding standard error.

Two key assumptions

The ELL method is based on two key assumptions:

Model is accurate at each level it is applied: Tarozzi and Deaton (2007) refer to this as the `area homogeneity' assumption. While the model is typically estimated at the regional level, predicted expenditures are aggregated over much smaller areas (think of provinces and districts). Consistency therefore requires that any omitted variables, which end up in the error term, have zero expectation at any level of aggregation.

Spatial correlation is accurately accounted for: The errors for different households are likely to exhibit a level of correlation, in particular when the households live close to each other such that they are subject to similar (unobserved) geographical effects. An accurate account of this spatial correlation is important for the precision of the standard errors of the SAEs.

ELL accommodate spatial correlation by assuming that the error can be decomposed into a cluster error (an error that is shared by all households living in the same cluster) and a household specific error. The common error is referred to as location error. The household specific error will also be referred to as idiosyncratic error. Empirical results from a wide range of countries indicate that spatial correlation is indeed significant, and that the approach put forward by ELL works quite well.

To illustrate the effect of spatial correlation, consider for simplicity the case where the variance of both the location and idiosyncratic error is assumed constant, such that the variance of the average total error is given by:

$$\text{var}\left[\frac{1}{n}\sum\nolimits_{ch} u_{ch}\right] = \frac{\sigma_\eta^2}{k} + \frac{\sigma_\varepsilon^2}{n}. \qquad (5)$$

where k and n denote the number of clusters and number of households, respectively. The number of clusters will obviously be much smaller than the number of households, which means that the variance of the location error will play an important role in the size of standard errors. While the errors of the SAEs will not be of this convenient linear form, as they are non-linear functions of the location and idiosyncratic errors, they show a similar dependence on the number of clusters and the number of households.

A violation of either of the two key assumptions will affect the precision of the SAEs. Therefore, each time the methods is used, it is important that the user tests the validity of these assumptions, as this may vary from country to country. Specifically, if one decides to ignore spatial correlation, while it is in fact present, one runs the risk of significantly underestimating the standard errors, and hence overestimating precision.

Definitions of poverty and inequality indicators

The three poverty indicators considered are all special cases of the more general Foster-Greer-Thorbecke (FGT) poverty measure (see Foster et al, 1984). It will be convenient to introduce the following two variables (which will feature in the definitions of the poverty indicators). First the consumption shortfall of household *ch* to the poverty line:

$$g_{ch} = \max\left[0, z - y_{ch}\right] \geq 0, \tag{6}$$

which is zero when $y_{ch} \geq z$, and equals $z - y_{ch}$ when $y_{ch} < z$. Second, $n(y,z)$ will denote the number of poor households (whose consumption falls short of the poverty line).

The head-count index:

$$P_0\left(y,z\right) = \frac{n(y,z)}{n}, \tag{7}$$

where *n* denotes the total number of households. The head-count is arguably the most popular and frequently used measure of poverty, largely due to its cleanness; it simply measures the percentage of poor. In its simplicity however it provides no information on how poor the poor are exactly; for example how far are the poor from escaping poverty?

The poverty gap index:

$$P_1\left(y,z\right) = \frac{1}{n}\sum_{ch}\left(\frac{g_{ch}}{z}\right) = P_0\left[\frac{1}{n(y,z)}\sum_{ch}\left(\frac{g_{ch}}{z}\right)\right], \tag{8}$$

where P_0 denotes the head-count index. The poverty gap index equals the head-count index times the standardized gap between the average poor household and the poverty line. It is therefore informative on the level of poverty among the poor; the index increases both when the number of poor increases and when the poor become more poor. However it is insensitive to transfers of resources among the poor; a transfer from the moderately poor to the very poor leaves the poverty gap index unchanged.

The poverty severity index:

$$P_2\left(y,z\right) = \frac{1}{n}\sum_{ch}\left(\frac{g_{ch}}{z}\right)^2 = P_0\left[\frac{1}{n(y,z)}\sum_{ch}\left(\frac{g_{ch}}{z}\right)^2\right], \tag{9}$$

where P_0 denotes the head-count index. Let us define $G_{ch} = g_{ch}/z$ (the standardized shortfall) and $\bar{G} = \sum G_{ch}/n(y,z)$ (the average shortfall). Then we may rewrite poverty severity as:

$$P_2(y,z) = P_0\left[\bar{G}^2 + \frac{1}{n(y,z)}\sum_{ch}\left(G_{ch} - \bar{G}\right)^2\right]. \tag{10}$$

This representation tells us that, in addition to the number of poor and the average level of poverty among the poor, the severity index is also sensitive to changes in inequality among the poor (the term on the right). A transfer from the moderately poor to the very poor will reduce poverty severity.

Inequality measure

To measure the inequality, we use the most common measure of inequality of the Gini coefficient. The Gini index can be calculated from the individual expenditures or incomes in the population as follows:

$$G = \frac{1}{2n(n-1)\mu}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y_i - y_j\right| \tag{11}$$

where y_i is the income of the i^{th} person, and n is the total number of people in the population. The double sum in (11) can be hard to calculate if n is relatively large, and an equivalent but computationally more convenient form is:

$$G = \frac{n+1}{n-1} - \frac{2}{n(n-1)\mu}\sum_{n}\rho_i y_i \tag{12}$$

where ρ_i is the rank of individual i in the y-distribution, counting from the top so that the richest has the rank of 1.

The value of the Gini coefficient varies from 0 when everyone has the same income to 1 when one person has everything. The closer a Gini coefficient is to one, the more unequal is the income distribution. For most developing countries, Gini coefficients for expenditures or incomes range between 0.3 and 0.6.

4. SELECTION OF EXPLANATORY VARIABLES

The first step in the poverty mapping is to select the explanatory variables in the regression model of consumption expenditure and income. These variables should meet the following criteria:

- Available in both the household survey and the census.
- Comparable between the household survey and census, i.e., they are constructed in similar definitions and have similar distribution.
- Correlated with household expenditure and income.

Ideally, data on the common variables between the survey and census are collected using the same questionnaires. The condition that the common variables are the same for households in the census and the survey is mentioned as an assumption on "measurement of predictors" by Tarozzi and Deaton (2007). The closeness of the data collection including questionnaires between the survey and census is required to ensure this assumption. Thus, the selected explanatory variables from the survey and the census should be similar not only in the distribution but also in the questionnaires used to collect data on these variables. When the questionnaires of the survey and the census are not identical, we have to find some ways to define variables so that the defined variables are comparable between the survey and the census.

After comparing the mean and standard deviation, and questionnaires of different common variables in the 2006 VHLSS and the 2006 RAFC, we select 27 household variables which will be used as the explanatory variables in the models of household expenditure and income. Table 1 presents the list of the selected variables, and Tables in Appendix 1 reports the basic statistics of these variables in the 2006 VHLSS and the 2006 RAFC. In general, the selected household variables are quire similar in the definition and basic statistics.

Table 1: Common household variables between the 2006 VHLSS and the 2006 RAFC

Variable	Type	Questionnaires
Ethnic minorities (yes=1)	Binary	The same
Household size	Discrete	The same
Permanent house	Binary	Practically the same
Semi-permanent house	Binary	Practically the same
Temporary house	Binary	Practically the same
Tap water	Binary	Practically the same
Clean water	Binary	Practically the same
Other water	Binary	Practically the same
Flush toilet	Binary	Practically the same
Other toilets	Binary	Practically the same
No toilet	Binary	Practically the same
Have Radio	Binary	The same
Have Computer	Binary	The same
Have Motorbike	Binary	The same
Have Color television	Binary	The same
Have Mobile	Binary	The same
Have Telephone	Binary	The same
Have Fridge	Binary	The same
Have Fan	Binary	The same
Ratio of female members to working members	Continuous	Practically the same
Ratio of working member to household size	Continuous	Practically the same
Ratio of service members to working members	Continuous	Practically the same
Ratio of working members without vocational training	Continuous	Practically the same
Ratio of working members with vocational training	Continuous	Practically the same
Ratio of working members with college/university	Continuous	Practically the same
Log of per capita living area (log of m2)	Binary	The same
Have or own annual land (yes=1)	Binary	Practically the same

It should be noted that we use the household variables from the 2006 ARFC to estimate the variable means at the commune variables. For example, we construct the percentage of ethnic minorities of communes, the average household size of communes, etc. These variables are called mean variables of communes, and they can be merged with the 2006 VHLSS to estimate the consumption and income models.

In addition to household variables and mean variables of commune, commune variables from the 2006 ARFC and GIS variables are also merged to the 2006 VHLSS and to construct the consumption and income models. The list of the commune and GIS variables is presented in Table 2.

Table 2: Commune variables and GIS district variables

Variable	Type
Commune variables	
Commune have national electricity system cover all villages	Binary
The road to this commune center is concrete and always available in year	Binary
Ratio of concrete road in commune	Continuous
Numbers of primary schools per 1000 households	Discrete
Numbers of secondary schools per 1000 households	Discrete
Number of irrigation per 1000 households	Discrete
Number of extension staff per 1000 households	Discrete
Number of markets per 1000 households	Discrete
Number of concrete markets per 1000 households	Discrete
Have bank branch	Binary
GIS variables at the district level	
Percentage of area elevation lower than 250m in total area	Continuous
Percentage of area slope lower 4 degree in total area	Continuous
Mean Elevation	Continuous
Mean Sunshine	Continuous
Mean temperature	Continuous
Mean rainfall	Continuous

5. ESTIMATES OF EXPENDITURE POVERTY AND INEQUALITY

5.1. Expenditure Model

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 a separate expenditure model for each region.

To examine the sensitivity of the poverty estimates to model specifications, for each region, we compare 2 different models, which mostly vary in the number of explanatory variables they included. These models refer large and small specification. In total, there are 16 expenditure regressions. In general, to avoid over-fitting, we tend to use relatively small, but robust models.

It should be noted that we used the latest version of the PovMap program to estimate poverty and inequality (updated in March 2009).[2] Districts are specified as cluster in modeling location effect. This software reports the results from the GLS regression.

Tables from 3 to 10 present the GLS regressions of logarithm of per capita expenditure. In these tables, results from both the large and small models are reported. It

[2] The program is developed by researchers of WB.
http://iresearch.worldbank.org/PovMap/PovMap2/PovMap2Main.asp

shows that all the explanatory variables have expected and reasonable signs. The large and small models give very similar size of coefficient estimates.

Table 3: Expenditure regression: Red River Delta

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.935	0.082	0.000	7.943	0.078	0.000
Household variables						
Have computer	0.197	0.06	0.001			
Have mobile	0.154	0.033	0.000			
Have mobile	0.203	0.022	0.000	0.233	0.022	0.000
Have fridge	0.135	0.028	0.000			
Have telephone	0.176	0.026	0.000	0.255	0.025	0.000
Household size	-0.056	0.008	0.000	-0.064	0.008	0.000
Log of living area per capita	0.114	0.021	0.000	0.138	0.022	0.000
Flush toilet	0.135	0.024	0.000	0.18	0.025	0.000
% working members without vocational training	-0.152	0.03	0.000			
% working member to household size	0.34	0.039	0.000	0.257	0.037	0.000
Commune variables						
% households have mobile in commune	0.583	0.168	0.001			
% concrete road in commune	0.098	0.037	0.008			
Number of obs.	1521			1521		
Number of cluster	92			92		
Adj-Rsquared	0.439			0.389		
Rho[3]	0.096			0.098		

[3] Rho is the ratio of $\hat{\sigma}_{\eta}^{2} / \hat{\sigma}_{u}^{2}$, which measures the relative component of location errors in the total errors in the model.

Table 4: Expenditure regression: North East

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	8.098	0.141	0.000	8.684	0.155	0.000
Household variables						
Have fan	0.118	0.03	0.000			
Have mobile	0.201	0.054	0.000	0.301	0.065	0.000
Have motorbike	0.271	0.025	0.000	0.32	0.025	0.000
Have fridge	0.16	0.045	0.001			
Have telephone	0.119	0.043	0.006	0.219	0.04	0.000
Ethnic minority	-0.064	0.033	0.049			
Household size	-0.122	0.028	0.000	-0.07	0.01	0.000
Household size squared	0.006	0.002	0.014			
Temporary house type	-0.139	0.03	0.000	-0.163	0.031	0.000
Log of living area per capita	0.146	0.03	0.000	0.169	0.03	0.000
No toilet	-0.124	0.041	0.002			
Others water	-0.106	0.029	0.000			
% working members without vocational training	-0.243	0.044	0.000	-0.242	0.043	0.000
% service members to working members	0.116	0.045	0.010			
% working member to household size	0.16	0.051	0.002			
Commune variables						
Commune mean of % service members to working members	0.487	0.172	0.005			
Average of household size in commune				-0.139	0.03	0.000
Number of obs.	1017			1017		
Number of cluster	105			105		
Adj-Rsquared	0.571			0.519		
Rho	0.136			0.166		

Table 5: Expenditure regression: North West

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.749	0.196	0.000	6.580	0.113	0.000
Household variables						
Have fan	0.154	0.044	0.001			
Have motorbike	0.327	0.042	0.000	0.339	0.037	0.000
Have fridge	0.235	0.089	0.009	0.458	0.118	0.000
Ethnic minority	-0.254	0.068	0.000			
Household size	-0.044	0.012	0.000			
Log of living area per capita	0.215	0.051	0.000	0.392	0.043	0.000
Flush toilet	0.249	0.085	0.004			
No toilet	-0.250	0.058	0.000	-0.275	0.058	0.000
% working members without vocational training	-0.192	0.082	0.020			
Commune variables						
% households have color TV in commune				0.453	0.102	0.000
Number of obs.	346			346		
Number of cluster	33			33		
Adj-Rsquared	0.595			0.531		
Rho	0.112			0.111		

Table 6: Expenditure regression: North Central Coast

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.487	0.169	0.000	6.763	0.114	0.000
Household variables						
Have fan	0.140	0.035	0.000			
Have motorbike	0.281	0.027	0.000	0.295	0.025	0.000
Have fridge	0.251	0.057	0.000	0.260	0.056	0.000
Have telephone	0.198	0.042	0.000	0.210	0.041	0.000
Household size	-0.050	0.010	0.000			
Temporary house type	-0.142	0.044	0.001			
Log of living area per capita	0.186	0.033	0.000	0.290	0.026	0.000
No toilet	-0.197	0.043	0.000			
% working members without vocational training	-0.174	0.056	0.002	-0.255	0.048	0.000
% service members to working members	0.173	0.048	0.000			
% working member to household size	0.378	0.057	0.000	0.371	0.056	0.000
Commune variables						
% households have color TV in commune	0.399	0.102	0.000	0.679	0.110	0.000
% households have others toilet in commune	-0.280	0.070	0.000			
Number of obs.	849			849		
Number of cluster	76			76		
Adj-Rsquared	0.542			0.500		
Rho	0.102			0.103		

Table 7: Expenditure regression: South Central Coast

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.535	0.103	0.000	7.450	0.104	0.000
Household variables						
Have motorbike	0.281	0.033	0.000	0.332	0.034	0.000
Have telephone	0.248	0.045	0.000	0.329	0.047	0.000
Ethnic minority	-0.367	0.067	0.000	-0.392	0.079	0.000
Log of living area per capita	0.260	0.029	0.000	0.286	0.030	0.000
No toilet	-0.082	0.033	0.014			
% working members without vocational training	-0.330	0.053	0.000	-0.166	0.047	0.000
% service members to working members	0.112	0.046	0.015			
% working member to household size	0.365	0.071	0.000			
Number of obs.	585			585		
Number of cluster	53			53		
Adj-Rsquared	0.529			0.492		
Rho	0.066			0.073		

Table 8: Expenditure regression: Central Highland

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.735	0.165	0.000	7.153	0.095	0.000
Household variables						
Have mobile	0.254	0.076	0.001			
Have motorbike	0.362	0.040	0.000	0.324	0.038	0.000
Have telephone	0.326	0.075	0.000	0.438	0.073	0.000
Ethnic minority	-0.332	0.047	0.000	-0.364	0.046	0.000
Household size	-0.227	0.056	0.000			
Log of living area per capita	0.276	0.042	0.000	0.385	0.034	0.000
No toilet	-0.127	0.049	0.009	-0.179	0.048	0.000
Others water	-0.141	0.048	0.003			
Number of obs.	404			404		
Number of cluster	54			54		
Adj-Rsquared	0.695			0.671		
Rho	0.177			0.167		

Table 9: Expenditure regression: South East

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.604	0.120	0.000	7.566	0.123	0.000
Household variables						
Have computer	0.167	0.062	0.008			
Have fridge	0.225	0.042	0.000	0.242	0.041	0.000
Have telephone	0.129	0.038	0.001	0.157	0.038	0.000
Ethnic minority	-0.289	0.062	0.000	-0.334	0.073	0.000
Household size	-0.037	0.009	0.000	-0.036	0.010	0.001
Log of living area per capita	0.250	0.032	0.000	0.287	0.034	0.000
Have motorbike	0.311	0.040	0.000	0.335	0.043	0.000
% working members with vocational training	0.219	0.086	0.011			
Flush toilet	0.194	0.039	0.000	0.213	0.040	0.000
Clean water	0.098	0.040	0.015			
Commune variables						
% households have temporary house in commune	-0.585	0.187	0.002			
% households have radio in commune	0.465	0.194	0.017			
Number of obs.	639			639		
Number of cluster	60			60		
Adj-Rsquared	0.619			0.585		
Rho	0.136			0.153		

Table 10: Expenditure regression: Mekong River Delta

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.642	0.095	0.000	7.180	0.057	0.000
Household variables						
Have annual land	0.048	0.020	0.019			
Have fan	0.133	0.022	0.000	0.142	0.022	0.000
Have mobile	0.174	0.033	0.000	0.186	0.034	0.000
Have motorbike	0.189	0.023	0.000	0.200	0.022	0.000
Have fridge	0.192	0.032	0.000	0.201	0.034	0.000
Have telephone	0.179	0.027	0.000	0.191	0.028	0.000
Ethnic minority	-0.125	0.043	0.004			
Household size	-0.044	0.007	0.000			
Temporary house	-0.103	0.022	0.000			
Log of living area per capita	0.227	0.023	0.000	0.345	0.018	0.000
% working members with vocational training	0.190	0.065	0.004			
% working members with college/university	0.340	0.089	0.000			
% working members to household size	0.143	0.036	0.000			
Commune variables						
% households have mobile in commune	0.776	0.248	0.002	0.801	0.258	0.002
Number of obs.	1466			1466		
Number of cluster	111			111		
Adj-Rsquared	0.512			0.474		
Rho	0.166			0.171		

5.2. Poverty Estimates

5.2.1. Regional estimates

Table 11 presents the estimates of the poverty incidence of 8 rural regions. It shows that the estimates from the small area estimation, both from large and small models, are very close to the estimates based on the 2006 VHLLSS. For Central Highlands, although the point estimates are quite different, the poverty estimates are not statistically different. The standard error associated with the poverty estimate of Central Highlands in the 2006 VHLSS is very high due to the small number of observations.

According to the 2006 VHLSS, the poorest region is North West which has the poverty rate of around 56%. North West, North Central Coast, and High Lands also have high poverty rates, at 30%, 33% and 34%, respectively. The remaining regions have lower poverty rates of around 10%.

Table 11: The poverty incidence estimates of regions

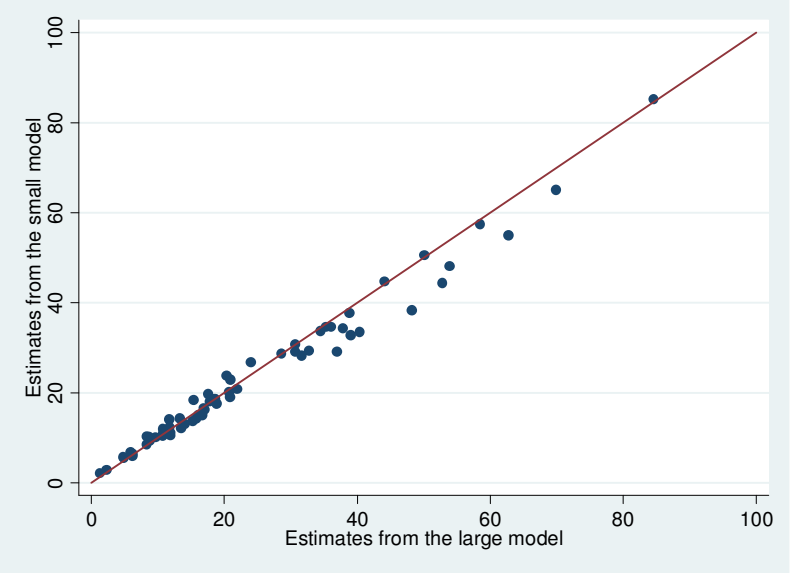
Region	VHLSS 2006	Large model	Small model
Red River Delta	11.0	11.3	11.0
	[1.1]	[0.9]	[1.0]
North East	29.9	31.6	30.0
	[1.8]	[1.6]	[1.8]
North West	56.4	57.3	53.4
	[3.7]	[2.6]	[2.7]
North Central Coast	33.1	32.9	31.4
	[2.4]	[1.7]	[1.8]
South Central Coast	17.1	17.8	17.3
	[2.1]	[1.2]	[1.2]
Central Highlands	34.4	39.9	38.6
	[3.7]	[2.0]	[2.1]
North East South	9.9	10.1	10.4
	[1.5]	[0.9]	[1.1]
Mekong River Delta	11.8	12.6	13.1
	[1.0]	[1.3]	[1.4]

Standard error in the brackets

5.2.2. Provincial estimates

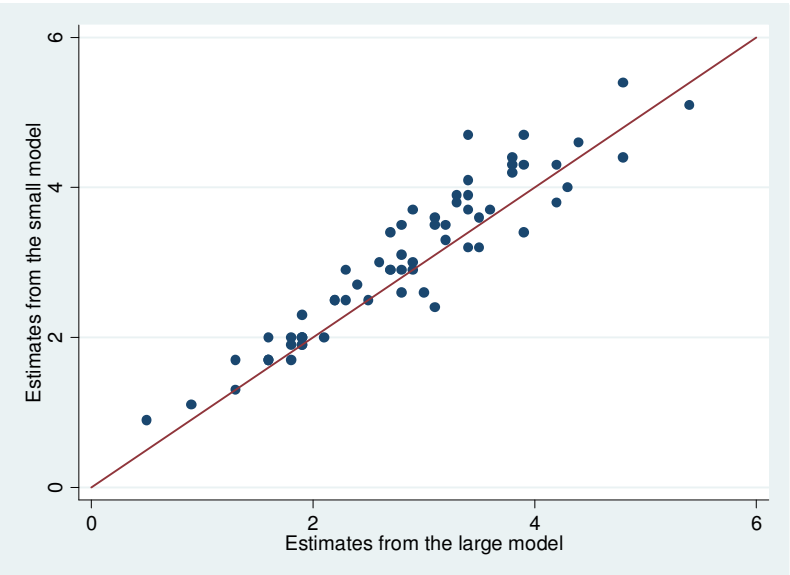
Figure 1 presents the estimates of poverty headcount index of provinces using two models, large and small models. It shows that two models results in very similar estimates of the poverty incidences.

Figure 1: Estimates of the provincial poverty incidence from the large and small models



However, the large model tends to give smaller standard errors than the small model (Figure 2). Thus we incline to use the estimates from the large model for the interpretation. The comparison of estimates of other poverty indexes and Gini coefficient between the small and large models is presented in Appendix 2. In general, both the models yield similar estimates, but the small model tends to have larger standard errors than the large model.

Figure 2: Standard errors of the provincial poverty incidence from the large and small models



The estimates of the provincial poverty are presented in Tables 12 to 20. It shows that the poorest provinces are Lai Chau, Dien Bien, Ha Giang, which have the poverty rate of over 60%. These provinces belong to North West and North East. Cities such as Ho Chi Minh, Ha Noi, Binh Duong have very low rural poverty rates, which are below 5%. In addition, there is a high variation in provincial poverty rate in most regions. In addition to the poverty rate, the poverty gap and severity indexes are also presented in these tables.

Table 12: The expenditure poverty and inequality: Red River Delta

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ha Noi	4.8	1.3	0.0081	0.0026	0.0022	0.0008	0.2871	0.0128
Hai Phong	11.8	2.2	0.0209	0.0049	0.0058	0.0016	0.2514	0.0068
Vinh Phuc	13.5	2.5	0.0242	0.0056	0.0068	0.0019	0.2360	0.0075
Ha Tay	11.9	1.6	0.0213	0.0035	0.0060	0.0012	0.2481	0.0063
Bac Ninh	9.6	1.9	0.0166	0.0040	0.0045	0.0013	0.2560	0.0092
Hai Duong	10.8	1.8	0.0184	0.0039	0.0050	0.0012	0.2312	0.0055
Hung Yen	11.9	1.9	0.0210	0.0041	0.0058	0.0014	0.2344	0.0055
Ha Nam	14.1	3	0.0254	0.0069	0.0071	0.0023	0.2315	0.0068
Nam Dinh	10.8	1.8	0.0186	0.0037	0.0051	0.0012	0.2306	0.0052
Thai Binh	11.3	1.9	0.0194	0.0042	0.0052	0.0013	0.2297	0.0053
Ninh Binh	15.8	3.1	0.0292	0.0073	0.0084	0.0025	0.2355	0.0064
Total	11.3	0.9	0.0200	0.0022	0.0055	0.0008	0.2522	0.0049

Table 13: The expenditure poverty and inequality: North East

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ha Giang	62.7	3.9	0.1765	0.0197	0.0655	0.0100	0.2537	0.0100
Cao Bang	48.2	3.2	0.1279	0.0152	0.0464	0.0077	0.2916	0.0109
Lao Cai	53.9	3.9	0.1480	0.0180	0.0549	0.0088	0.2738	0.0108
Bac Kan	36.9	4.2	0.0886	0.0142	0.0305	0.0061	0.2553	0.0076
Lang Son	40.4	3.8	0.0956	0.0132	0.0323	0.0056	0.2635	0.0076
Tuyen Quang	28.6	4.8	0.0628	0.0138	0.0204	0.0053	0.2799	0.0097
Yen Bai	38.8	4.4	0.0969	0.0156	0.0341	0.0069	0.2693	0.0094
Thai Nguyen	21.9	3.3	0.0438	0.0085	0.0132	0.0030	0.2693	0.0071
Phu Tho	20.9	3.2	0.0405	0.0087	0.0119	0.0032	0.2676	0.0088
Bac Giang	17.6	2.7	0.0341	0.0067	0.0102	0.0024	0.2501	0.0078
Quang Ninh	20.3	2.9	0.0425	0.0072	0.0134	0.0026	0.2839	0.0078
Total	31.6	1.6	0.0751	0.0055	0.0256	0.0024	0.2831	0.0053

Table 14: The expenditure poverty and inequality: North West

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Lai Chau	84.6	2.9	0.3551	0.0292	0.1789	0.0211	0.2745	0.0118
Dien Bien	69.9	3.8	0.2559	0.0245	0.1191	0.0154	0.2907	0.0163
Son La	52.8	3.8	0.1562	0.0181	0.0634	0.0095	0.2718	0.0103
Hoa Binh	44.1	4.3	0.1132	0.0174	0.0410	0.0082	0.2694	0.0103
Total	57.3	2.6	0.1864	0.0135	0.0813	0.0077	0.2909	0.0089

Table 15: The expenditure poverty and inequality: North Central Coast

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Thanh Hoa	36.1	2.4	0.0861	0.0080	0.0296	0.0034	0.2764	0.0057
Nghe An	32.8	2.8	0.0814	0.0087	0.0294	0.0037	0.2910	0.0065
Ha Tinh	30.7	3.1	0.0679	0.0098	0.0221	0.0040	0.2673	0.0066
Quang Binh	30.7	4.2	0.0721	0.0135	0.0248	0.0056	0.2872	0.0082
Quang Tri	35.3	3.6	0.0962	0.0122	0.0373	0.0058	0.2903	0.0071
Thua Thien Hue	24.0	2.6	0.0564	0.0081	0.0195	0.0034	0.2987	0.0073
Total	32.9	1.7	0.0793	0.0056	0.0277	0.0024	0.2858	0.0051

Table 16: The expenditure poverty and inequality: South Central Coast

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Da Nang	8.3	3.4	0.0137	0.0066	0.0037	0.0020	0.2353	0.0054
Quang Nam	17.8	1.6	0.0406	0.0041	0.0140	0.0017	0.2569	0.0072
Quang Ngai	20.7	1.9	0.0493	0.0055	0.0174	0.0023	0.2633	0.0070
Binh Dinh	15.2	1.9	0.0281	0.0043	0.0083	0.0014	0.2387	0.0063
Phu Yen	18.8	2.1	0.0400	0.0053	0.0131	0.0020	0.2514	0.0063
Khanh Hoa	18.5	2.2	0.0429	0.0059	0.0149	0.0024	0.2709	0.0063
Total	17.8	1.2	0.0392	0.0031	0.0132	0.0012	0.2562	0.0059

Table 17: The expenditure poverty and inequality: High Land

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Kon Tum	58.5	3.4	0.1951	0.0208	0.0838	0.0123	0.3416	0.0105
Gia Lai	50.1	2.7	0.1677	0.0158	0.0730	0.0093	0.3438	0.0089
Dak Lak	34.5	2.8	0.0978	0.0116	0.0384	0.0058	0.3219	0.0088
Da Nang	37.9	4.8	0.1051	0.0188	0.0405	0.0091	0.3039	0.0119
Lam Dong	31.6	3.5	0.0889	0.0138	0.0349	0.0068	0.3480	0.0123
Total	39.9	2.0	0.1212	0.0090	0.0498	0.0048	0.3387	0.0075

Table 18: The expenditure poverty and inequality: South East

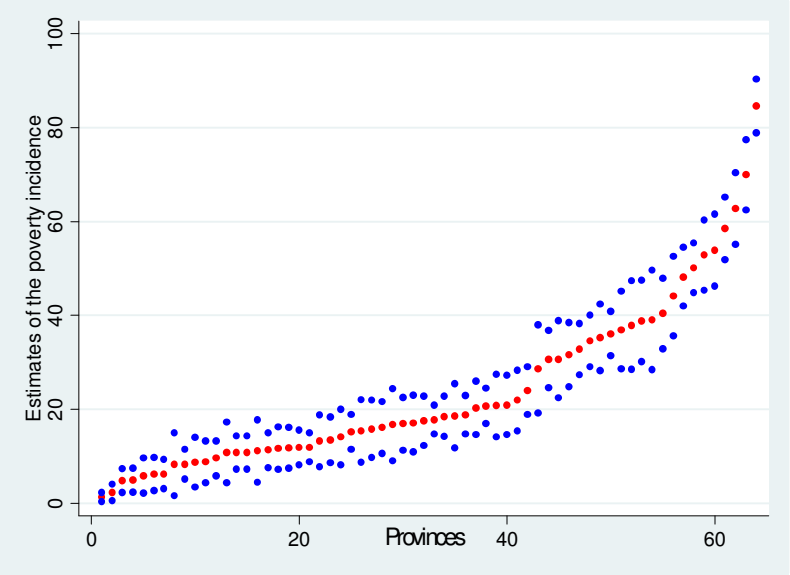
Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ho Chi Minh	2.3	0.9	0.0035	0.0017	0.0009	0.0005	0.2772	0.0106
Ninh Thuan	39.0	5.4	0.1061	0.0202	0.0404	0.0094	0.2797	0.0117
Binh Phuoc	16.1	2.8	0.0341	0.0077	0.0110	0.0031	0.2942	0.0107
Tay Ninh	6.2	1.6	0.0094	0.0032	0.0023	0.0010	0.2515	0.0100
Binh Duong	1.3	0.5	0.0017	0.0009	0.0004	0.0002	0.2724	0.0104
Dong Nai	8.3	1.6	0.0156	0.0037	0.0046	0.0013	0.2894	0.0092
Binh Thuan	16.9	2.9	0.0353	0.0081	0.0112	0.0032	0.2830	0.0095
Vung Tau	5.9	1.9	0.0095	0.0037	0.0025	0.0011	0.2776	0.0091
Total	10.1	0.9	0.0214	0.0025	0.0070	0.0010	0.3053	0.0072

Table 19: The expenditure poverty and inequality: Mekong River Delta

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Long An	4.9	1.3	0.0077	0.0025	0.0020	0.0007	0.2475	0.0073
Dong Thap	11.7	2.3	0.0205	0.0050	0.0057	0.0016	0.2573	0.0072
An Giang	15.4	3.4	0.0291	0.0083	0.0084	0.0029	0.2567	0.0070
Tien Giang	6.2	1.8	0.0104	0.0037	0.0028	0.0011	0.2620	0.0086
Vinh Long	8.7	2.7	0.0144	0.0056	0.0038	0.0018	0.2570	0.0089
Ben Tre	8.8	2.3	0.0155	0.0050	0.0043	0.0016	0.2649	0.0077
Kien Giang	18.6	3.5	0.0365	0.0089	0.0109	0.0032	0.2643	0.0071
Can Tho	11.1	3.4	0.0190	0.0074	0.0051	0.0023	0.2551	0.0123
Hau Giang	10.8	3.3	0.0179	0.0068	0.0047	0.0021	0.2462	0.0083
Tra Vinh	16.7	3.9	0.0321	0.0096	0.0095	0.0034	0.2596	0.0067
Soc Trang	20.8	3.4	0.0431	0.0094	0.0135	0.0036	0.2673	0.0069
Bac Lieu	13.3	2.8	0.0251	0.0067	0.0074	0.0023	0.2718	0.0089
Ca Mau	17.0	3.1	0.0351	0.0081	0.0111	0.0030	0.2843	0.0094
Total	12.6	1.3	0.0235	0.0032	0.0069	0.0011	0.2692	0.0047

It should be noted that the point estimates of poverty cannot be used alone to rank the provincial poverty, since there are standard errors associated with the poverty estimates. To highlight this issue, Figure 3 presents the 95% confidence interval of the poverty incidence of provinces. The red dots are the estimates of the poverty incidence of provinces, while the above and below blue dots present the upper and lower bounds of the 95% confidence interval, respectively. To compare the poverty of two provinces, one can use the 95% confidence interval of the poverty estimates. Roughly speaking, the poverty estimate of one province is statistically significantly higher than the poverty estimate of another province if the lower bound of the 95% confidence interval of the first province is higher than the upper bound of the 95% confidence interval of the second province.

Figure 3: 95% confidence interval of the poverty incidence of provinces

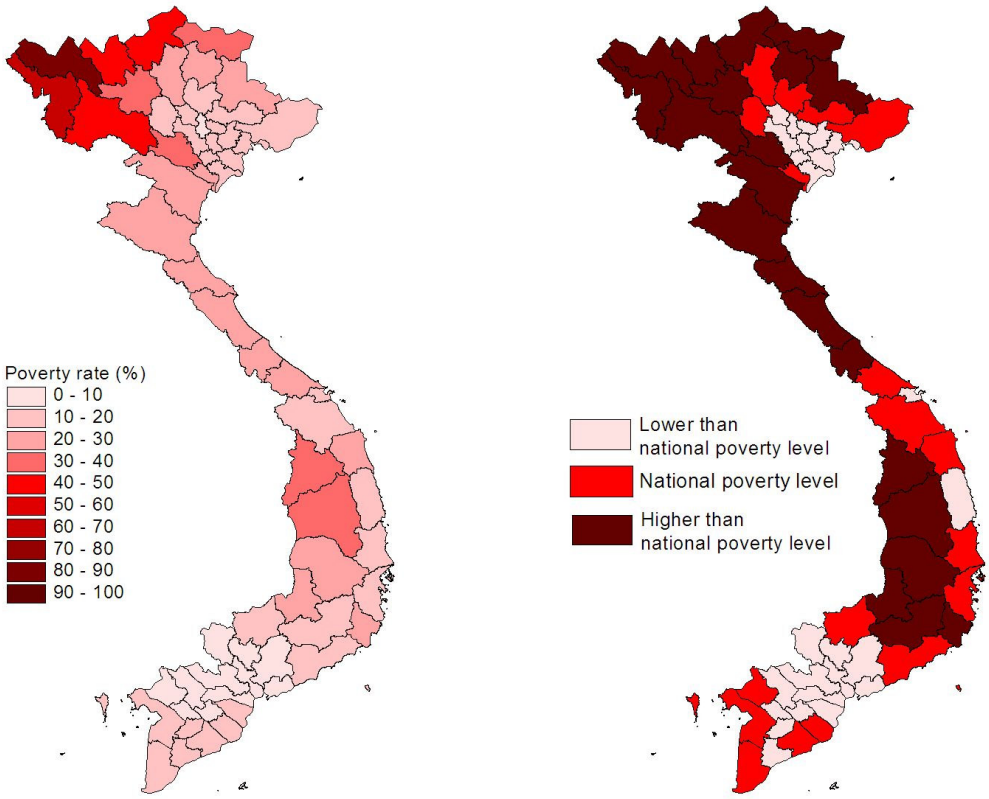


The left panel of Figure 4 presents the map of the poverty incidence of provinces. The darker color reflects higher poverty. The map again shows the spatial aspect of poverty. The North East and High Land regions tend to have higher poverty, while delta regions such as Red River Delta and South East have much lower poverty.

In the right panel of Figure 4, the standard errors of the poverty estimates are taken into account. Provinces are grouped into 3 groups: (i) provinces which have the poverty estimate statistically significant lower than the national poverty level (i.e., 20%), (ii) provinces which have the poverty estimate around than the national poverty level, (i) provinces which have the poverty estimate statistically significant higher than the national poverty level.

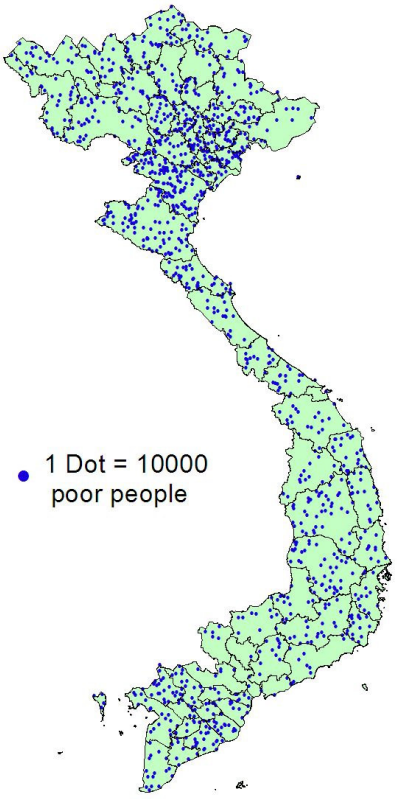
Figure 4: Map of the provincial poverty rates

The poverty rate (%) Compared with national poverty



Although the poverty rate is much higher in North East and Central High Land, the number of the poor in these regions is not high because the lower population. Figure 5 shows the poverty density with a dot presenting 10 thousand poor people. It shows that the poor tends to be more concentrated in delta regions including Red River Delta and Mekong River Delta.

Figure 5: The provincial poverty density



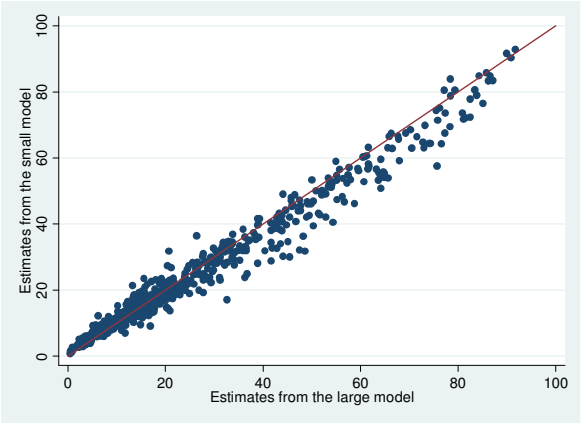
5.2.3. District estimates

For poverty targeting, it is worth to have the poverty estimates of small areas such as districts and communes. Since the number of households in communes is often small, especially when we have the 50% rural sample of the 2006 ARFC. However, the census allows for estimates of district poverty.

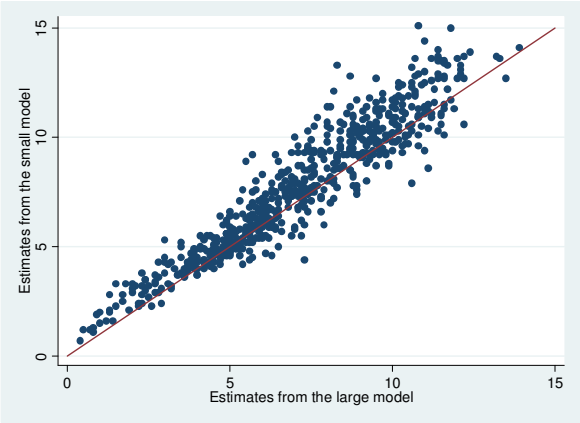
Figure 6 presents the estimates of poverty headcount index of provinces using two models, large and small models. Again it shows that two models results in very similar estimates of the poverty incidences, and the large model tends to give smaller standard errors than the small model.

Figure 6: Estimates of the district poverty incidence from the large and small models

Poverty rate



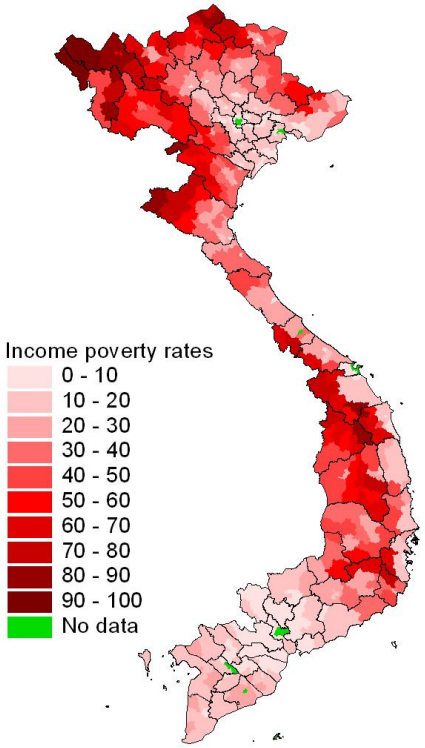
Standard errors



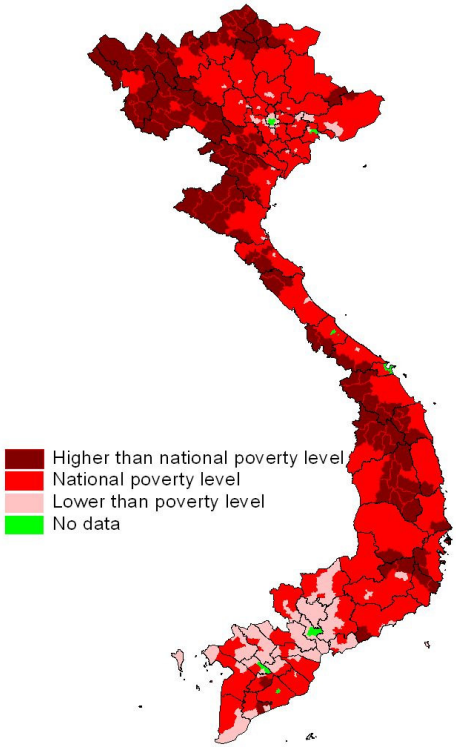
Similar to Figure 4, Figure 7 presents the two maps of the district poverty. It shows that there is a large variation in districts poverty within some provinces. It should be noted that this study estimates rural poverty and inequality, and urban districts which are not analyzed in this study are presented by green colors in maps.

Figure 7: The expenditure poverty incidence of districts

The poverty rate (%)



Compared with national poverty



When ranking district poverty using the poverty estimates, one should take into account the standard errors of the poverty estimates. Figure 8 presents the 95% confidence

interval of the district poverty estimates. The standard errors are quite high at the district level. To examine the standard errors, we graph the poverty estimates and their standard errors by regions (Figure 9). It seems that regions which have low location errors in the expenditure models, e.g., Red River Delta and South Central Coast tend to have lower standard errors of poverty estimates.

Figure 8: The 95% confidence interval of the expenditure poverty incidence of districts

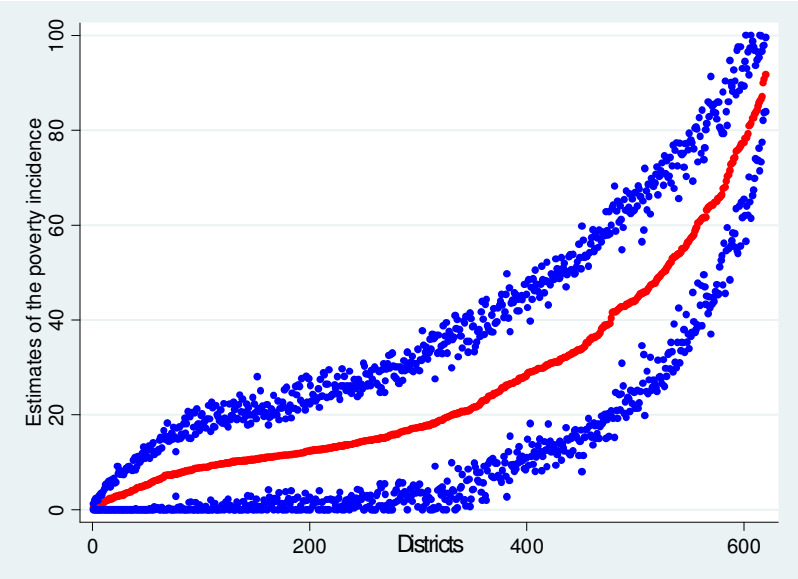
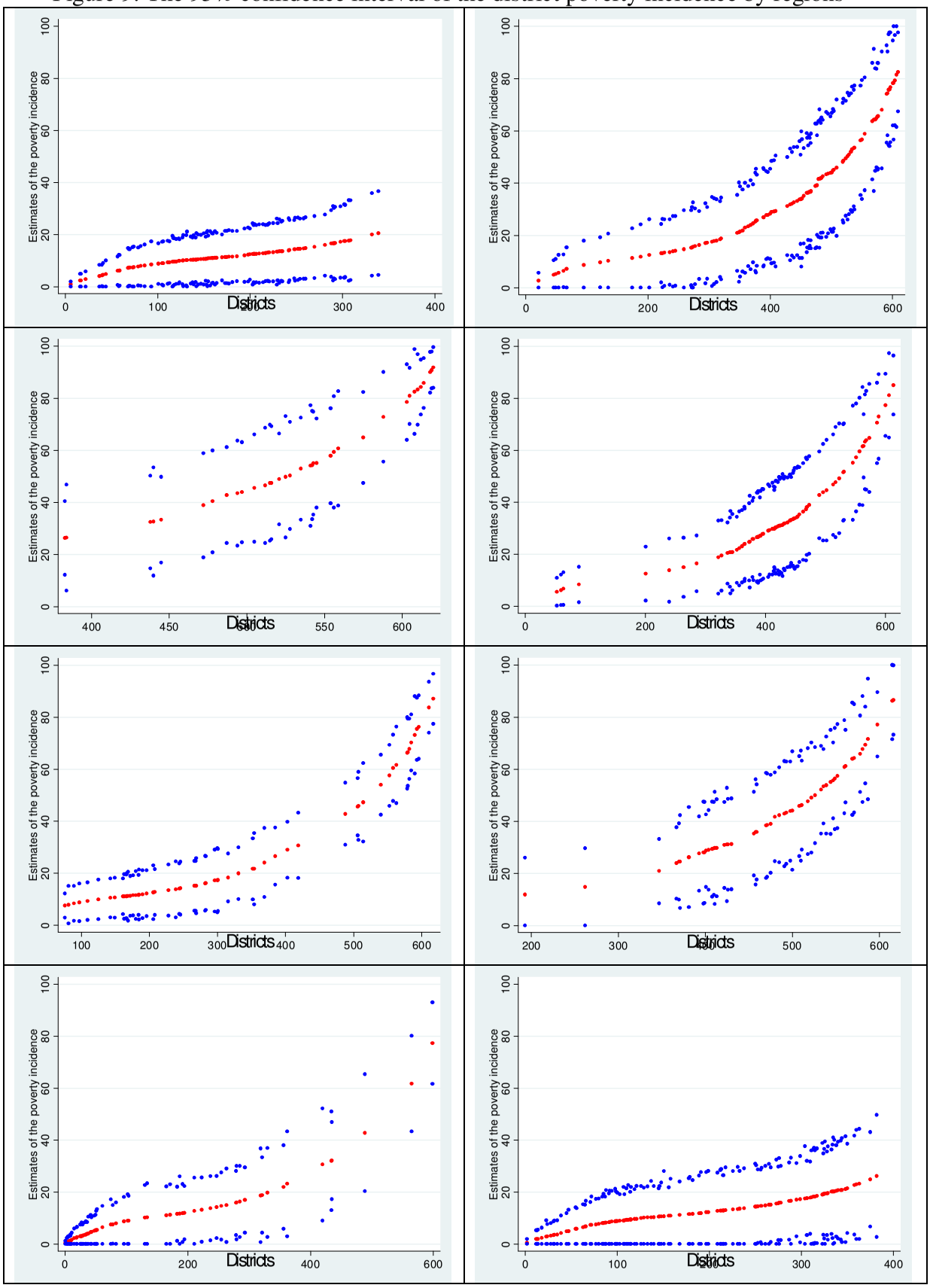


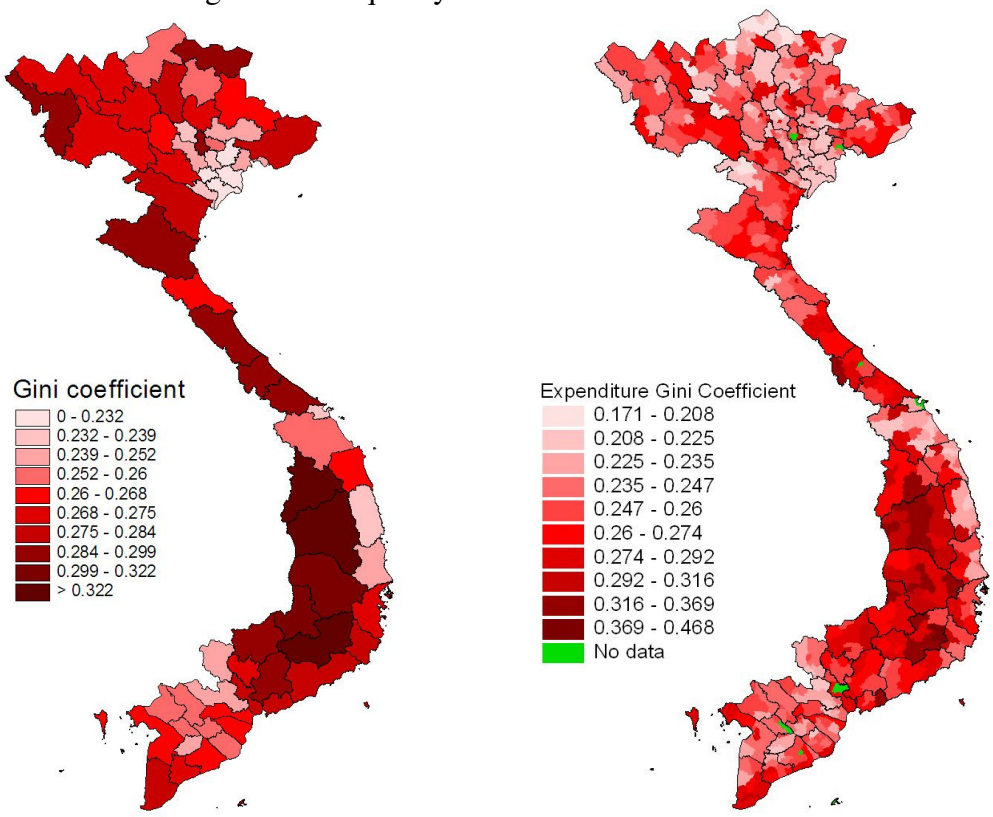
Figure 9: The 95% confidence interval of the district poverty incidence by regions



5.3. Inequality and poverty

Figure 10 examines the spatial pattern of expenditure inequality in Vietnam. As mentioned, the Gini coefficient is used to measure the inequality (The provincial estimates of the Gini coefficients are presented in Tables from 12 to 19). The darker color indicates the higher inequality. It shows that inequality varies across provinces and districts, and it tends to be smaller in smaller areas. The average inequality of expenditure is rather low at 0.27 for the provinces and at 0.25 for districts. The province with the lowest Gini of 0.23 is Thai Binh, while the province with the highest Gini of 0.35 is Lam Dong. At the district level, Meo Vac disitrict of Ha Giang province has the lowest Gini of 0.17, while Da Lat city of Lam Dong province has the highest Gini of 0.47.

Figure 10: Inequality of Provinces and Districts



It is interesting that some very poor provinces and some rich provinces have low expenditure inequality. Figure 11 examines the relationship between poverty and inequality. It seems that there is a quadratic relation between poverty and inequality at both the provincial and district levels. Inequality tends to be lower for areas with relative low poverty and areas with relatively high poverty. High inequality happens in provinces

and districts with middle poverty rates. This finding implies the Kuznets hypothesis that inequality tends to increase as an economy is growing, then decrease after achieving a maxima at the certain economic level.

Figure 11: Inequality (Gini index) and poverty (P0) at the provincial level

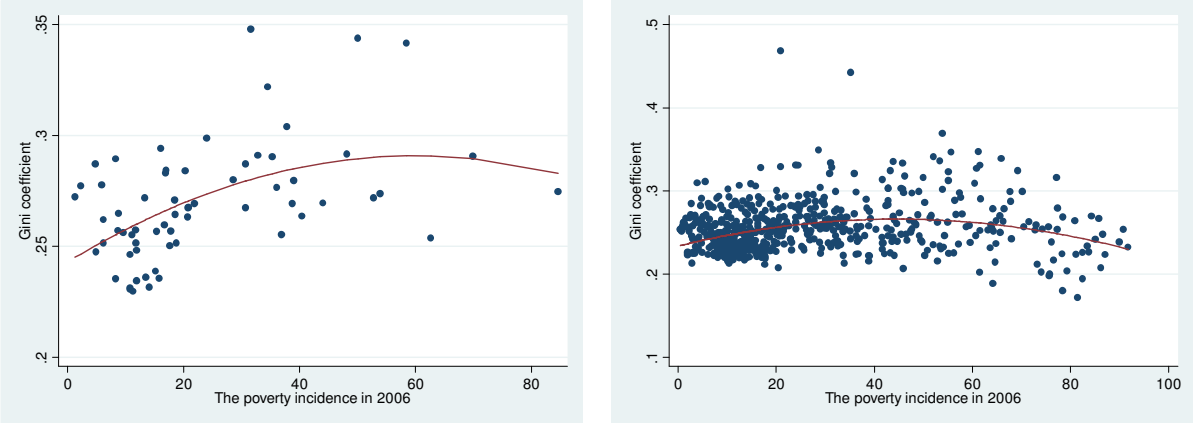
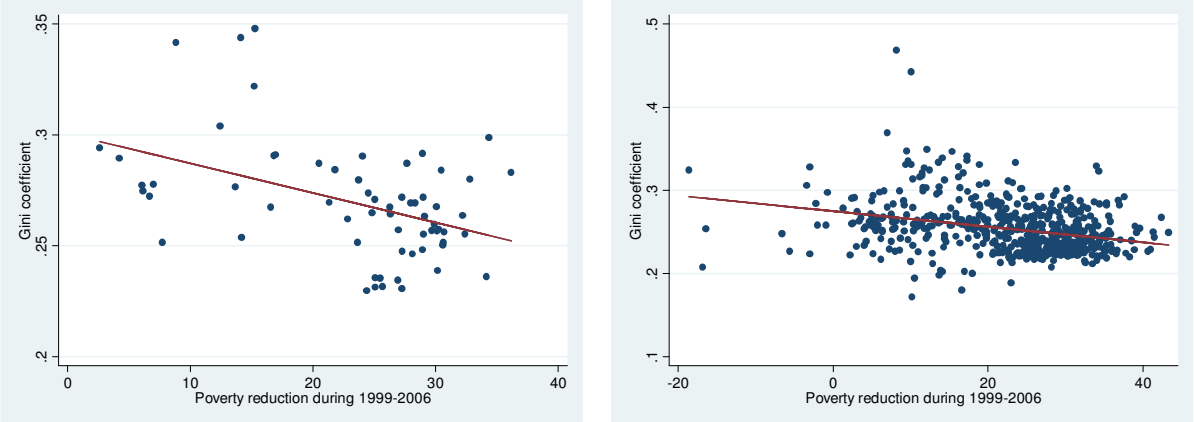


Figure 12: Poverty reduction and inequality during 1999-2006 at the provincial level

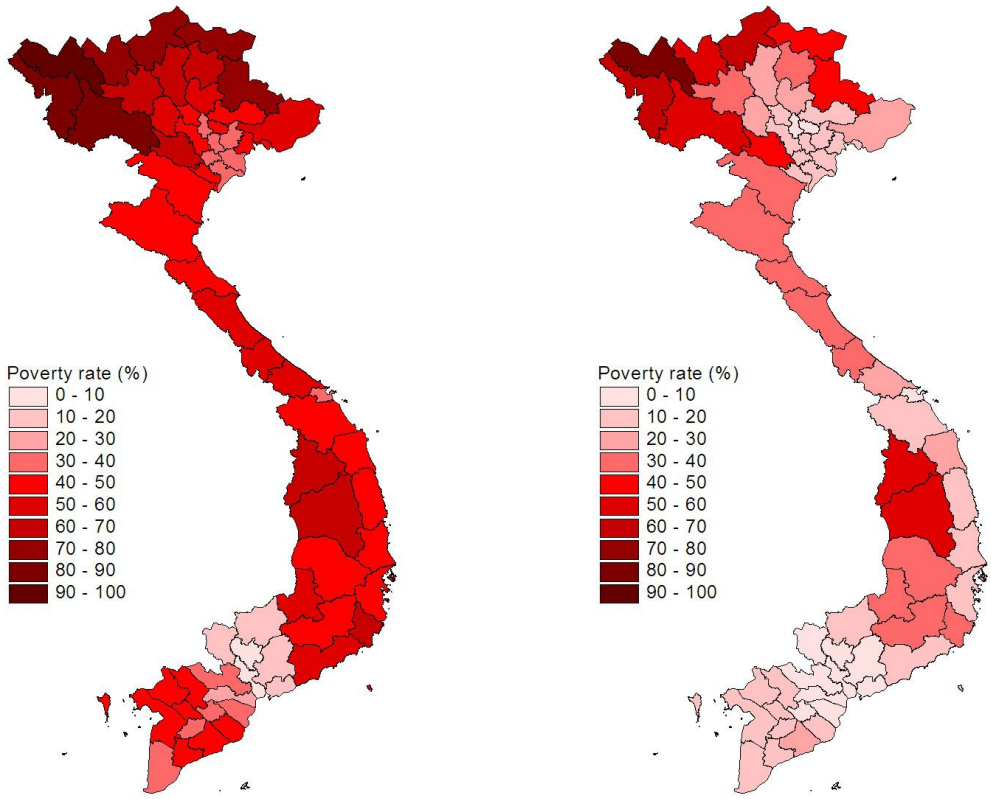


5.4. Poverty Change during the Period 1999-2006

Figure 13 presents the poverty map in 1999 and 2006. Clearly, poverty is reduced significantly during 1999-2006. All the provinces experienced in the reduction in the poverty rate.

Figure 13: The provincial poverty incidence over 1999-2006

1999 2006



The poverty reduction tends to be higher for provinces with middle poverty in 1999 (Figure 14). It is not surprising that the decreased percentage points in poverty are smaller for provinces with the low poverty. Poor provinces are not successful in reducing poverty.

Figure 14: The poverty incidence of provinces in 1999 and 2006

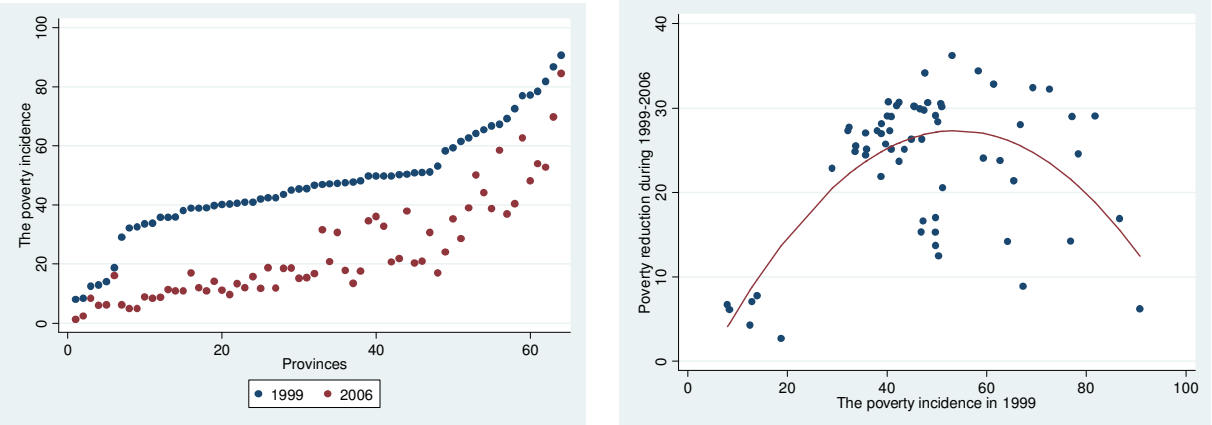


Figure 15 presents the map of district poverty rates during 1999-2006. Similar to the provinces, districts with very low or very high poverty in 1999, experienced smaller reduction in the poverty rate (Figure 16).

Figure 15: The district poverty incidence over 1999-2006

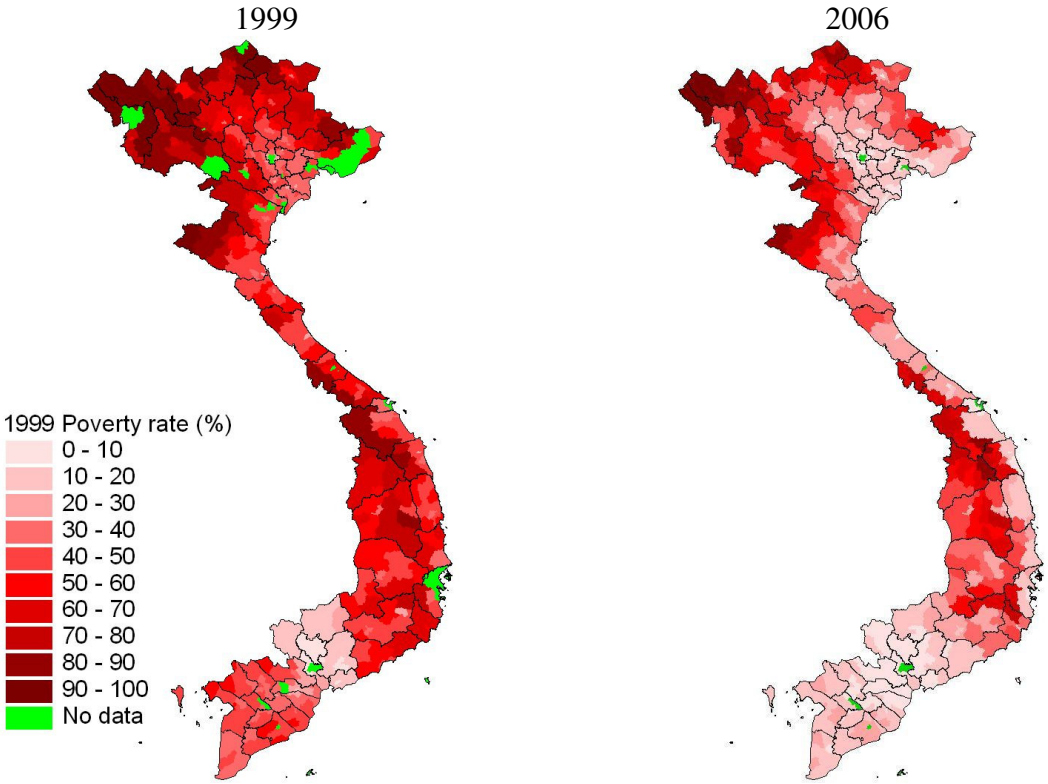
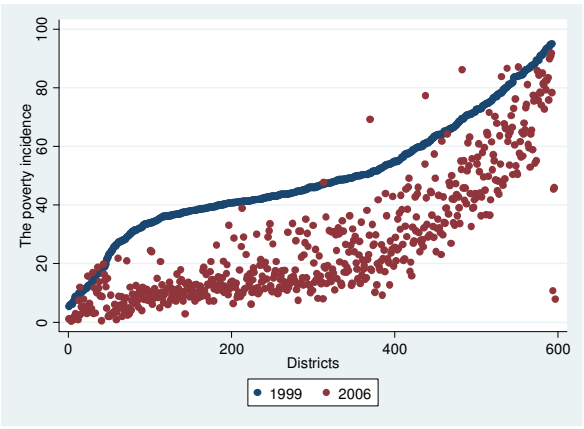


Figure 16: The poverty incidence of districts in 1999 and 2006



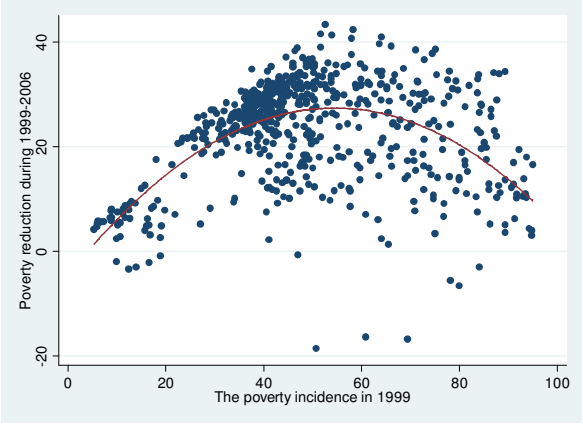
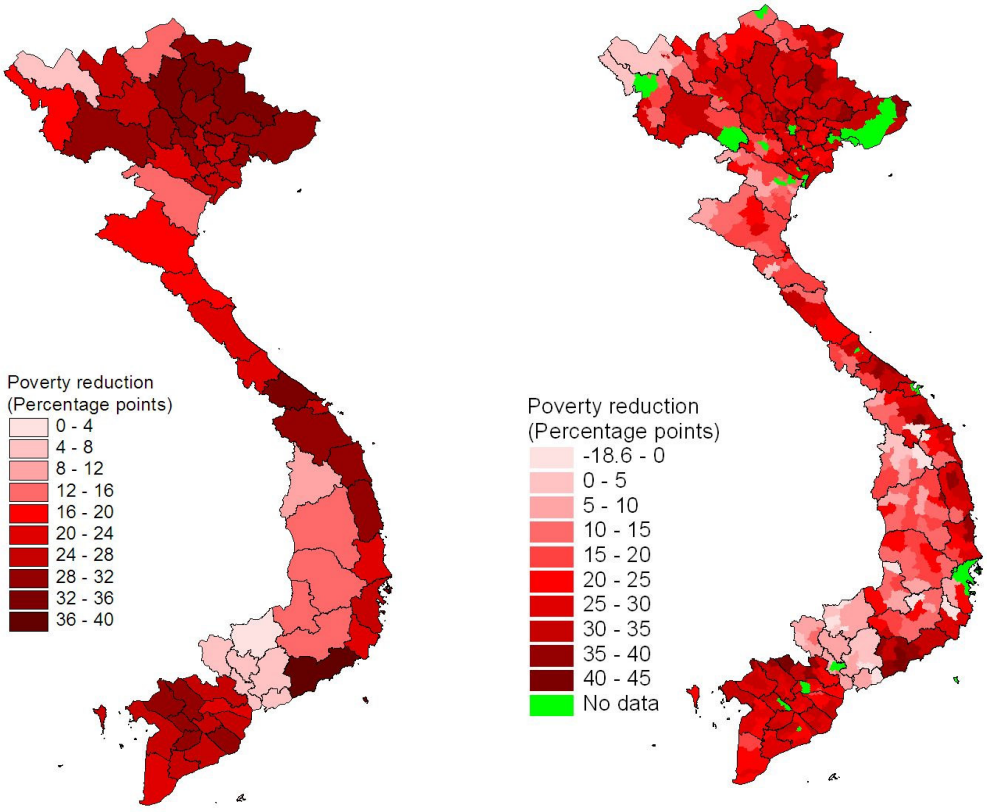


Figure 17: Map of poverty reduction of provinces and districts during 1999-2006



6. ESTIMATES OF INCOME POVERTY AND INEQUALITY

This section presents the estimates of income poverty and inequality.

6.1. Income models

Similar to the estimation of expenditure poverty and inequality, the first step in estimating the income poverty and inequality is to construct the income models. We also estimate separate expenditure models for 8 regions. For each region, we use a large model and a small model to examine the sensitivity of the poverty estimates to model specifications. In total, there are 16 income regressions.

Tables from 20 to 27 present the GLS regressions of logarithm of per capita income. In these tables, results from both the large and small models are reported. It shows that all the explanatory variables have expected and reasonable signs. The large and small models give very similar size of coefficient estimates.

Table 20: Income regression: Red River Delta

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	8.067	0.106	0.000	8.009	0.102	0.000
Household variables						
Have color TV	0.289	0.037	0.000	0.297	0.037	0.000
Have mobile	0.305	0.047	0.000	0.348	0.047	0.000
Have motorbike	0.179	0.029	0.000	0.185	0.029	0.000
Have telephone	0.181	0.035	0.000	0.213	0.035	0.000
Household size	-0.073	0.011	0.000	-0.082	0.011	0.000
Permanent house type	0.084	0.028	0.003			
Log of Living area per capita	0.094	0.030	0.002	0.120	0.029	0.000
% working members without vocational training	-0.171	0.042	0.000			
% working member to household size	0.433	0.055	0.000	0.342	0.051	0.000
Flush toilet	0.163	0.034	0.000	0.201	0.033	0.000
Commune variables						
% household have mobile in commune	0.814	0.212	0.000			
% household have no toilet in commune	-1.040	0.453	0.022			
Number of obs.						
Number of cluster	1521			1521		
Adj-Rsquared	94			94		
Rho	0.387			0.370		

Table 21: Income regression: North East

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	8.487	0.174	0.000	8.640	0.174	0.000
Household variables						
Have color TV	0.221	0.032	0.000	0.238	0.032	0.000
Have mobile	0.312	0.070	0.000	0.340	0.070	0.000
Have motorbike	0.207	0.031	0.000	0.218	0.032	0.000
Have telephone	0.138	0.053	0.009	0.150	0.053	0.004
Ethnic minority	-0.084	0.039	0.032			
Household size	-0.053	0.010	0.000	-0.056	0.011	0.000
Temporary house type	-0.105	0.035	0.003			
Log of Living area per capita	0.198	0.034	0.000	0.248	0.034	0.000
% working members without vocational training	-0.347	0.054	0.000	-0.284	0.054	0.000
% service members to working members	0.248	0.057	0.000	0.269	0.057	0.000
% working members to household size	0.288	0.064	0.000			
Commune variables						
% concrete road in commune	0.147	0.064	0.022			
Average of Hhsize in commune	-0.086	0.031	0.005	-0.138	0.032	0.000
Number of Obs	1017			1017		
Number of Cluster	105			105		
R-square	0.528			0.502		
Ratio of Variance of Eta over MSE	0.100			0.123		

Table 22: Income regression: North West

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	8.143	0.242	0.000	7.621	0.201	0.000
Household variables						
Have color TV	0.206	0.049	0.000	0.226	0.051	0.000
Have computer	0.512	0.214	0.017			
Have mobile	0.501	0.153	0.001	0.582	0.147	0.000
Have motorbike	0.196	0.048	0.000	0.192	0.049	0.000
Ethnic minority	-0.193	0.085	0.024			
Log of Living area per capita	0.271	0.053	0.000	0.268	0.054	0.000
% working members without vocational training	-0.823	0.175	0.000	-0.525	0.113	0.000
% working members with vocational training	-0.766	0.221	0.001			
% working member to household size	0.432	0.131	0.001	0.342	0.129	0.009
No toilet	-0.300	0.066	0.000	-0.304	0.066	0.000
No clean water	-0.122	0.061	0.046			
Commune variables						
% of household have Tap-water in commune	3.308	1.399	0.019	2.976	0.805	0.000
Number of obs.	346			346		
Number of cluster	33			33		
Adj-Rsquared	0.551			0.516		
Rho	0.082			0.061		

Table 23: Income regression: North Central Coast

	Large model			Small model		
Log of income per capita	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	8.009	0.196	0.000	7.640	0.166	0.000
Household variables						
Have color TV	0.212	0.042	0.000	0.229	0.041	0.000
Have mobile	0.236	0.086	0.006			
Have motorbike	0.258	0.039	0.000	0.249	0.039	0.000
Have fridge	0.253	0.077	0.001	0.334	0.085	0.000
Have telephone	0.309	0.057	0.000	0.354	0.059	0.000
Household size	-0.054	0.014	0.000	-0.061	0.014	0.000
Temporary house type	-0.224	0.061	0.000	-0.199	0.059	0.001
Log of Living area per capita	0.208	0.045	0.000	0.217	0.045	0.000
% working members without vocational training	-0.300	0.070	0.000			
% working member to household size	0.415	0.081	0.000	0.285	0.074	0.000
Commune variables						
% household have permanent house in commune	0.627	0.173	0.000	0.547	0.180	0.002
% households have other toilet in commune	-0.230	0.090	0.010			
Number of obs.	849			849		
Number of cluster	76			76		
Adj-Rsquared	0.466			0.443		
Rho	0.038			0.049		

Table 24: Income regression: South Central Coast

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.982	0.175	0.000	7.407	0.112	0.000
Household variables						
Have mobile	0.341	0.079	0.000	0.407	0.116	0.001
Have motorbike	0.265	0.046	0.000	0.165	0.081	0.042
Have telephone	0.292	0.066	0.000			
Ethnic minority	-0.206	0.072	0.004	-0.238	0.066	0.000
Household size	-0.058	0.016	0.000	0.300	0.037	0.000
Log of Living area per capita	0.178	0.047	0.000	0.280	0.045	0.000
Temporary house	-0.203	0.062	0.001	0.344	0.079	0.000
Flush toilet	0.118	0.054	0.029			
% working members without vocational training	0.409	0.113	0.000	0.294	0.066	0.000
% working member to household size	0.169	0.079	0.032			
Number of obs.	585			585		
Number of cluster	53			53		
Adj-Rsquared	0.445			0.420		
Rho	0.078			0.090		

Table 25: Income regression: Central Highland

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.744	0.184	0.000	7.305	0.126	0.000
Household variables						
Have mobile	0.322	0.087	0.000	0.470	0.118	0.000
Have motorbike	0.331	0.051	0.000	0.236	0.083	0.005
Have radio	-0.180	0.078	0.022			
Have telephone	0.254	0.083	0.002			
Ethnic minority	-0.334	0.057	0.000	-0.361	0.056	0.000
Household size	-0.028	0.012	0.015	0.223	0.102	0.029
Permanent house type	0.234	0.103	0.023	0.368	0.044	0.000
Temporary house type	-0.191	0.059	0.001	0.301	0.086	0.001
Log of Living area per capita	0.277	0.052	0.000	0.349	0.051	0.000
No toilet	-0.183	0.059	0.002			
% working member to household size	0.452	0.116	0.000	-0.172	0.060	0.004
Number of obs.	404			404		
Number of cluster	54			54		
Adj-Rsquared	0.616			0.599		
Rho	0.091			0.094		

Table 26: Income regression: South East

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	7.806	0.137	0.000	7.526	0.108	0.000
Household variables						
Have color TV	0.129	0.053	0.015			
Have mobile	0.208	0.057	0.000	0.239	0.055	0.000
Have motorbike	0.165	0.053	0.002	0.191	0.049	0.000
Have telephone	0.211	0.048	0.000	0.214	0.046	0.000
Ethnic minority	-0.355	0.073	0.000	-0.383	0.074	0.000
Log of Living area per capita	0.265	0.037	0.000	0.321	0.034	0.000
Flush toilet	0.188	0.049	0.000	0.223	0.048	0.000
% working members without vocational training	-0.206	0.071	0.004			
% working member to household size	0.476	0.091	0.000	0.337	0.081	0.000
Number of obs.	639			639		
Number of cluster	60			60		
Adj-Rsquared	0.530			0.486		
Rho	0.146			0.190		

Table 27: Income regression: Mekong River Delta

	Large model			Small model		
	Coef.	Std. Err.	P-value	Coef.	Std. Err.	P-value
Intercept	9.039	0.311	0.000	8.579	0.274	0.000
Household variables						
Have color TV	0.190	0.043	0.000	0.185	0.040	0.000
Have mobile	0.249	0.060	0.000	0.225	0.063	0.000
Have motorbike	0.222	0.041	0.000	0.226	0.038	0.000
Have radio	0.093	0.045	0.038			
Have fridge	0.298	0.062	0.000	0.313	0.057	0.000
Household size	-0.032	0.014	0.022			
Semi-permanent house type	-0.153	0.071	0.031			
Temporary house type	-0.259	0.077	0.001	-0.111	0.038	0.003
Log of Living area per capita	0.183	0.043	0.000	0.247	0.034	0.000
% working members without vocational training	-0.182	0.075	0.015	-0.217	0.068	0.002
% working member to household size	0.445	0.081	0.000	0.473	0.075	0.000
Commune variables						
Average log of living area per capita in commune	-0.362	0.103	0.000	-0.300	0.100	0.003
% household have mobile in commune	1.077	0.410	0.009			
Number of obs.	1466			1466		
Number of cluster	111			111		
Adj-Rsquared	0.351			0.334		
Rho	0.044			0.060		

6.2. Poverty and inequality estimates

6.2.1. Regional estimates

Table 28 presents the estimates of the poverty incidence of 8 rural regions. It shows that the estimates from the small area estimation, both from large and small models, are very close the estimates based on the 2006 VHLLSS.

According to the 2006 VHLSS, the poorest region is North West which has the poverty rate of around 19%. North Central Coast and High Lands also have high poverty rates, at 28% and 24%, respectively. The region which has a lower poverty rate of 8% is North East South.

Table 28: The income poverty incidences of regions

Region	VHLSS 2006	Large model	Small model
Red River Delta	15.5	15.3	15.3
	[1.1]	[0.7]	[0.8]
North East	22.0	24.4	25.1
	[1.6]	[1.4]	[1.5]
North West	48.8	49.2	48.7
	[3.6]	[2.5]	[2.0]
North Central Coast	28.2	26.7	26.0
	[1.9]	[1.1]	[1.2]
South Central Coast	20.3	18.7	20.3
	[1.9]	[1.4]	[1.6]
Central Highlands	24.4	25.4	28.4
	[3.0]	[1.2]	[1.3]
North East South	7.7	8.6	8.6
	[1.2]	[1.2]	[1.5]
Mekong River Delta	11.5	11.0	11.0
	[0.9]	[1.0]	[1.1]

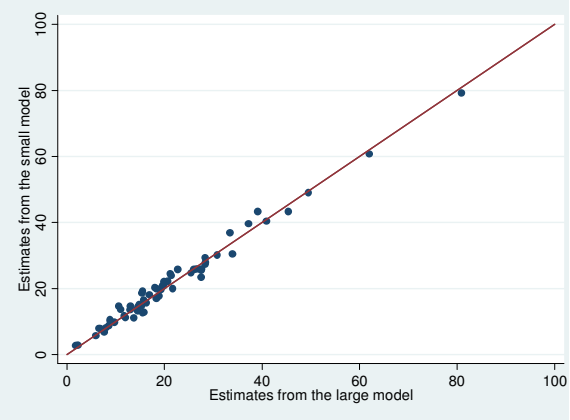
Standard error in the brackets

6.2.2. Provincial estimates

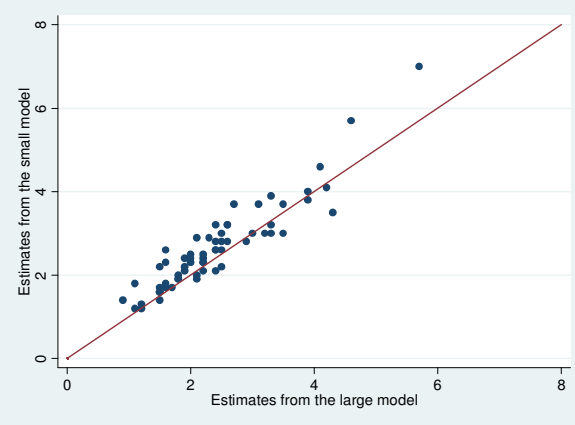
Figure 18 presents the estimates of provincial poverty rate using the large and small models. It shows that two models results in very similar poverty estimates. However, the large model tends to give smaller standard errors than the small model. Thus we incline to use the estimates from the large model for the interpretation. The comparison of estimates of other poverty indexes and Gini coefficient between the small and large models is presented in Appendix 2. In general, both the models yield similar estimates, but the small model tends to have larger standard errors than the large model.

Figure 18: Provincial estimates of the income poverty incidence from the large and small models

The poverty estimates



Standard errors



The estimates of the provincial poverty are presented in Tables 29 to 37. Similar to the expenditure poverty, The poorest provinces are Lai Chau, Dien Bien, Ha Giang, which have the poverty rate from 50% and above. These provinces belong to North West and North East. Cities such as Ho Chi Minh, Ha Noi, Binh Duong have very low rural poverty rates. In addition to the poverty rate, the poverty gap and severity indexes are also presented in these tables.

Table 29: The income poverty and inequality: Red River Delta

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ha Noi	6.5	1.1	0.0129	0.0028	0.0040	0.0010	0.3457	0.0097
Hai Phong	15.9	1.8	0.0340	0.0050	0.0110	0.0019	0.3144	0.0066
Vinh Phuc	18.3	2.1	0.0396	0.0060	0.0129	0.0023	0.3010	0.0065
Ha Tay	14.6	1.2	0.0305	0.0034	0.0097	0.0013	0.3078	0.0056
Bac Ninh	12.9	1.5	0.0267	0.0040	0.0084	0.0015	0.3168	0.0069
Hai Duong	14.8	1.5	0.0313	0.0041	0.0101	0.0016	0.2990	0.0059
Hung Yen	15.2	1.5	0.0319	0.0040	0.0102	0.0015	0.2969	0.0057
Ha Nam	18.8	2.5	0.0414	0.0071	0.0137	0.0028	0.2966	0.0063
Nam Dinh	16.3	1.5	0.0350	0.0042	0.0115	0.0016	0.3014	0.0056
Thai Binh	15.7	1.6	0.0337	0.0043	0.0110	0.0017	0.2988	0.0060
Ninh Binh	21.7	2.4	0.0495	0.0073	0.0169	0.0030	0.3028	0.0060
Total	15.3	0.7	0.0327	0.0022	0.0106	0.0055	0.3161	0.0055

Table 30: The income poverty and inequality: North East

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ha Giang	49.5	4.2	0.1275	0.0172	0.0453	0.0080	0.2964	0.0114
Cao Bang	33.9	3.3	0.0823	0.0120	0.0284	0.0053	0.3295	0.0114
Lao Cai	40.9	3.9	0.1018	0.0152	0.0356	0.0069	0.3124	0.0102
Bac Kan	27.5	3.1	0.0619	0.0097	0.0205	0.0040	0.2891	0.0078
Lang Son	28.4	3.3	0.0628	0.0103	0.0203	0.0042	0.2989	0.0072
Tuyen Quang	25.4	4.1	0.0581	0.0128	0.0195	0.0053	0.3387	0.0128
Yen Bai	30.8	3.9	0.0774	0.0132	0.0277	0.0058	0.3220	0.0101
Thai Nguyen	19.6	2.6	0.0445	0.0078	0.0150	0.0031	0.3337	0.0088
Phu Tho	18.0	2.4	0.0399	0.0073	0.0131	0.0029	0.3340	0.0105
Bac Giang	15.4	2.3	0.0322	0.0063	0.0102	0.0024	0.3094	0.0084
Quang Ninh	15.5	2.1	0.0340	0.0058	0.0111	0.0022	0.3431	0.0097
Total	24.4	1.4	0.0569	0.0045	0.0193	0.0066	0.3351	0.0055

Table 31: The income poverty and inequality: North West

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Lai Chau	80.9	3.2	0.3212	0.0287	0.1555	0.0202	0.2849	0.0130
Dien Bien	62.0	4.3	0.2150	0.0232	0.0965	0.0136	0.3213	0.0166
Son La	45.4	3.5	0.1316	0.0149	0.0531	0.0076	0.5698	0.1052
Hoa Binh	37.2	3.3	0.0986	0.0130	0.0371	0.0062	0.4455	0.0673
Total	49.3	2.3	0.1554	0.0110	0.0663	0.0843	0.5112	0.0834

Table 32: The income poverty and inequality: North Central Coast

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Thanh Hoa	27.6	1.5	0.0709	0.0054	0.0265	0.0025	0.3343	0.0071
Nghe An	27.5	1.7	0.0708	0.0061	0.0266	0.0029	0.3457	0.0069
Ha Tinh	26.6	2.2	0.0668	0.0077	0.0246	0.0035	0.3310	0.0083
Quang Binh	26.0	2.4	0.0658	0.0081	0.0244	0.0036	0.3402	0.0078
Quang Tri	28.3	2.4	0.0764	0.0085	0.0299	0.0040	0.3343	0.0081
Thua Thien Hue	21.2	1.6	0.0536	0.0052	0.0200	0.0024	0.3529	0.0087
Total	26.8	1.1	0.0688	0.0043	0.0257	0.0069	0.3402	0.0067

Table 33: The income poverty and inequality: South Central Coast

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Da Nang	10.6	4.6	0.0199	0.0107	0.0058	0.0036	0.2865	0.0059
Quang Nam	19.3	2.2	0.0419	0.0060	0.0136	0.0023	0.2921	0.0084
Quang Ngai	20.6	2.5	0.0457	0.0068	0.0151	0.0027	0.2913	0.0090
Binh Dinh	16.9	2.5	0.0340	0.0063	0.0105	0.0023	0.2780	0.0079
Phu Yen	19.9	2.6	0.0431	0.0071	0.0141	0.0028	0.2815	0.0096
Khanh Hoa	19.8	3.0	0.0458	0.0086	0.0157	0.0034	0.3114	0.0078
Total	19.0	1.5	0.0411	0.0042	0.0134	0.0069	0.2906	0.0075

Table 34: The income poverty and inequality: High Land

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Kon Tum	39.1	2.9	0.1174	0.0128	0.0482	0.0067	0.3714	0.0107
Gia Lai	33.4	2.0	0.1005	0.0089	0.0415	0.0047	0.3742	0.0086
Dak Lak	22.7	1.9	0.0615	0.0070	0.0239	0.0033	0.3501	0.0095
Da Nang	21.4	2.6	0.0570	0.0092	0.0219	0.0042	0.3473	0.0108
Lam Dong	18.3	2.1	0.0489	0.0076	0.0189	0.0036	0.3594	0.0097
Total	25.4	1.2	0.0719	0.0049	0.0287	0.0085	0.3642	0.0085

Table 35: The income poverty and inequality: South East

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Ho Chi Minh	2.2	1.1	0.0035	0.0020	0.0009	0.0006	0.3154	0.0148
Ninh Thuan	28.3	5.7	0.0749	0.0196	0.0283	0.0090	0.3055	0.0157
Binh Phuoc	11.0	2.7	0.0226	0.0068	0.0071	0.0025	0.3155	0.0103
Tay Ninh	7.6	2.2	0.0139	0.0049	0.0040	0.0016	0.3044	0.0133
Binh Duong	1.8	0.9	0.0029	0.0017	0.0007	0.0005	0.3140	0.0152
Dong Nai	8.0	2.0	0.0156	0.0050	0.0048	0.0018	0.3165	0.0118
Binh Thuan	15.8	3.5	0.0344	0.0099	0.0114	0.0039	0.2956	0.0100
Vung Tau	5.9	2.5	0.0103	0.0054	0.0029	0.0018	0.3053	0.0127
Total	8.6	1.2	0.0181	0.0031	0.0059	0.0102	0.3350	0.0102

Table 36: The income poverty and inequality: Mekong River Delta

Provincial Name	Poverty rate (%)		Poverty Gap		Poverty Severity		Gini	
	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.	Estimate	Std. Err.
Long An	6.8	1.2	0.0126	0.0030	0.0037	0.0011	0.2989	0.0093
Dong Thap	8.8	1.6	0.0158	0.0041	0.0044	0.0015	0.2841	0.0104
An Giang	8.9	1.8	0.0161	0.0049	0.0046	0.0020	0.2826	0.0096
Tien Giang	8.6	1.6	0.0164	0.0041	0.0049	0.0015	0.3033	0.0090
Vinh Long	8.9	1.8	0.0165	0.0045	0.0048	0.0016	0.3009	0.0081
Ben Tre	13.7	2.2	0.0297	0.0069	0.0098	0.0029	0.3169	0.0093
Kien Giang	14.4	1.5	0.0302	0.0046	0.0096	0.0019	0.3093	0.0081
Can Tho	9.7	2.0	0.0192	0.0057	0.0059	0.0023	0.3150	0.0086
Hau Giang	12.0	1.9	0.0246	0.0051	0.0077	0.0020	0.3145	0.0090
Tra Vinh	15.5	2.2	0.0333	0.0066	0.0109	0.0027	0.3059	0.0092
Soc Trang	14.5	2.4	0.0305	0.0069	0.0098	0.0028	0.3101	0.0093
Bac Lieu	11.7	1.9	0.0242	0.0053	0.0077	0.0021	0.3244	0.0084
Ca Mau	13.0	2.0	0.0276	0.0058	0.0090	0.0023	0.3286	0.0105
Total	11.0	1.0	0.0222	0.0030	0.0069	0.0081	0.3073	0.0081

Figure 20 presents the 95% confidence interval of the income poverty incidence of provinces. The red dots are the estimates of the poverty incidence of provinces, while the above and below blue dots present the upper and lower bounds of the 95% confidence interval, respectively.

Figure 19: The 95% confidence interval of the income poverty incidence of provinces

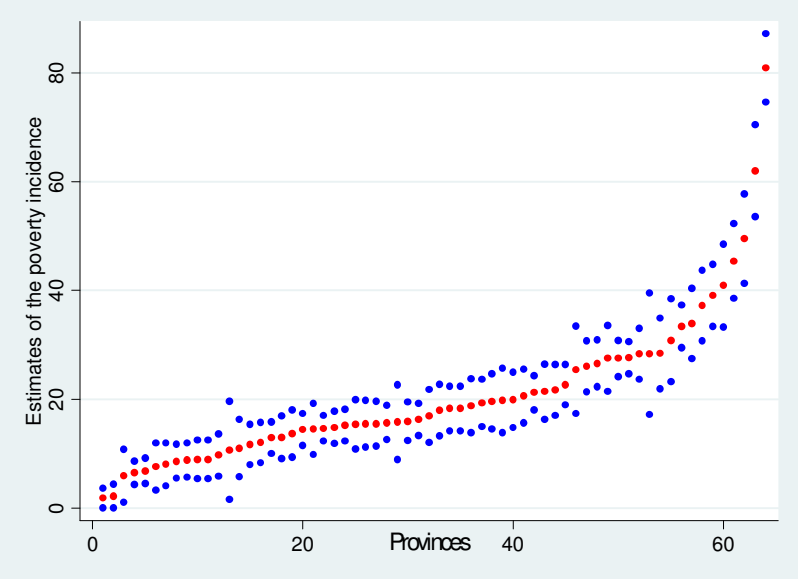
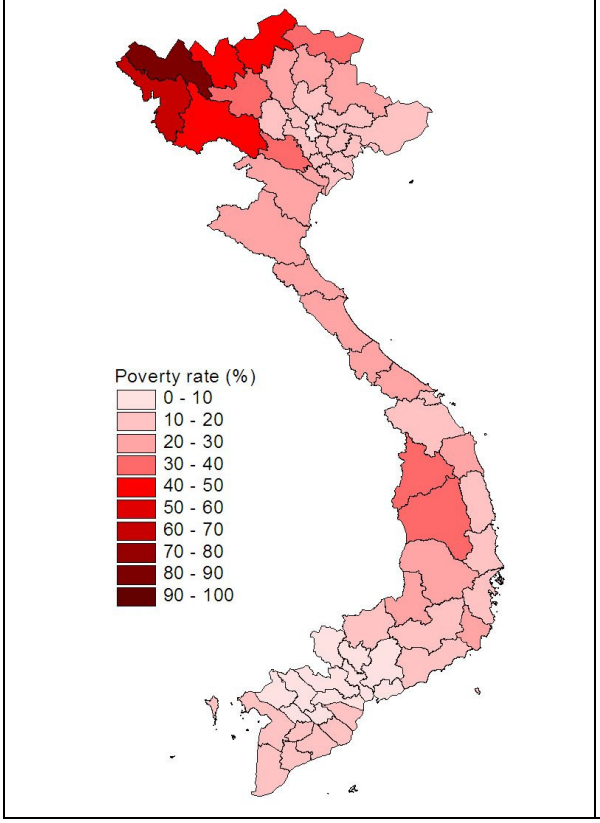
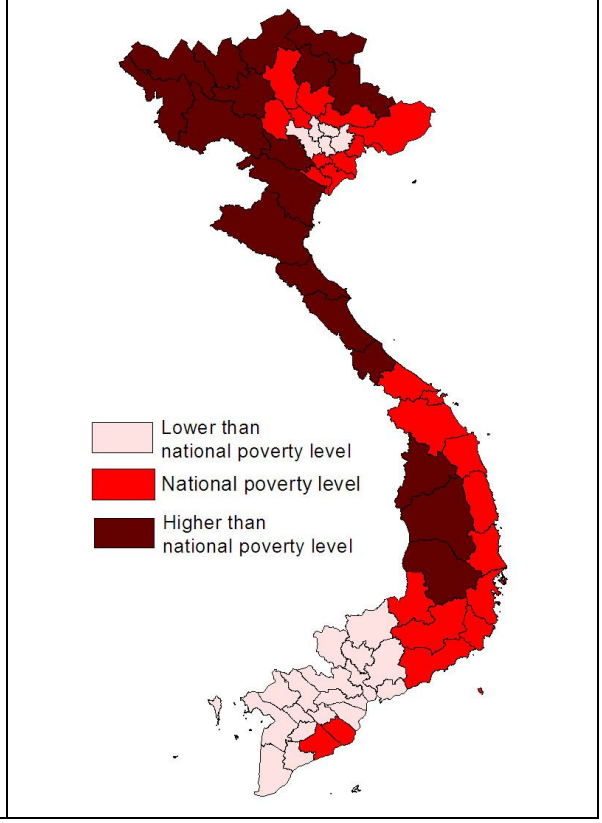


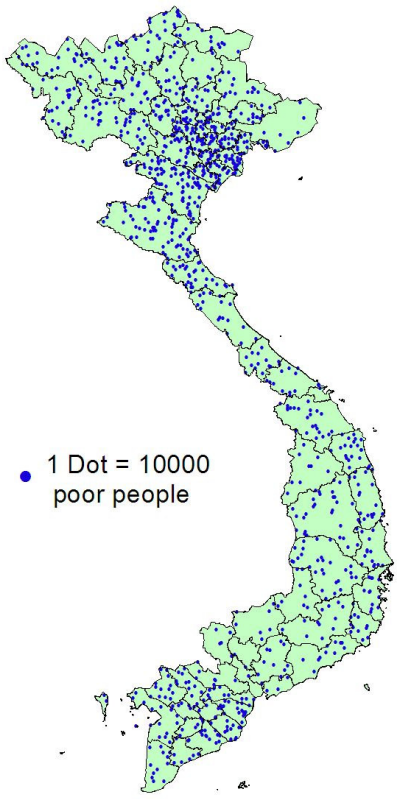
Figure 20 presents the map of the income poverty incidence and the comparison of provincial poverty with the national poverty level (The income national poverty rate for the rural is also 20%).

Figure 20: Map of the provincial income poverty rate

The poverty rate (%)	Compared with national poverty
	

Similar to the expenditure poverty, although the income poverty is much higher in North East and Central High Land, the income poor tend to be more concentrated in delta regions including Red River Delta and Mekong River Delta.

Figure 21: The provincial income poverty density

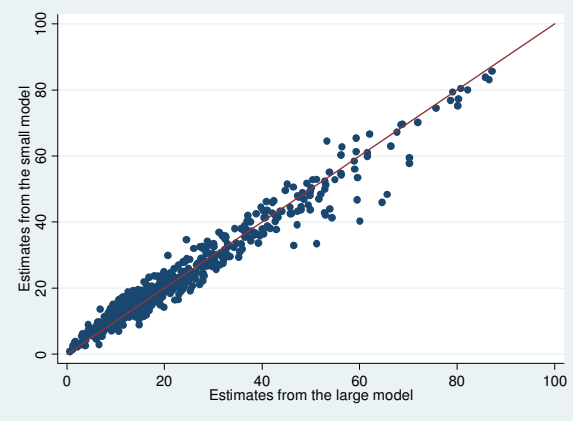


6.2.3. District estimates

Figure 22 presents the estimates of income poverty estimates of districts using two models, large and small ones. Again it shows that two models results in very similar estimates of the poverty incidences, and the large model tends to give smaller standard errors than the small model.

Figure 22: The income poverty incidence (P0) of districts

The poverty estimates



Standard errors

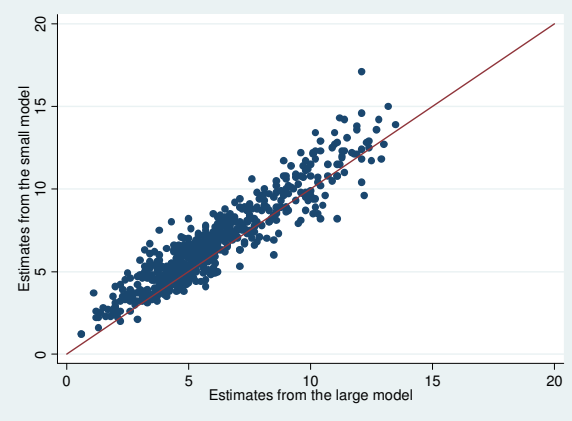
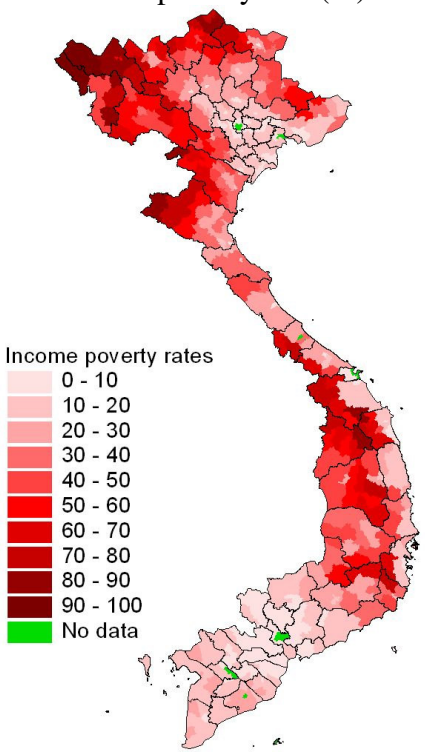


Figure 23 presents the two maps of the district poverty. It shows that there is a large variation in districts poverty within some provinces. It should be noted that districts without data are presented by green colors in maps.

Figure 23: The income poverty map of districts

The poverty rate (%)



Compared with national poverty

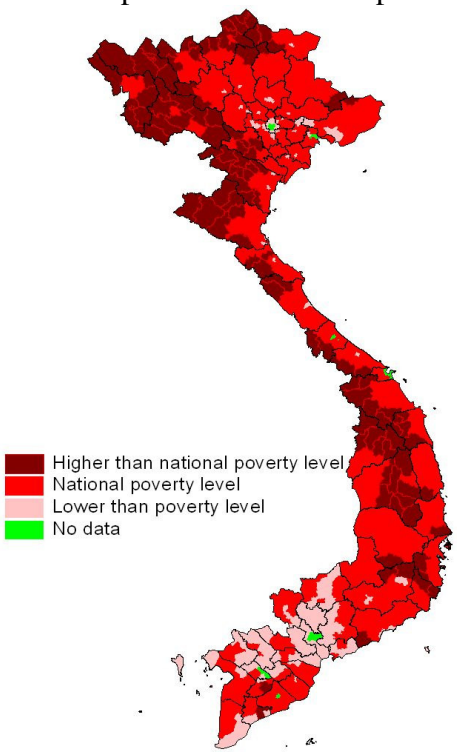


Figure 24: The 95% confidence interval of the income poverty incidence of districts

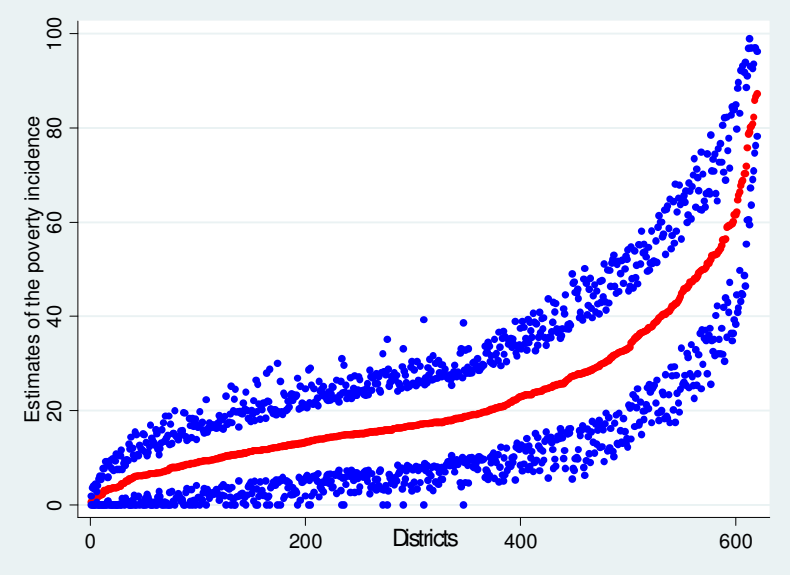
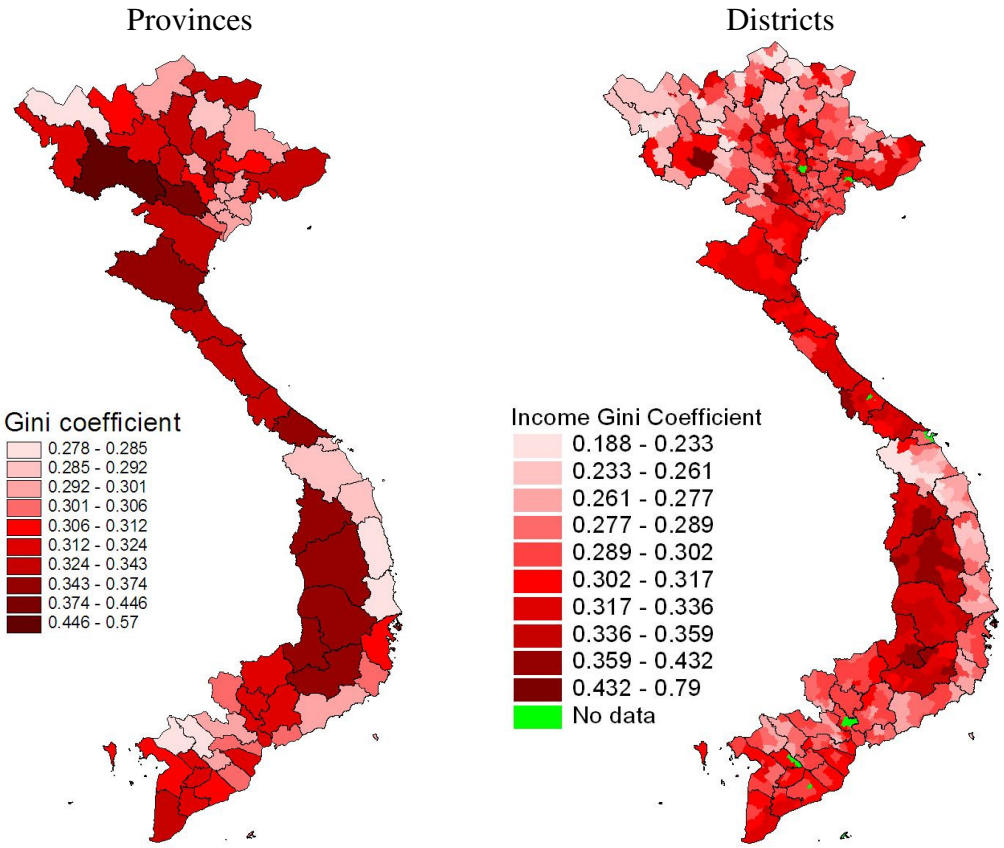


Figure 25 presents the income inequality measured by Gini coefficient. Income inequality is much higher than expenditure inequality. The average Gini of provinces and districts is 0.32 and 0.30, respectively. The income inequality estimates is smallest in Binh Dinh province, at 0.28, while it is highest in Son La, at 0.57. The income inequality estimates of districts range from 0.19 (Nam Giang district, Quang Nam province) to 0.79 (Son La town of Son La province). Again, these results should be interpreted with caution, since there are standard errors of the inequality estimates.

Figure 25: The income inequality



7. COMPARISON OF ALTERNATIVE POVERTY INDICATORS

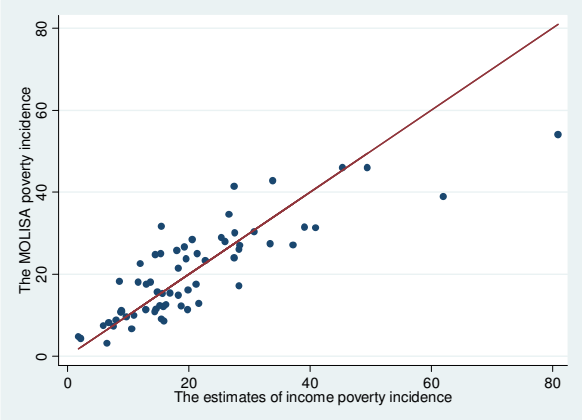
This section compares the poverty estimates from different sources, including the income poverty estimates, MOLISA poverty rates, and expenditure poverty estimates.

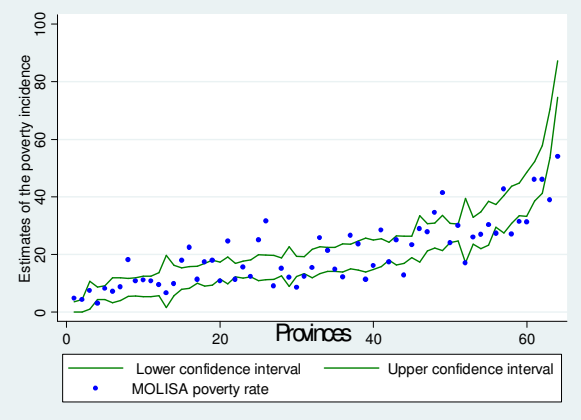
7.1. Income poverty and MOLISA

Figure 26 compares the MOLISA income poverty rates and the income poverty estimates at the provincial level (all the estimates refer to the year 2006). The left panel of this figure graphs both the poverty classification methods in the same graph. If the two methods give similar poverty rates, the points will be close to the diagonal line. It shows that both the methods give rather similar poverty estimates for provinces with low poverty rates. When poverty rates are high, income-based estimates tend to give higher poverty estimates than the MOLISA classification.

However, when comparing these two poverty classification methods, we should keep two things in mind. Firstly, we do not have the MOLISA poverty rate for the rural areas. The MOLISA poverty rates refer to the whole province poverty, including both urban and rural poverty. Meanwhile, the income-based method produces the rural poverty only. Secondly, there are standard errors associated with the income-based estimates. The left panel of Figure 26 presented the 95% confidence interval of income poverty estimates and the MOLISA estimates. We find that 32 out of 64 provinces have the MOLISA poverty rate lying between the 95% confidence interval of income poverty estimates.

Figure 26: MOLISA income poverty rates and the income poverty estimates of provinces



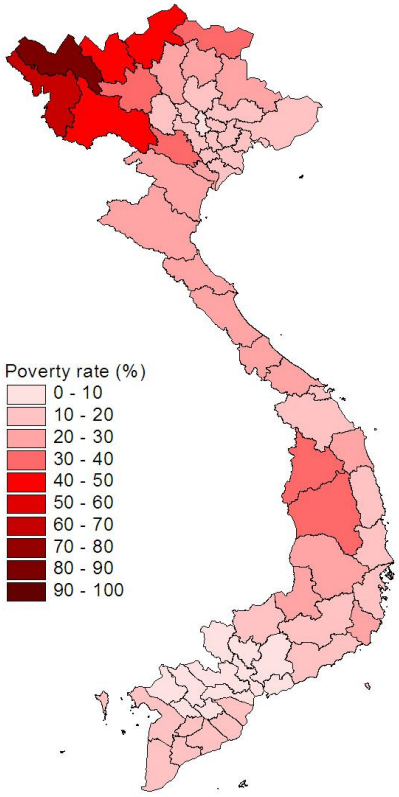


However, the spatial pattern of poverty given by the MOLISA poverty rates and income-based estimates are quite similar at the provincial level (Figure 27).

Figure 28 compares the MOLISA income poverty rates and the income poverty estimates at the district level. Since we do not have the MOLISA poverty rates for the rural districts, we have to compare the poverty rates of districts with higher rural population. In our data set, there are 148 districts in which the rural population accounts for more than 95%. It is expected that the MOLISA poverty rates are close to the rural MOLISA poverty rates in these districts. It is showed from Figure 28 that the MOLISA poverty rates and the income-based poverty rates are quite similar in districts with low poverty. It is found that 25 out of 148 districts have the MOLISA poverty rate outside the 95% confidence interval of income poverty estimates.

Figure 27: Income poverty estimates and MOLISA poverty rates of provinces

Income poverty rate



MOLISA poverty rate

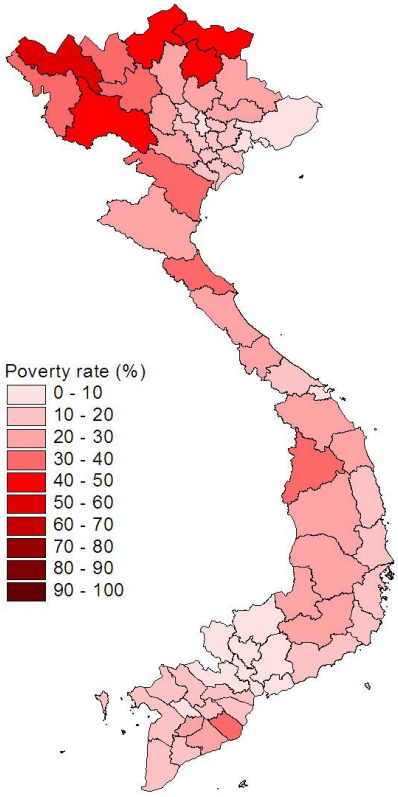
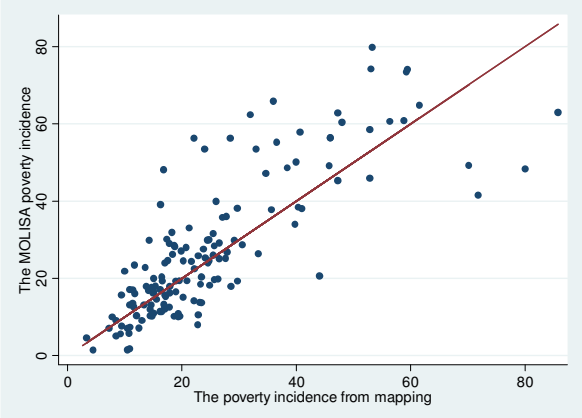


Figure 28: MOLISA income poverty rates and the income poverty estimates of districts



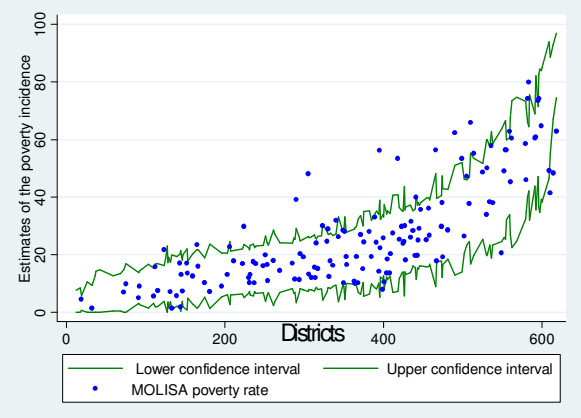
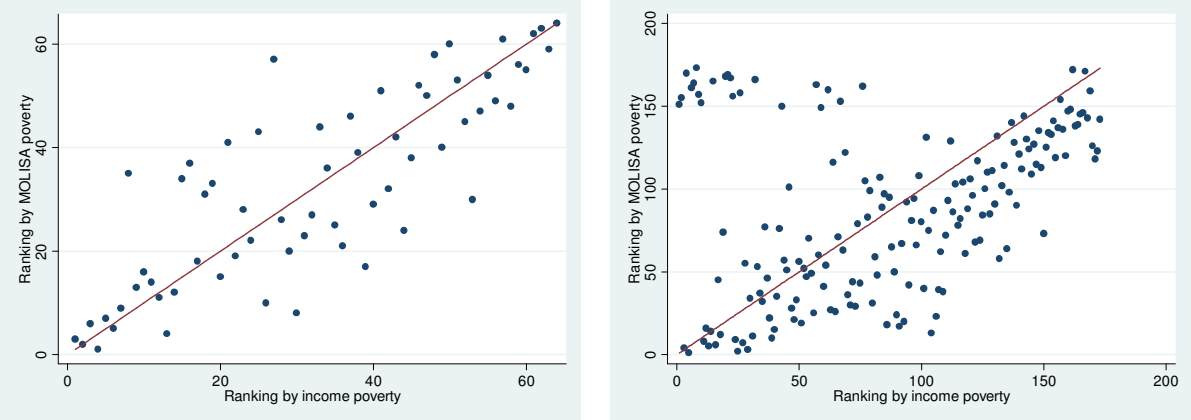


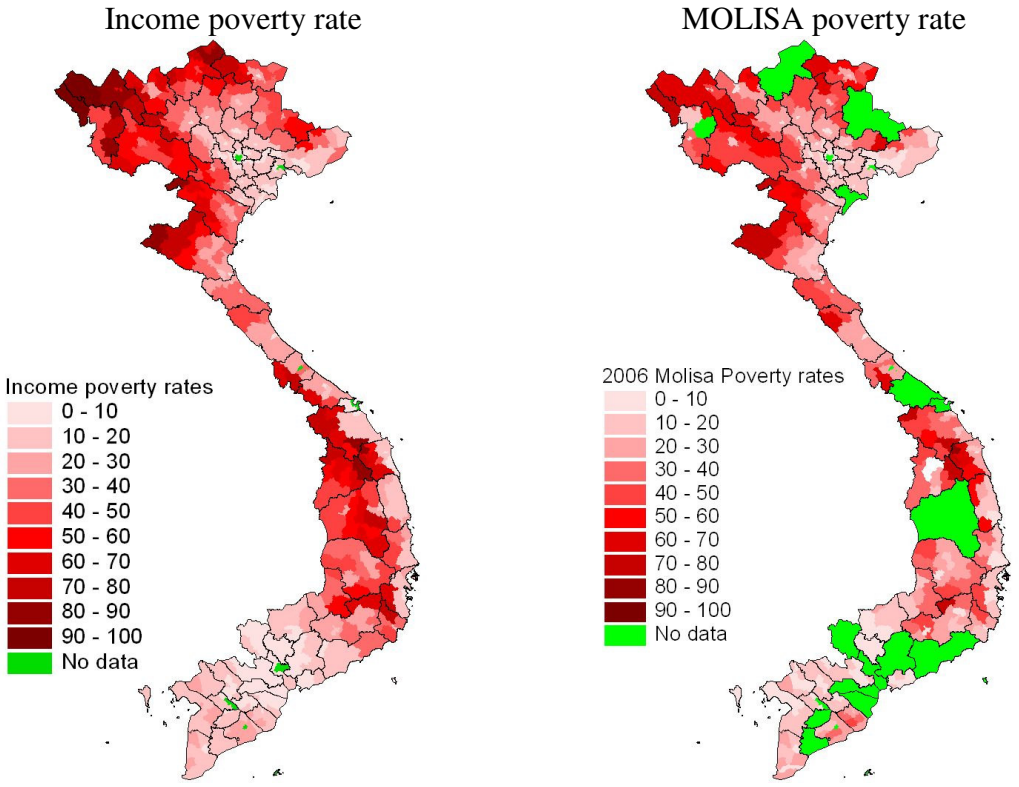
Figure 29 examines the difference in poverty ranking of districts and provinces using the the MOLISA poverty rates and income poverty rates. Provinces and districts are ranked from the lowest poverty to the highest poverty. If a province or a district has the same rank by the two poverty classification methods, the dot representing it will be lying in the diagonal. It shows that a large number of provinces and districts have different ranks when classified by the two methods.

Figure 29: Poverty ranking between the MOLISA poverty rates and income poverty rates



Finally, Figure 30 shows that the geographic pattern of the MOLISA poverty and income-based poverty are rather similar. So compared with the estimates from Minot et al. (2002), the income estimates from our study are much closer to the MOLISA poverty rates.

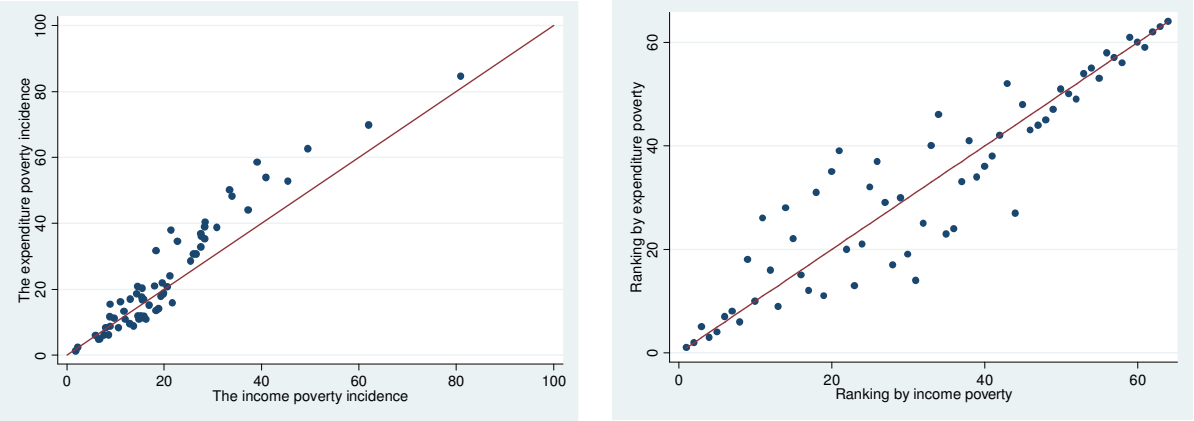
Figure 30: Income poverty estimates and MOLISA poverty rates of provinces



7.2. Expenditure and income based poverty

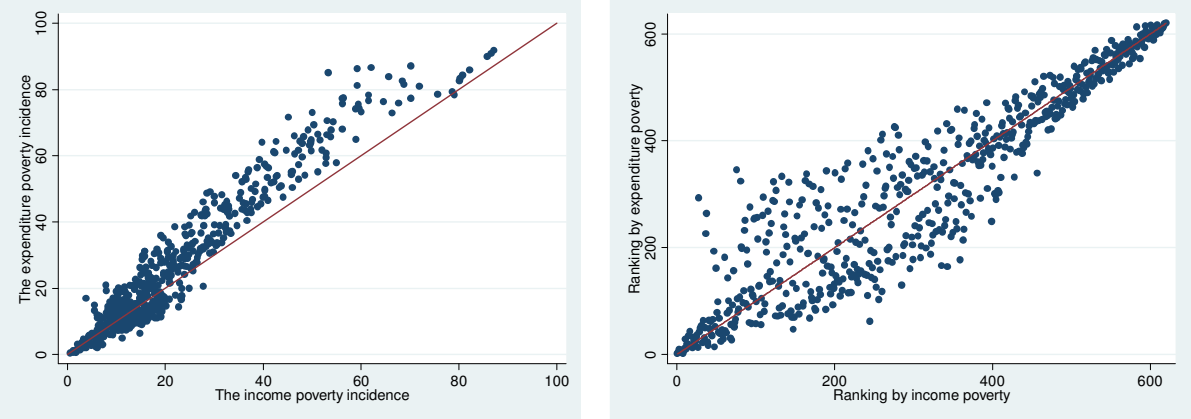
This section compares the expenditure poverty estimates and income poverty estimates. Figure 31 shows that the two methods give very similar poverty estimates and rank at the provincial level.

Figure 31: The expenditure poverty incidence and the income poverty incidence of provinces



The district poverty estimates from the income and expenditure models are also similar, especially at the low poverty districts (Figure 32).

Figure 32: The expenditure poverty incidence and the income poverty incidence of districts



Tables 37 and 38 compute the correlation coefficients between poverty rates estimated from different methods. It shows that expenditure and income poverty rates are strongly correlated with very high correlation coefficients. Correlation coefficients between the MOLISA poverty rates and income poverty rates are rather high, above 0.8. It is interesting that the expenditure poverty rates have stronger relation with the MOLISA poverty rates than the income poverty rates, at both the provincial and district levels.

Table 37: Correlation between the provincial poverty

	Expenditure poverty rate	Income poverty rate	MOLISA poverty rate
Expenditure poverty rate	1		
Income poverty rate	0.9575	1	
MOLISA poverty rate	0.8693	0.8046	1

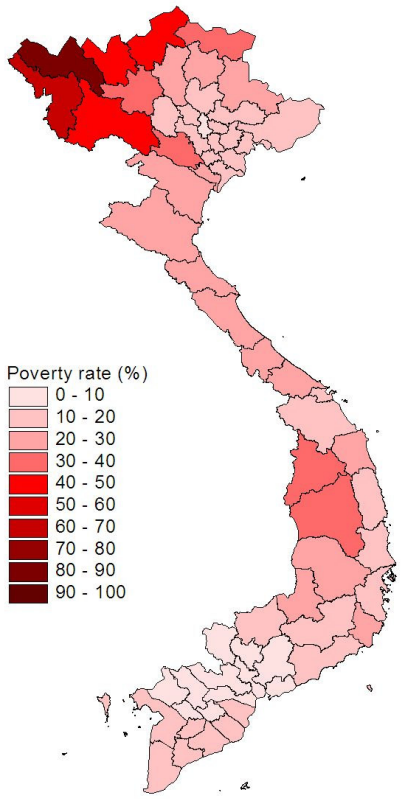
Table 38: Correlation between the district poverty (Districts with the percentage of rural population higher than 95%)

	Expenditure poverty rate	Income poverty rate	MOLISA poverty rate
Expenditure poverty rate	1		
Income poverty rate	0.9615	1	
MOLISA poverty rate	0.8503	0.831	1

Figures 33 and 34 show a very similar pattern of poverty between the expenditure poverty rates and income poverty rates.

Figure 33: Income poverty estimates and MOLISA poverty rates of provinces

Income poverty rate



expenditure poverty rate

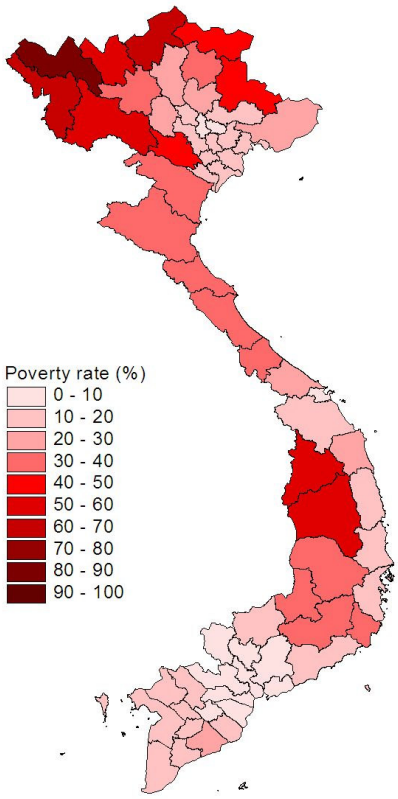


Figure 34: Income poverty estimates and MOLISA poverty rates of districts

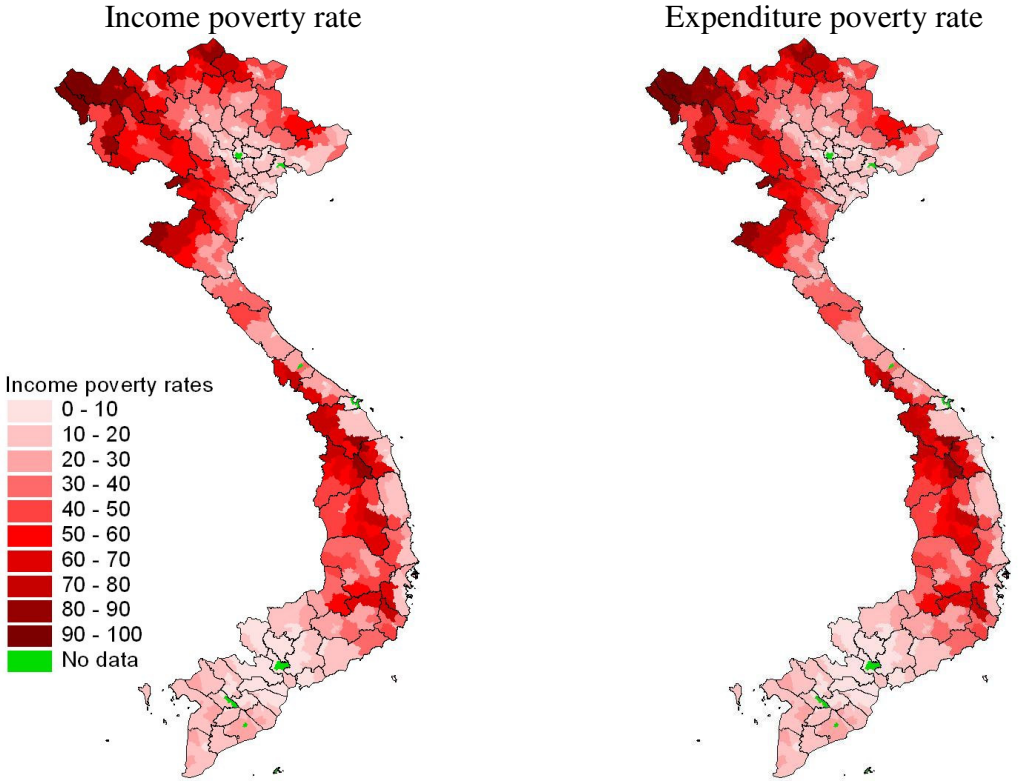
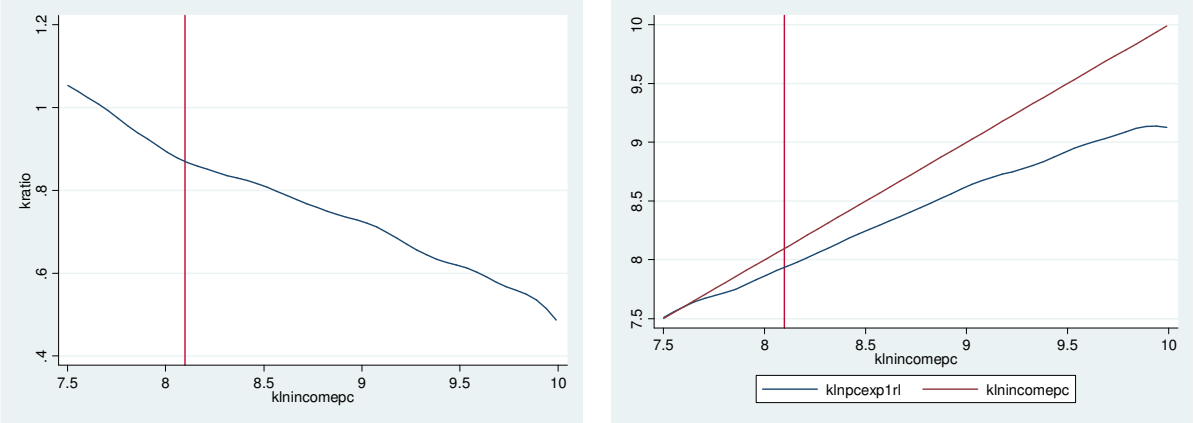


Table 39: Ratio of consumption to income



7.3. Expenditure poverty and basic characteristics

Finally, Figures 35 and 36 graph the expenditure poverty rates and several household characteristics at the provincial and district levels. It shows that the spatial pattern of poverty and the household characteristics are relatively similar. It suggests that basic household characteristics such as ethnic minorities and household assets and housing can be used for poverty targeting in some cases.

Figure 35: Expenditure poverty and household characteristics at the provincial level

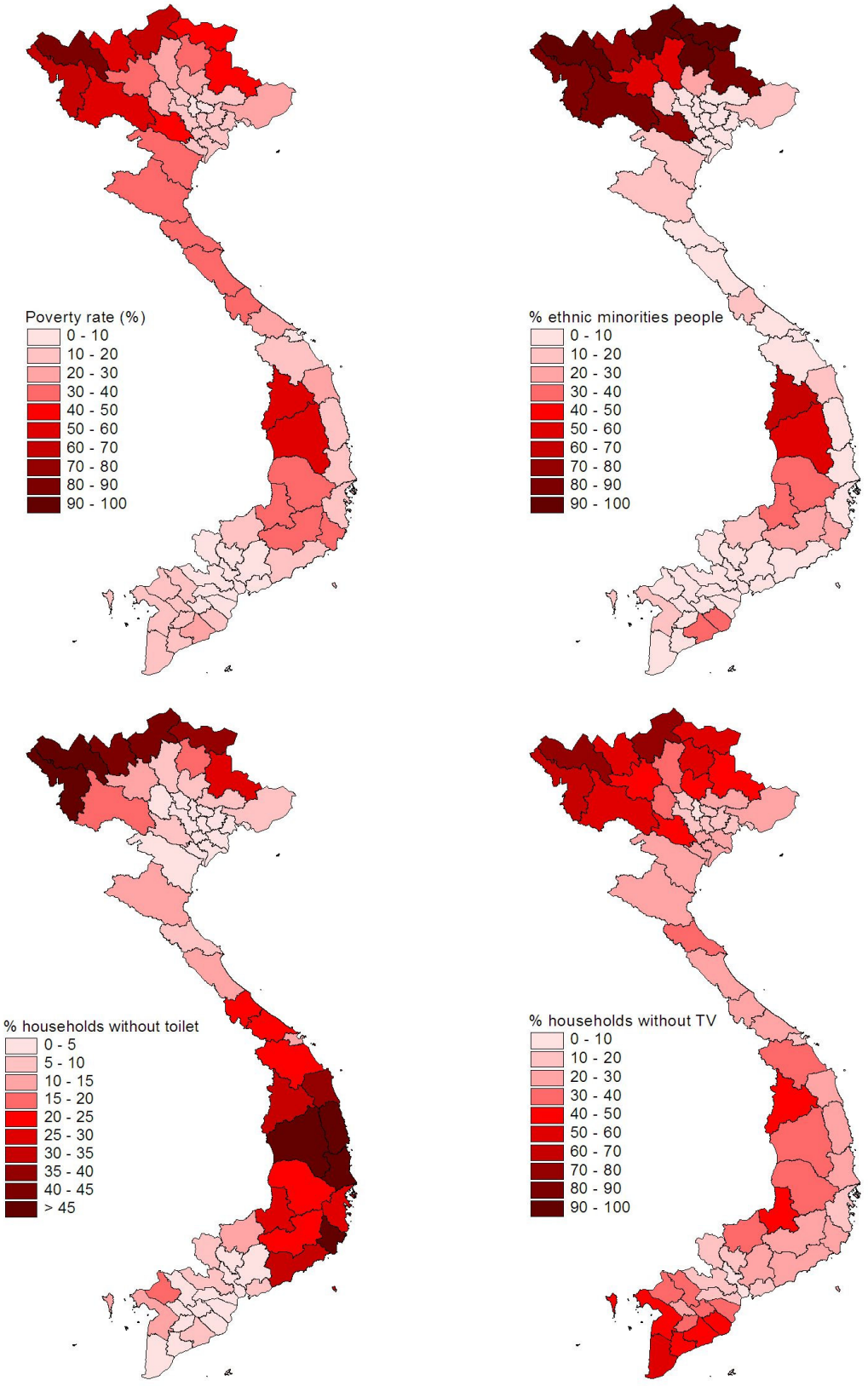
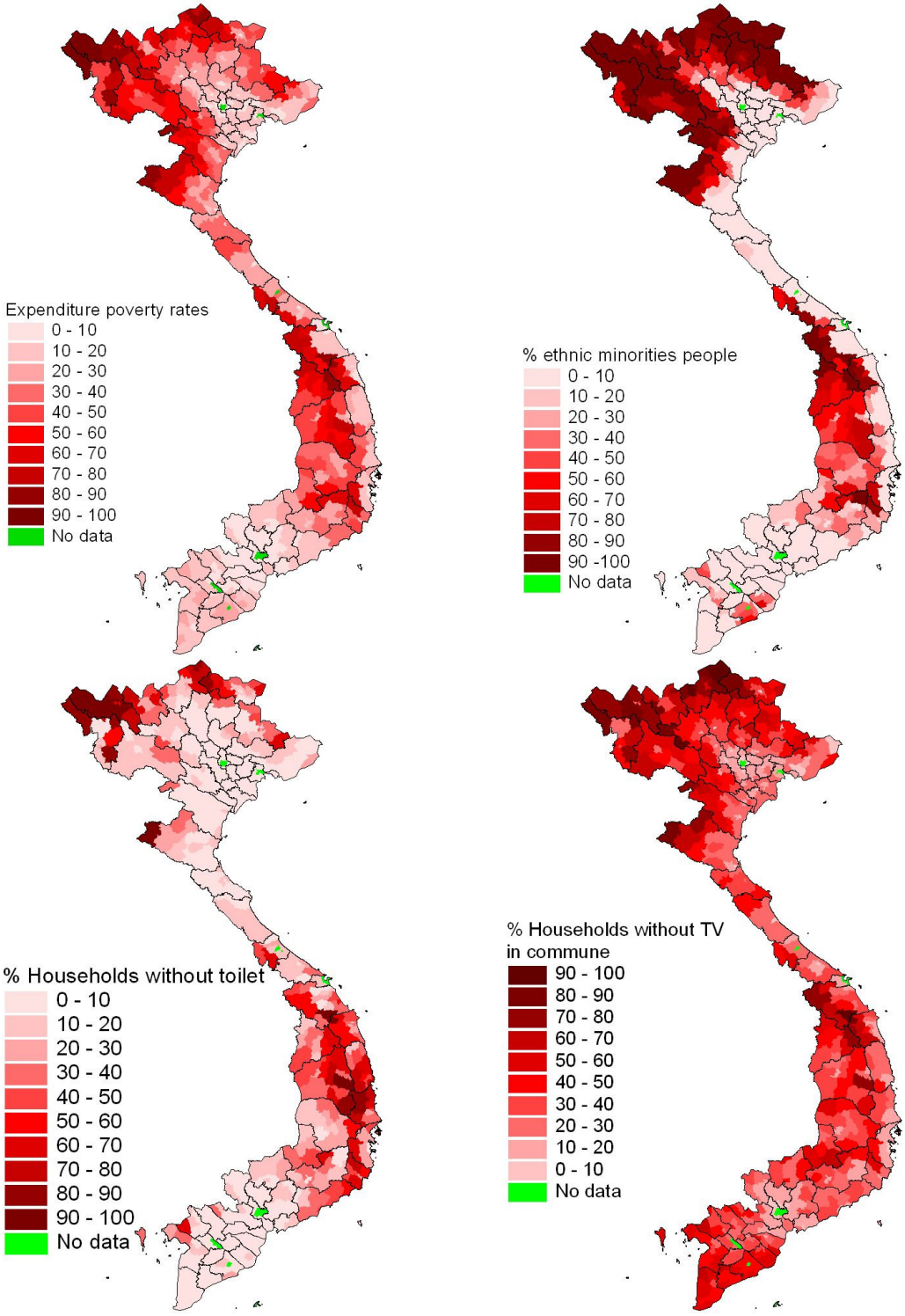


Figure 36: Expenditure poverty and household characteristics at the district level



8. CONCLUSION

Main findings from the small area estimations

This report presents the estimates of rural poverty and inequality at the regional, provincial and district levels, and with consideration of both expenditure and income based measures. The estimation method employed is Elber et al. (2002, 2003), and the used data are from the 2006 VHLSS and the 2006 RAFC. It is found that poverty remains a geographical phenomenon in Vietnam. North West and High Lands have very high poverty, while delta regions such as Red River Delta and South East have much lower poverty. There is a large variation in the expenditure poverty among provinces and districts. Some provinces such as Lai Chau, Dien Bien and Ha Giang have very high poverty rates of over 60%, while cities such as Ho Chi Minh, Ha Noi, Binh Duong have very low poverty rates below 5%. Poverty rates also vary significantly across districts from 0% to 92%. Income poverty estimates are very similar to the expenditure poverty estimates, at both the provincial and district levels. Poverty maps show that the spatial pattern of income and expenditure poverty is also quire similar.

Although the national inequality seems to be increasing, our estimates of expenditure inequality within provinces and districts are quite low. This implies that inequality of regions and nation can stem from the inequality between local areas rather than within local areas. As expected, income inequality is higher than expenditure inequality. It is interesting that inequality tends to be higher for the low poverty areas and high poverty areas. Inequality becomes highest in areas with middle poverty rates.

All the provinces experienced rural poverty reduction during the period 1999-2006. Poverty is reduced remarkably in provinces with the poverty rate around the average poverty level. Very poor provinces seem not to be very successful in poverty reduction.

Compared with the poverty estimates from Minot et al. (2002), our poverty estimates are closer to the MOLISA poverty rates. The correlation coefficients between the MOLISA poverty rates and our poverty estimates are more than 0.8. It is interesting that the expenditure poverty estimates seem to be more similar to the MOLISA poverty rates than the income poverty estimates. The spatial pattern of poverty is also similar between the MOLISA poverty and our poverty estimates. However, there are still many areas which have poverty rank and poverty point estimates very different from the rank and rates of the MOLISA poverty classification. Thus, more studies should be implemented for validation of the poverty and inequality estimated based on the small area estimation method.

Lesson learns and policy implications

Policies that may benefit from having small area estimates of poverty and inequality include: (a) cash transfers and income support programs; (b) local government support and community development programs investing in e.g. health care, infrastructure, education, labour markets, agricultural productivity and micro finance; (c) food-and-cash for work programs; (d) fund raising and donor coordination; and (e) evaluation of country strategies and monitoring progress towards millennium development goals (MDGs).

To take full advantage of the poverty maps, in particular of their policy relevance, it is key that they are accessible to a wide range of policy makers that include local entities as well as high level officials. It is not uncommon that public institutions, many of which may be potential users, are left largely unaware of the results from the poverty mapping exercise and their potential applications. Also important is that outdated estimates are timely replaced with up-to-date estimates poverty and inequality.

Let us conclude with some examples of how poverty maps have been used in other countries.

From Bulgaria: "Immediately after the 2005 maps had been completed, the MLSP organized consultations with the mayors and other representatives of the 13 poorest municipalities", which resulted in "the development of an ad hoc Program for Poverty Reduction … It identified priority areas for intervention and the allocation of resources, including the generation of employment, especially among the long-term unemployed and disadvantaged groups in the labor market" (Gotcheva, 2007). And, "a small number of smaller-scale programs … contribute to reducing poverty in the disadvantaged municipalities by creating alternative income sources such as agro-industries, bio-fuels, rural tourism, local crafts, wood working, carpentry …" (Gotcheva, 2007).

From Cambodia: The ministry of Agriculture, Forestry and Fisheries has "used the poverty map as a guide in selecting target areas for agro-ecosystems analysis", and "to target the poorest communes for agricultural productivity improvement and crop diversification" (Fujii, 2007).

From Yunnan, China: Food-and-cash for work programs make "use of the surplus labor resources in poor areas to build infrastructure such as roads, water management structures and drinking water treatment facilities. The program aims at providing poor farmers with job opportunities and sources of income" (Ahmand and Goh, 2007). The poverty map was used to identify these poor areas.

From Indonesia: "In 2005, the government of Indonesia decided to cut fuel subsidies. The resulting increase in fuel prices would particularly affect the poor, and the government planned to cushion this negative shock by providing unconditional cash

transfers to the poor. The Ministry of Finance used the poverty maps to estimate the budget for the cash transfers" (Ahmad and Goh, 2007).

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Appendix 1: Variable comparison

Table 40: Comparison of explanatory variables between the survey and census: Red River Delta

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.0058	0.0763	0.0079	0.0886
Household size	3.7472	1.5131	3.8440	1.4591
Permanent house	0.3819	0.4858	0.3719	0.4835
Semi-permanent house	0.5956	0.4908	0.5952	0.4910
Temporary house	0.0225	0.1484	0.0329	0.1783
Tap water	0.0563	0.2305	0.0602	0.2379
Clean water	0.9319	0.2520	0.9229	0.2668
Other water	0.0118	0.1081	0.0169	0.1289
Flush toilet	0.2450	0.4301	0.2414	0.4281
Other toilets	0.7451	0.4358	0.7419	0.4377
No toilet	0.0099	0.0988	0.0167	0.1281
Radio	0.1150	0.3190	0.0718	0.2583
Computer	0.0149	0.1211	0.0214	0.1447
Motorbike	0.5158	0.4998	0.5091	0.5001
Color television	0.8227	0.3819	0.8204	0.3840
Mobile	0.0904	0.2867	0.0807	0.2724
Telephone	0.2166	0.4119	0.2208	0.4149
Fridge	0.1161	0.3203	0.1392	0.3462
Fan	0.9893	0.1030	0.9255	0.2627
Ratio of female members to working members	0.4573	0.2637	0.4721	0.2635
Ratio of working member to household size	0.5263	0.2704	0.5246	0.2743
Ratio of service members to working members	0.1706	0.3309	0.1911	0.3159
Ratio of working members without vocational training	0.7822	0.3790	0.7675	0.3760
Ratio of working members with vocational training	0.0774	0.2143	0.0968	0.2326
Ratio of working members with college/university	0.0291	0.1438	0.0219	0.1172
Log of per capita living area (log of m2)	2.5640	0.5524	2.5982	0.5393
Have or own annual land (yes=1)	0.8376	0.3688	0.9062	0.2916

Table 41: Comparison of explanatory variables between the survey and census: North East

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.4297	0.4950	0.4400	0.4966
Household size	4.3348	1.6656	4.3955	1.5756
Permanent house	0.1347	0.3414	0.1455	0.3528
Semi-permanent house	0.7565	0.4292	0.6436	0.4792
Temporary house	0.1088	0.3114	0.2109	0.4081
Tap water	0.0361	0.1865	0.0309	0.1731
Clean water	0.5949	0.4909	0.6591	0.4742
Other water	0.3690	0.4825	0.3100	0.4627
Flush toilet	0.0549	0.2278	0.0715	0.2578
Other toilets	0.7989	0.4008	0.8383	0.3684
No toilet	0.1462	0.3533	0.0902	0.2867
Radio	0.1186	0.3233	0.0813	0.2734
Computer	0.0065	0.0801	0.0115	0.1068
Motorbike	0.4772	0.4995	0.5360	0.4989
Color television	0.5998	0.4899	0.6561	0.4752
Mobile	0.0491	0.2160	0.0637	0.2444
Telephone	0.1120	0.3153	0.1379	0.3450
Fridge	0.0804	0.2719	0.0956	0.2941
Fan	0.8188	0.3852	0.7847	0.4112
Ratio of female members to working members	0.4796	0.2187	0.4914	0.2095
Ratio of working member to household size	0.5464	0.2202	0.5713	0.2282
Ratio of service members to working members	0.1076	0.2748	0.1334	0.2826
Ratio of working members without vocational training	0.8727	0.2982	0.8686	0.2941
Ratio of working members with vocational training	0.0666	0.2015	0.0818	0.2205
Ratio of working members with college/university	0.0210	0.1189	0.0183	0.1167
Log of per capita living area (log of m2)	2.5941	0.5159	2.6049	0.4844
Have or own annual land (yes=1)	0.9051	0.2931	0.9346	0.2473

Table 42: Comparison of explanatory variables between the survey and census: North West

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.8600	0.3469	0.8820	0.3230
Household size	5.0313	2.1063	5.0037	2.0086
Permanent house	0.1034	0.3044	0.1094	0.3125
Semi-permanent house	0.6842	0.4648	0.6395	0.4808
Temporary house	0.2124	0.4090	0.2511	0.4343
Tap water	0.0206	0.1419	0.0299	0.1706
Clean water	0.2620	0.4397	0.2984	0.4582
Other water	0.7175	0.4502	0.6717	0.4703
Flush toilet	0.0375	0.1899	0.0398	0.1958
Other toilets	0.6902	0.4624	0.7303	0.4444
No toilet	0.2724	0.4452	0.2298	0.4213
Radio	0.1831	0.3868	0.1143	0.3187
Computer	0.0036	0.0599	0.0149	0.1213
Motorbike	0.4763	0.4994	0.4500	0.4982
Color television	0.4662	0.4989	0.4882	0.5006
Mobile	0.0225	0.1483	0.0260	0.1593
Telephone	0.0549	0.2278	0.0701	0.2556
Fridge	0.0431	0.2032	0.0532	0.2247
Fan	0.5019	0.5000	0.5012	0.5007
Ratio of female members to working members	0.4925	0.1852	0.5141	0.1722
Ratio of working member to household size	0.5277	0.1929	0.5438	0.1827
Ratio of service members to working members	0.0773	0.2383	0.0918	0.2409
Ratio of working members without vocational training	0.9301	0.2233	0.9186	0.2310
Ratio of working members with vocational training	0.0424	0.1613	0.0564	0.1803
Ratio of working members with college/university	0.0137	0.0969	0.0121	0.0958
Log of per capita living area (log of m2)	2.4346	0.4958	2.4364	0.4652
Have or own annual land (yes=1)	0.9410	0.2356	0.9621	0.1913

Table 43: Comparison of explanatory variables between the survey and census: North Central Coast

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.1109	0.3140	0.1008	0.3013
Household size	4.2137	1.7029	4.3152	1.7014
Permanent house	0.1236	0.3291	0.1327	0.3394
Semi-permanent house	0.7992	0.4006	0.7706	0.4207
Temporary house	0.0773	0.2670	0.0967	0.2957
Tap water	0.0562	0.2303	0.0540	0.2262
Clean water	0.8180	0.3859	0.8293	0.3764
Other water	0.1258	0.3317	0.1166	0.3212
Flush toilet	0.0989	0.2986	0.1033	0.3045
Other toilets	0.8091	0.3930	0.7914	0.4065
No toilet	0.0919	0.2890	0.1053	0.3071
Radio	0.1272	0.3332	0.0842	0.2779
Computer	0.0086	0.0925	0.0081	0.0900
Motorbike	0.4420	0.4966	0.4302	0.4954
Color television	0.7113	0.4531	0.7207	0.4489
Mobile	0.0497	0.2174	0.0454	0.2083
Telephone	0.1462	0.3533	0.1332	0.3400
Fridge	0.0520	0.2220	0.0541	0.2264
Fan	0.9118	0.2836	0.8560	0.3512
Ratio of female members to working members	0.4559	0.2620	0.4666	0.2376
Ratio of working member to household size	0.4816	0.2418	0.4994	0.2470
Ratio of service members to working members	0.1369	0.3038	0.1422	0.2872
Ratio of working members without vocational training	0.8187	0.3576	0.8491	0.3242
Ratio of working members with vocational training	0.0615	0.1954	0.0557	0.1726
Ratio of working members with college/university	0.0232	0.1297	0.0120	0.0846
Log of per capita living area (log of m2)	2.5512	0.5417	2.5289	0.5444
Have or own annual land (yes=1)	0.8374	0.3690	0.8465	0.3607

Table 44: Comparison of explanatory variables between the survey and census: South Central Coast

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.0710	0.2568	0.0686	0.2531
Household size	4.1466	1.7338	4.2221	1.6094
Permanent house	0.0416	0.1996	0.0659	0.2484
Semi-permanent house	0.8799	0.3250	0.8331	0.3732
Temporary house	0.0785	0.2689	0.1009	0.3015
Tap water	0.0482	0.2142	0.0730	0.2603
Clean water	0.8640	0.3428	0.8067	0.3952
Other water	0.0878	0.2830	0.1203	0.3256
Flush toilet	0.2432	0.4290	0.2573	0.4375
Other toilets	0.3680	0.4823	0.3408	0.4744
No toilet	0.3887	0.4875	0.4000	0.4903
Radio	0.0937	0.2914	0.1079	0.3105
Computer	0.0150	0.1215	0.0305	0.1720
Motorbike	0.6335	0.4818	0.6205	0.4857
Color television	0.7400	0.4387	0.7604	0.4272
Mobile	0.0690	0.2534	0.0869	0.2820
Telephone	0.1561	0.3630	0.1492	0.3566
Fridge	0.0682	0.2520	0.0784	0.2691
Fan	0.8988	0.3016	0.8595	0.3478
Ratio of female members to working members	0.4499	0.2695	0.4548	0.2660
Ratio of working member to household size	0.5010	0.2447	0.4797	0.2444
Ratio of service members to working members	0.1709	0.3240	0.1928	0.3235
Ratio of working members without vocational training	0.8340	0.3416	0.8061	0.3622
Ratio of working members with vocational training	0.0502	0.1710	0.0608	0.1886
Ratio of working members with college/university	0.0243	0.1270	0.0271	0.1370
Log of per capita living area (log of m2)	2.6115	0.5889	2.6365	0.5591
Have or own annual land (yes=1)	0.7661	0.4233	0.8369	0.3698

Table 45: Comparison of explanatory variables between the survey and census: Central Highlands

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.3913	0.4881	0.3479	0.4769
Household size	4.6568	1.8844	4.9939	1.9353
Permanent house	0.0481	0.2141	0.0605	0.2388
Semi-permanent house	0.8361	0.3702	0.7099	0.4544
Temporary house	0.1158	0.3200	0.2296	0.4211
Tap water	0.0192	0.1373	0.0228	0.1494
Clean water	0.4775	0.4995	0.7217	0.4487
Other water	0.5033	0.5000	0.2555	0.4367
Flush toilet	0.0922	0.2893	0.1408	0.3483
Other toilets	0.6072	0.4884	0.6292	0.4836
No toilet	0.3006	0.4585	0.2300	0.4213
Radio	0.0964	0.2952	0.0998	0.3001
Computer	0.0177	0.1319	0.0359	0.1864
Motorbike	0.6474	0.4778	0.6738	0.4694
Color television	0.6550	0.4754	0.7261	0.4465
Mobile	0.0804	0.2719	0.0986	0.2985
Telephone	0.1205	0.3256	0.1258	0.3320
Fridge	0.0595	0.2365	0.0761	0.2654
Fan	0.4707	0.4991	0.4980	0.5006
Ratio of female members to working members	0.4781	0.2132	0.4750	0.2111
Ratio of working member to household size	0.5196	0.2081	0.5024	0.2069
Ratio of service members to working members	0.0946	0.2607	0.1190	0.2635
Ratio of working members without vocational training	0.9189	0.2422	0.8760	0.2892
Ratio of working members with vocational training	0.0408	0.1581	0.0682	0.1959
Ratio of working members with college/university	0.0167	0.1057	0.0189	0.1192
Log of per capita living area (log of m2)	2.3385	0.5929	2.4096	0.5926
Have or own annual land (yes=1)	0.6370	0.4809	0.6169	0.4867

Table 46: Comparison of explanatory variables between the survey and census: South East

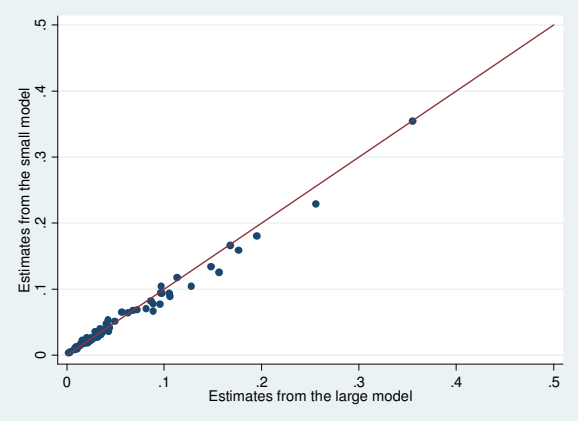
	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.0598	0.2372	0.0674	0.2510
Household size	4.3084	1.8064	4.5168	1.8520
Permanent house	0.0723	0.2590	0.0910	0.2879
Semi-permanent house	0.8140	0.3891	0.7225	0.4481
Temporary house	0.1136	0.3174	0.1865	0.3898
Tap water	0.1196	0.3245	0.1202	0.3255
Clean water	0.7585	0.4280	0.7832	0.4124
Other water	0.1219	0.3272	0.0966	0.2956
Flush toilet	0.3291	0.4699	0.4098	0.4922
Other toilets	0.5570	0.4967	0.4635	0.4991
No toilet	0.1139	0.3177	0.1266	0.3328
Radio	0.1474	0.3545	0.1486	0.3560
Computer	0.0473	0.2122	0.0940	0.2920
Motorbike	0.8019	0.3986	0.7959	0.4034
Color television	0.8005	0.3996	0.8302	0.3758
Mobile	0.1881	0.3908	0.2059	0.4047
Telephone	0.2960	0.4565	0.3456	0.4759
Fridge	0.2051	0.4038	0.2632	0.4407
Fan	0.8544	0.3527	0.8122	0.3908
Ratio of female members to working members	0.4565	0.2557	0.4467	0.2590
Ratio of working member to household size	0.5602	0.2366	0.5215	0.2420
Ratio of service members to working members	0.2448	0.3809	0.2688	0.3800
Ratio of working members without vocational training	0.8578	0.3120	0.8307	0.3282
Ratio of working members with vocational training	0.0738	0.2163	0.0691	0.1978
Ratio of working members with college/university	0.0292	0.1402	0.0346	0.1503
Log of per capita living area (log of m2)	2.6862	0.6637	2.7104	0.6007
Have or own annual land (yes=1)	0.3196	0.4663	0.3643	0.4816

Table 47: Comparison of explanatory variables between the survey and census: Mekong River Delta

	Census		Survey	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Ethnic minorities (yes=1)	0.0699	0.2550	0.0697	0.2548
Household size	4.3076	1.7071	4.1867	1.6875
Permanent house	0.0709	0.2566	0.0822	0.2747
Semi-permanent house	0.6391	0.4803	0.4658	0.4990
Temporary house	0.2900	0.4538	0.4520	0.4979
Tap water	0.1944	0.3957	0.1723	0.3778
Clean water	0.5802	0.4935	0.6379	0.4808
Other water	0.2254	0.4179	0.1898	0.3922
Flush toilet	0.1333	0.3399	0.1600	0.3668
Other toilets	0.8205	0.3838	0.6827	0.4656
No toilet	0.0462	0.2100	0.1573	0.3642
Radio	0.2349	0.4240	0.2011	0.4010
Computer	0.0117	0.1074	0.0295	0.1693
Motorbike	0.4321	0.4954	0.4572	0.4983
Color television	0.6396	0.4801	0.6925	0.4616
Mobile	0.0974	0.2965	0.1210	0.3262
Telephone	0.1761	0.3809	0.2064	0.4048
Fridge	0.0740	0.2618	0.1197	0.3247
Fan	0.7227	0.4477	0.6696	0.4705
Ratio of female members to working members	0.4636	0.2358	0.4414	0.2512
Ratio of working member to household size	0.6018	0.2335	0.5660	0.2547
Ratio of service members to working members	0.1785	0.3444	0.2161	0.3480
Ratio of working members without vocational training	0.9167	0.2457	0.8801	0.2997
Ratio of working members with vocational training	0.0356	0.1464	0.0359	0.1453
Ratio of working members with college/university	0.0163	0.1029	0.0176	0.1088
Log of per capita living area (log of m2)	2.6035	0.5889	2.7306	0.5847
Have or own annual land (yes=1)	0.5011	0.5000	0.5230	0.4996

Appendix 2: Comparison between large and small models

Figure 37: The expenditure poverty gap index (P1) of provinces



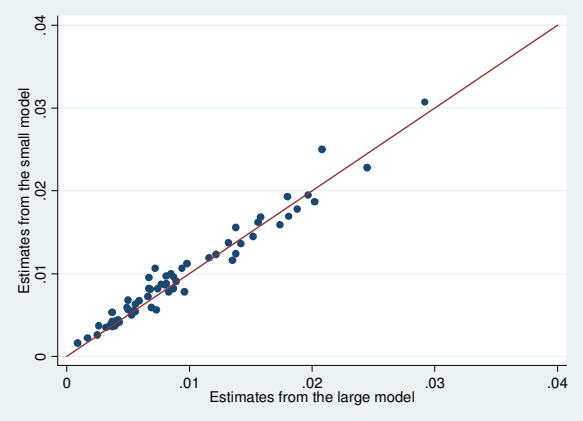
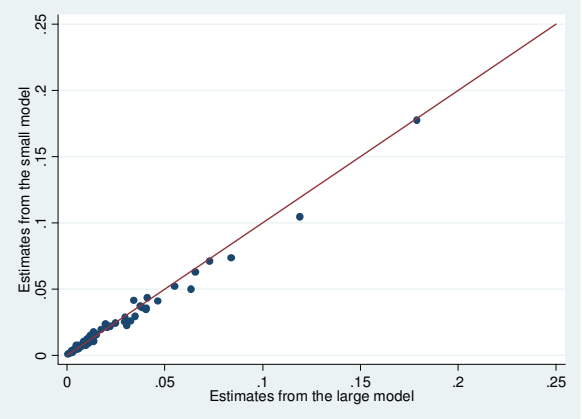


Figure 38: The expenditure poverty severity index (P2) of provinces



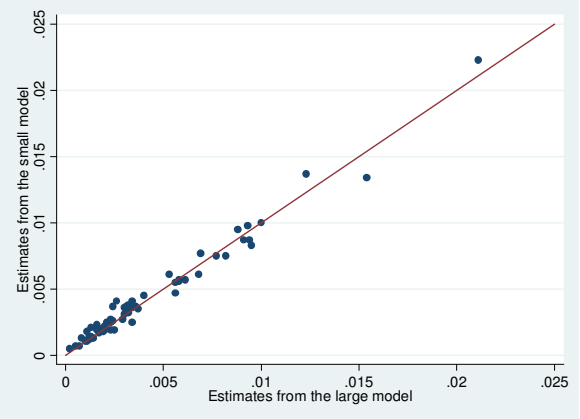
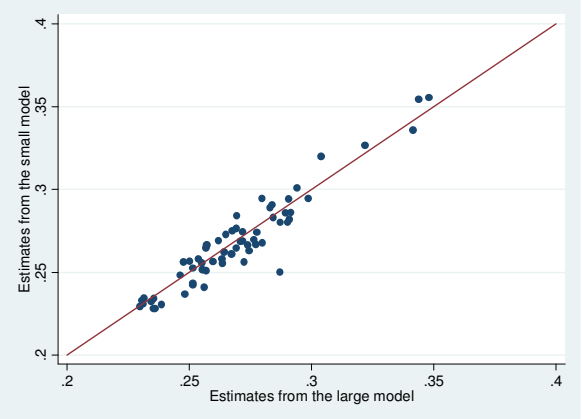


Figure 39: The expenditure Gini index of provinces



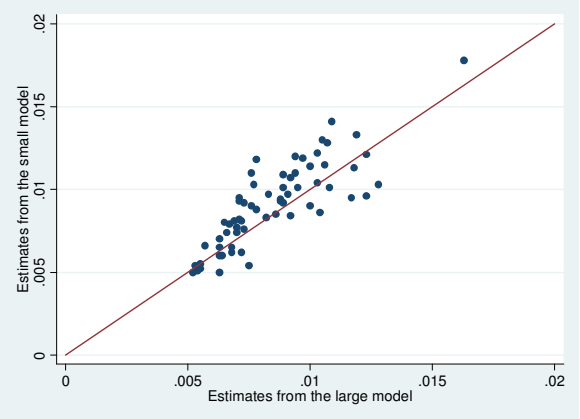
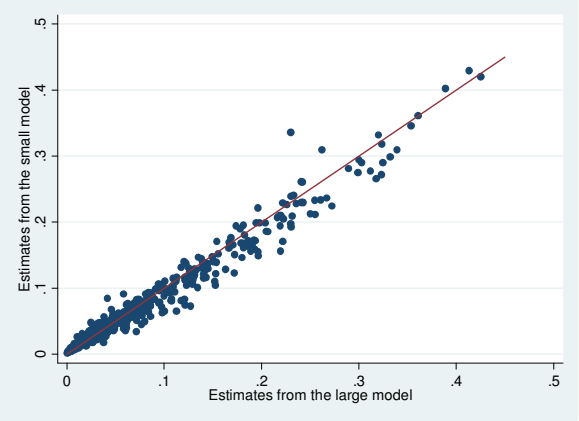


Figure 40: The expenditure poverty gap index (P1) of districts



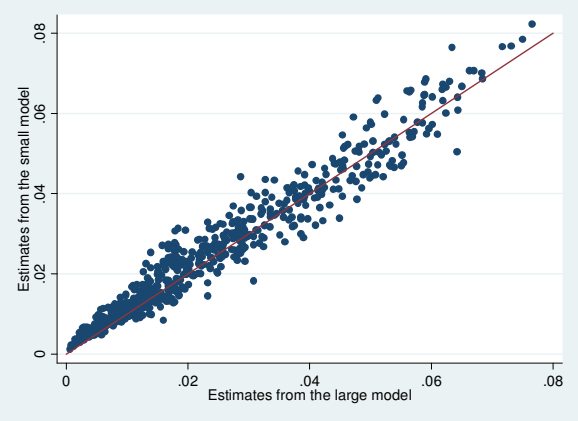
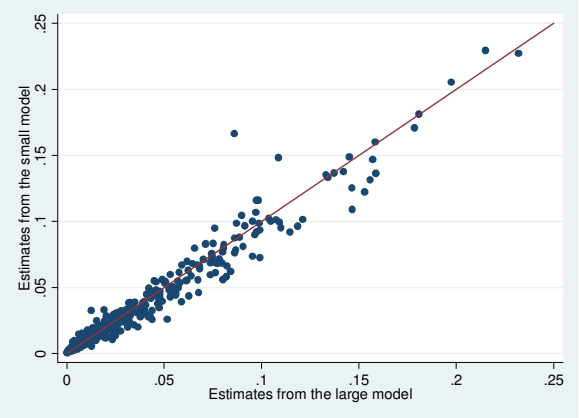


Figure 41: The expenditure poverty gap index (P2) of districts



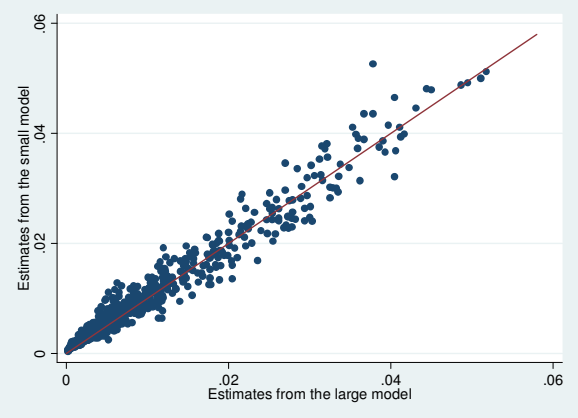
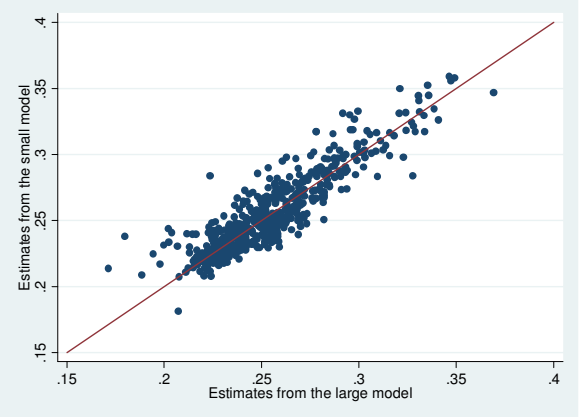


Figure 42: The expenditure Gini index (P2) of districts



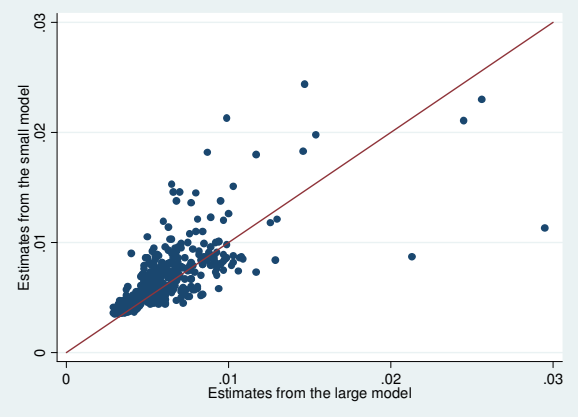


Figure 43: The income poverty gap index of provinces

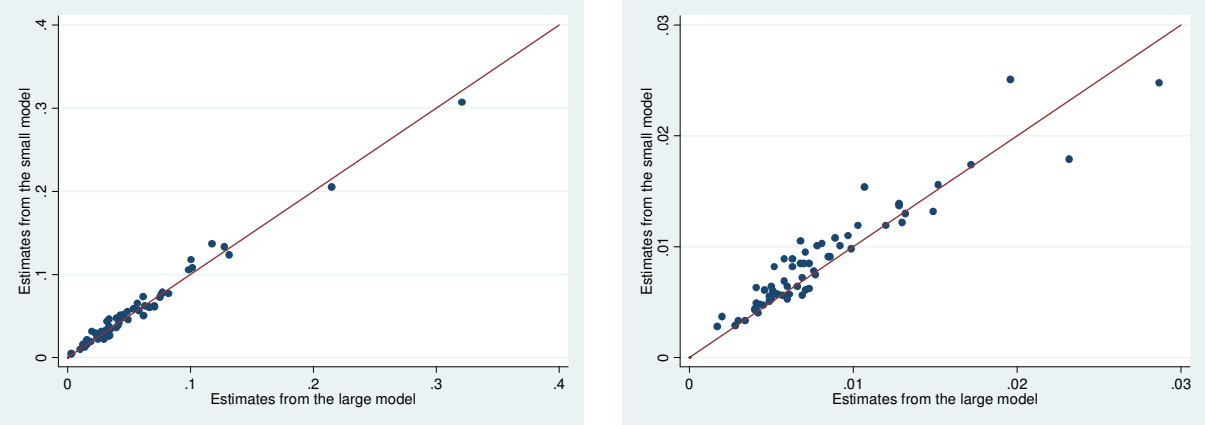


Figure 44: The income poverty severity index of provinces

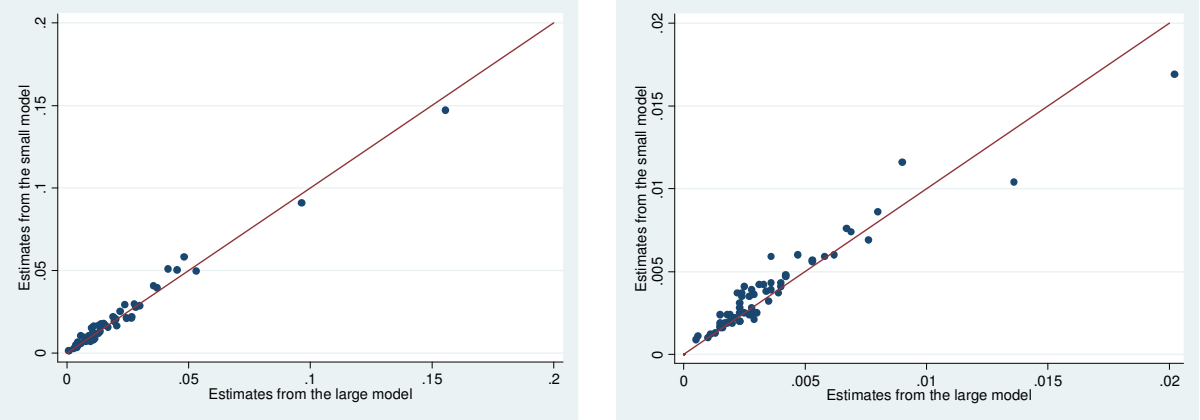


Figure 45: The income Gini index of provinces

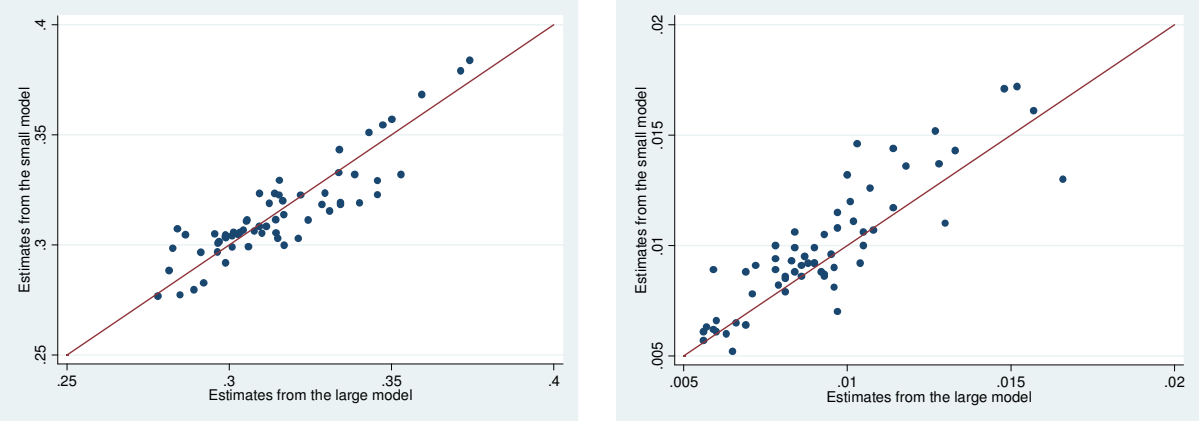
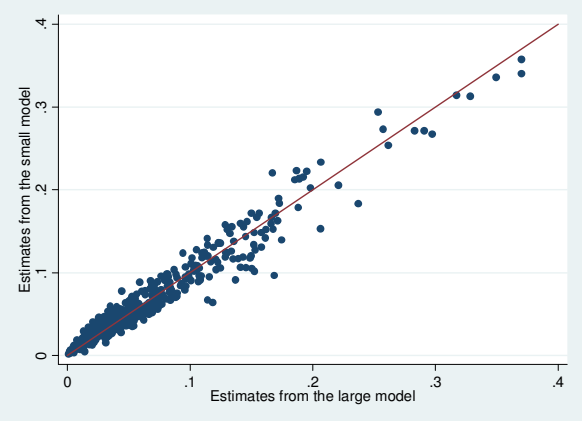


Figure 46: The income poverty gap index of districts



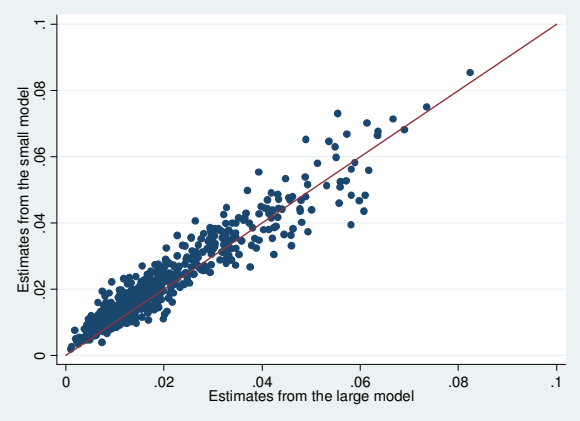
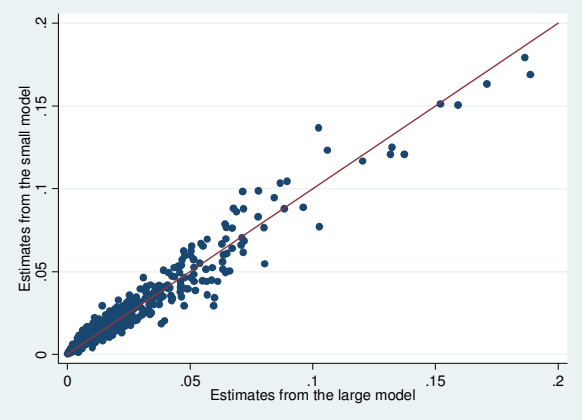


Figure 47: The income poverty severity index of districts



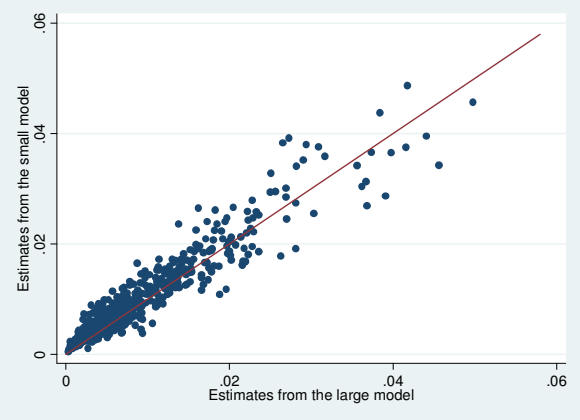


Figure 48: The income Gini index of districts