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How to prioritise policies for poverty reduction: Applying Bayesian Model Averaging to Vietnam

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Abstract

The UN Millennium Development Goals have recognized poverty reduction as the main goal of global development policy. A comprehensive framework to evaluate the effectiveness of single policy measures and policy packages with respect to poverty reduction is still lacking, though. Policy evaluation is exposed to manifold uncertainties given the dependency of the preferred outcomes on a chosen policy, available information, and policy makers' preferences. We show that Bayesian Model Averaging (BMA) is most valuable in this context as it addresses the parameter and model uncertainty inherent in development policies. Using data for the 61 Vietnamese provinces we are able to ascertain the most important determinants of poverty from a large number of potential explanatory variables.

JEL Classification: C11, C52, O18, O53, R11

Keywords: Poverty determinants, Vietnam, model uncertainty, Bayesian Model Averaging (BMA)

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1 Introduction

The UN Millennium Development Goals have recognized poverty reduction as the main goal of global development policy. Today, there seems to be a broad consensus that poverty reduction should not be separated from growth-supportive strategies for developing countries, but should rather be combined in a vision of pro-poor growth.¹ This vision also acknowledges that the poverty reducing effects of growth are the more effective the less they are accompanied by increasing inequality.² Finally, one can find conjectures that poverty reduction is most effective, if targeted government policies are implemented that directly influence the well-being of the poor.³

To be most valuable for guiding development policies, we feel that empirical poverty research should not confine itself to evaluating only one of those components. Rather, it should be interested in the relative poverty impacts of single policy measures and the combined impacts of particular policy packages. Many cross-country regressions as well as country specific studies with various econometric techniques have been conducted. Such poverty research, however, still suffers from a high degree of parameter and model uncertainty which makes the results ambiguous and artificial.⁴ Similar problems with model uncertainty in the empirics of economic growth and the justifications for well determined growth-promoting policies have led Brock and Durlauf (2001) or Brock et al. (2003) to proclaim the necessity of policy-relevant empirical analyses on the basis of Bayesian econometric methods.

Furthermore, the selection of a single model for policy evaluation may not be appropriate given the dependency of the preferred outcomes on a chosen policy, available information, and a policy maker's preferences. Therefore, "conditioning policy evaluation on a particular model ignores the role of model uncertainty in the overall uncertainty that surrounds the effects of a given policy choice" (Brock et al. 2003, p.236). In the same spirit we make use in this paper of the Bayesian Model Averaging (BMA) method pioneered by Fernandez, Ley and Steel (2001) to measure the effectiveness of different determinants of poverty. The BMA framework has already been applied successfully to empirical studies of income convergence by Léon-Gonzalez and Montolio (2004) and of the determinants of (African) growth by Masanjala and Papageorgiou (2004).

Our paper is the first attempt to apply this framework to an analysis of the determinants

¹See e.g. Shorrocks and van der Hoeven 2004.

²Ravallion 1997, 2001, 2004; Kakwani 2000.

³Dagdeviren et al. 2004.

⁴Lopez 2004.

of poverty. Our BMA combines 'cross-country' and country specific approaches. We focus on one specific country, but take into account spatial differences in growth, inequality and targeted pro-poor policies by using sub-national-level data. From a very broad number of potential determinants of poverty reduction we select not only those regressors having the highest impact on poverty but as well the most appropriate combination of variables in a model.

We chose Vietnam for our case study because this country is considered to be a showcase for an effective policy of poverty reduction.⁵ Most observers link this achievement to the high aggregate growth rates that Vietnam recorded over the 1990s.⁶ But Vietnam also serves as an example for strong pro-poor effects of a relatively equal initial distribution of income and assets, due to both its communist past and a deliberate policy of land allocation as part of the transition strategy. Finally, the Vietnamese government tried to attack poverty by a package of targeted spending programmes. Since differences in the dynamics of growth, inequality, pro-poor public spending, and poverty reduction are quite pronounced across Vietnam's 61 provinces, and since the quality of available data has been considerably improved over the last years, we find good conditions for applying BMA to the Vietnamese provincial data. We use this data to explain poverty levels in 2002 by a series of possible determinants that can be regrouped in four clusters: structural variables, initial distribution, pro-growth policies and pro-poor policies.

As a first study, we find that poverty in Vietnam is best explained by variables coming from all clusters. Regarding policy conclusions, we find support for birth control, private sector development, SOE restructuring, promoting urbanisation, and a further implementation of the land reform as important instruments of poverty reduction. Income equality starts to become an obstacle for further poverty reduction. Finally, our results seem to indicate — given a high degree of data uncertainty — that the currently existing targeted pro-poor policies are useful for poverty reduction but, nevertheless, should be reformed. The paper is organized as follows. Section 2 provides a survey of the research on the complex relationship between poverty, growth, inequality, and policy measures. Section 3 briefly reviews the achievements of poverty reduction in Vietnam and the open questions related to the relative importance of the various potential determinants. Section 4 presents variables and data for the estimation. Section 5 describes the methodology of BMA, while section 6 reports and discusses the results. Section 7 concludes.

⁵Between 1986, the beginning of major policy reforms, and 2002, the year of the last household survey, the Vietnamese aggregate headcount index fell from over 70 per cent to under 30 per cent (World Bank 2003).

⁶The average rate of per capita GDP growth was about 5 per cent (Bonschab and Klump 2004).

2 Determinants of poverty and poverty reduction

2.1 The poverty-growth-inequality triangle

Since poverty reduction has been recognized as the most important goal of global development economics, much effort has been invested in the search for significant determinants of poverty and its reduction.⁷ Clearly, this research is conducted with a view of identifying those determinants that influence poverty most effectively and that could be influenced adequately by policy interventions. A major part of this research agenda concerns the so called "poverty-growth-inequality triangle" (Bourguignon 2004) which regards poverty as mainly influenced by growth and inequality but also highlights influences of inequality on growth. We take this concept as a starting point but go further in focussing on policies determining initial inequality of incomes and assets and the dynamics of growth and poverty. Therefore, we develop a conceptual framework that accounts for a very broad number of possible determinants of poverty. Empirical research should then be able to identify the most effective determinants.

The relationship between growth, inequality, and poverty has been in the centre of discussions about how to define and how to achieve pro-poor growth.⁸ There is a broad consensus today that growth is the major prerequisite for (income) poverty reduction under the assumption that the distribution of income remains more or less constant.⁹ Therefore, one should expect that growth-enhancing policies, such as higher investment or higher openness to international markets, should also improve the situation of the poor. However, the rate of income growth, or at least its poverty reducing effect, is reduced, if the inequality of income and/or assets is high.¹⁰ In particular, high inequality could reduce further growth and poverty education significantly via its negative effects on human capital formation, on agricultural productivity and on the political stability and support for further growth.¹¹ Furthermore, there are specific policy measures that are meant to influence the fate of the poor directly. They include targeted measures of social policy that redistribute from the rich to specific groups of the poor as well as public investment in infrastructure, education and health.¹² Certainly, such measures are useful. However, the opportunity costs in terms of potential losses of growth are generally not calculated.

⁷Recently, a survey of this research was given by Shorrocks and van der Hoeven (2004).

⁸See e.g. Klasen 2003; Cord et al. 2003; Ravallion 2004.

⁹See e.g. Deininger and Squire 1996, Dollar and Kraay 2001; Ravallion 2001; Bourguignon 2003.

¹⁰See e.g. Ravallion 1997.

¹¹Alesina and Perrotti 1996; Easterly 2001; Rehme 2003; Viaene and Zilcha 2003; Gundlach et al. 2004.

¹²Dagdeviren et al. 2004.

2.2 Empirical evidence

Dollar and Kraay (2002) presented cross-country evidence that growth is good for the poor. Inequality and specific pro-poor policies do not play a significant role according to this benchmark study. However, the results have been criticised from different sides. Ravalion (2001) has pointed out that the national average that has entered the Dollar-Kraay database hides a lot of interesting information about development on the sub-national level. If one looks beyond averages inequality may become an impediment for growth and poverty reduction. Gundlach et al. (2004) present empirical cross-country evidence that public investment on education has a positive effect on the poor, if the quality of education is taken into account more consistently than in the Dollar-Kraay study. This type of criticism can be extended to other Dollar-Kraay results.

If one accepts the idea that growth is at least among the most important sources of poverty reduction, one has to think about the most significant and most effective determinants of growth. Empirical evidence in this field is even more debated. The so-called Barro regressions¹³ have identified a lot of potentially important determinants of growth, but they have also revealed the problems related to parameter and model uncertainty in the estimation of cross-country growth regressions.¹⁴ Investment and openness seem to belong to the most robust determinants of long-term growth. But other variables may also become relevant for growth-enhancing policies once other criteria for robustness are chosen.¹⁵ Summing up the existing theoretical debate and the available empirical evidence, we propose the policy instruments that affect poverty can be systematically structured as follows:

1. The initial distribution of incomes and assets
2. Growth-enhancing policy instruments (pro-growth policies)
3. Targeted poverty reducing measures (pro-poor policies)

Generally, the three clusters of instruments work jointly and complementarily on the reduction of poverty.¹⁶ Empirical studies following this general framework should be able to ascertain the significant and most effective policy variables.

¹³Barro 1991; Barro and Sala-i-Martin 1995.

¹⁴See e.g. Levine and Renelt 1992; Durlauf and Quah 1999; Brock and Durlauf 2001.

¹⁵Sala-i-Martin 1997.

¹⁶See the discussion in section 2.1.

3 Poverty and poverty reduction in Vietnam

3.1 Historical context and trends in growth, inequality, and poverty

After decades of war Vietnam was reunited in 1975. The national development strategy at that time was based on the implementation of the socialist system of North Vietnam in the Republic of South Vietnam. All land was collectivised, markets were gradually abolished, and prices were strictly controlled. Production and investment should follow strict central state planning. This strategy led to a severe economic crisis. Political tensions with China in the late 1970s, the mass exodus of ethnic Chinese who had been the backbone of the South Vietnamese economy, and growing political and economic isolation forced Vietnamese political leaders to tackle fundamental reforms. Minor and uncoordinated reforms of the central planning system in the early 1980s only led to hyperinflation and trade imbalances. In this critical situation, the Sixth Congress of the Communist Party approved a comprehensive reform agenda under the name of *doi moi* (renovation) in 1986. *Doi moi* recognized the essential role of a multi-ownership structure of the economy, (re-)introduced free market prices for commodities and private property rights on land and enterprises, and supported macroeconomic stabilization and external liberalization. These reforms have been remarkably successful. GDP growth averaged 6.8 per cent per year between 1987 and 2001 - one of the highest rates in the world. Population growth also fell during those years, which kept per capita growth at an impressive 5 per cent.¹⁷

Vietnam's aggregate Gini-coefficient was relatively low with a value of 0.34 in 1993, certainly a result of the long socialist era. However, the aggregate Gini considerably increased over time to arrive at a value of 0.42 in 2002. Also, the steadily growing factor between expenditures of the richest and poorest quintile of the population - from under 5 in 1993 to over 6 in 2002 - indicates growing distributional imbalances which already seem alarming to some observers.¹⁸ Spatial differences in inequality are also pronounced in Vietnam. Urban areas recorded a Gini coefficient of 0.41 in 2002, while it was only at 0.36 in rural areas. Regional Gini coefficients range between 0.42 in the South East around Ho Chi Minh-City and 0.35 in South Central Coast.

Furthermore, *doi moi* has led to an impressive reduction of poverty in Vietnam.¹⁹ Before 1986 the national poverty rate in Vietnam stood at over 75 per cent; in 2002 it had fallen below 30 per cent. In its Comprehensive Poverty Reduction and Growth Strategy

¹⁷See e.g. White et al. 2001; Bonschab and Klump 2004.

¹⁸Fritzen 2002.

¹⁹World Bank 1999.

(CPRGS), the Vietnamese government aims at achieving a national poverty rate of fewer than 20 per cent by 2010.²⁰ Poverty in Vietnam has no particular gender-bias, but is concentrated in rural areas and among ethnic minorities. The regions with the higher poverty rates in 2002, North West (68 per cent) and Central Highlands (52 per cent), are mainly rural and have the highest share of ethnic minorities. The regions with the lowest poverty rates, South East (11 per cent) and Red River Delta (22 per cent), are located around the main economic centers, Ho Chi Minh City, and Hanoi. Given the growing spatial variation in poverty, a "rolling out of CPRGS to the provinces" (World Bank 2003) has been proclaimed.

3.2 Single determinants of poverty

Most empirical studies about the determinants of poverty in Vietnam rely on single factor approaches. Given the theoretical debate about the strong growth-poverty linkages, the pro-poorness of growth has been analysed in various regards and with different techniques. There also exist some investigations in the poverty effects of single pro-poor policy instruments, such as public spending for poor areas and households or investment in rural infrastructure.

Various measures of the pro-poorness of aggregate income growth in Vietnam have been calculated by Bonschab and Klump (2004). For the period 1993-2002 they find a poverty elasticity of growth of about 1, which is relatively high in an international perspective. Also a look at the growth incidence curve²¹ that depicts income growth for every percentile of the household distribution underlines that growth must have been essential for the broad and fast reduction of poverty. Explicit rates of pro-poor growth, that can be calculated from the growth incidence curves, range at about 4 per cent over the period 1993-2002. Over the whole period rates of pro-poor growth are much higher in urban than in rural areas of the country.

Van de Walle (2004) studied the poverty effects of public safety nets and derives sceptical conclusions. Given that available funds at the local level mainly depend on the relative development level, social transfers will not contribute actively to a catching-up of poorer areas. More is spent relatively and absolutely on the poor in the better-off communes. Larsen et al. (2004) investigated the poverty impact of Vietnam's public investment programme (PIP) that is basically spent for the improvement of public infrastructure. They conclude that spending an additional one per cent of GDP in public investment would

²⁰Socialist Republic of Vietnam 2002.

²¹Ravallion and Chen 2001.

be associated with a reduction of poverty in the order of 0.5 per cent. Fan et al. (2003) analyse the poverty and the growth effect of selected forms of public investment in rural infrastructure. They find that both growth and poverty reduction could be supported most efficiently by public investment in agricultural R&D.

What is lacking so far is an explicit test for the impact of income and asset inequality on poverty and poverty reduction in Vietnam. From a decomposition of aggregate poverty changes over the period 1993-2002 into growth and redistributive components one can draw the conclusion that income inequality had a significant and rising impact.²² Additionally, a recent study on land distribution in Vietnam by Do and Iyer (2004) could show that inter-provincial differences in the allocation of land-using rights had a significant impact on the productivity of agriculture and the extent of off-farm employment so that one should also expect explicit effects on poverty.

3.3 Multiple determinants of poverty

Empirical studies that consider multiple determinants of poverty in Vietnam are still rare. Several reasons can be made responsible for this finding. Firstly, problems with the availability of data for many relevant variables: The three existing household surveys, the Vietnam Living Standard Survey (VLSS) 1992/93 and 1997/98, and the Vietnam Household Living Standard Survey (VHLSS) 2002 are not fully comparable as the 2002 survey lacks a panel dimension; data from government sources, the national accounts or census data are sometimes highly inconsistent and unreliable. Secondly, there is no broad consensus about which variables other than growth should be considered as important determinants of poverty.²³ Thirdly, there is a conjecture that different models should explain poverty in urban and rural areas so that spatially disaggregated non-household survey data should be available which is an even more delicate requirement. Therefore, Minot et al. (2003) test for determinants of rural and urban poverty in Vietnam by employing spatial regression analysis to data from different levels (so-called "Poverty Mapping"). They start with a model that includes 32 agro-climatic and socio-economic variables and then proceed to selective models of rural and urban poverty. It turns out that 74 per cent of the variation in rural poverty can be explained by geographic variables and the distance from towns; while not even 30 per cent of the variation in urban poverty is related to agro-climatic variables or measures of market access. On the one hand, this study shows the power of small-area estimation methods to study the spatial pattern and determinants of poverty.

²²Bonschab and Klump 2004.

²³See, e.g. World Bank 1999, 2003.

Swinkels and Turk (2004), for example, use the poverty mapping approach to investigate the spatial impacts of targeted poverty alleviation programmes. On the other hand, the fundamental problem of model uncertainty is not solved by this estimation method. As in many growth regressions the optimal combination of significant regressors is chosen on a rather ad hoc basis.

Balisacan et al. (2003) analyse panel data of 4,302 households and a sub-sample of 3,494 rural households from the VLSS 1992/93, and 1997/97. They test for the determinants of poverty across Vietnam's 61 provinces, measured by the per capita expenditure of the lowest quintile. In a fixed effects regression they find that among a multitude of significant socio-economic variables (such as household size, number of children and gender of the household head) it is the mean provincial income, which has the most significant effect. The elasticity of local poverty reduction with regard to local income growth was found to be higher than 1.3. Provincial income growth has significant interactions with dummies for two regions (South Central Coast and Mekong River Delta) and with the availability of perennial land for households. However, this study does not take into account measures of income or asset inequality nor the effects of targeted pro-poor policies.

Since the VHLSS 2002 does not have the appropriate panel dimension the estimations of Balisacan et al. (2003) cannot be replicated with more recent data. However, we take these estimations as a support for our hypothesis that a proper understanding of poverty in Vietnam should pay special attention to its spatial dimensions. The two last Vietnam Development Reports (VDR)²⁴ have underlined that poverty dynamics in Vietnam cannot be properly understood without looking at sub-national-level developments. Despite a history of socialist planning, there is a much older tradition of strong local and provincial autonomy which has witnessed a revival after the beginning of *doi moi*.

Provincial income growth seems to play a major role for poverty reduction, but theoretical reasoning strongly suggests that also measures of inequality, a wide range of structural variables and many pro-poor policies have a some influence. From the existing empirical results it is very difficult to draw strong conclusions on the relative efficiency of the various policy instruments other than simple aggregate pro-growth measures. Therefore, we want to propose a new approach for selecting the most relevant determinants of poverty in Vietnam. In order to compensate for the missing panel dimension and to account for spatial differences in poverty, we base our study on data from household surveys and other sources, for the 61 Vietnamese provinces. And we do not apply classical econometric methods but BMA that explicitly deals with the high degree of parameter and model uncertainty.

²⁴World Bank 2003, 2004.

4 Variables and Data

4.1 Structural, distributional, and policy variables

Following our general framework, we include in our BMA all those variables that had been related to poverty in earlier studies on Vietnam, that can be suspected to influence poverty in a particular way, and for which data are available on the sub-national level. The use of sub-national-level data has major advantages over cross-country regressions as the problem of comparability across observation units of data on income or expenditure is much less serious and, thus, the potential bias due to the correlation between those data and the unobserved individual (country-)specific effects can be eliminated or reduced dramatically, at least. The comparison of political characteristics across countries can also be difficult due to the diversity in historical experiences, cultural norms, and institutional contexts; sub-national-level studies allow us to control for such contexts.

Some of our variables could be classified as structural in the sense that they identify some important structural characteristics of the Vietnamese economy which cannot be changed in the short run. For example, Share of Agriculture and Industry in Provincial GDP, Share of Urban Population, Share of Ethnic Minorities, South Dummy. Variables related to the labour force, human capital, and infrastructure such as Share of Graduates, Birth Rate, Life Expectancy, Literacy Rate or the Share of SOEs are much more open to short-run policy intervention. All other variables are (potentially) strongly influenced by direct or indirect policy interventions. We do not consider growth itself but we include different potential determinants of growth as they could represent determinants of poverty as well. As measures of inequality we look at a Gini Coefficient of Household Expenditures as well as at a Gini Coefficient of Land Use. We are also able to include two measures of institutional reforms on the provincial level, one related to the Implementation of Land Reform, the other related to the Implementation of the new Vietnamese Enterprise Law.

4.2 Data sources

We make use as far as possible of data originating from the most recent household survey, the VHLSS 2002. The first variable calculated from VHLSS is our dependent variable, the Provincial Poverty Rate, based on the expenditure-based general poverty line of 1,916,000 VND (Vietnamese Dong) per person and year.²⁵ This corresponds to the cost of purchasing a basket of food and non-food items that provide 2100 calories per day as well as a

²⁵This poverty line is calculated by the General Statistics Office, GSO, in Hanoi.

set of non-food basic needs.²⁶ To calculate the poverty rates we used the real per capita expenditures of each interviewed household weighted with an individual sampling weight to make this expenditure variable representative for the population.²⁷

Further variables computed on the basis of the VHLSS are the regressors measuring investment in human capital, namely the (nominal) Mean per capita Expenditure on Education and on Health of each household in 2002.²⁸ Besides, we computed two different inequality measures, the Expenditure Gini and the Land Gini. The Land Gini cannot be taken as representing the distribution of the asset land definitely²⁹ but serves as a good approximation as in the course of the land reform more and more households have been provided with land use certificates (LUCs) for their cultivated land. Another variable related to the process of land titling is the regressor Land Market as it measures the share of rural households with land leased in or out.³⁰ The varying Implementation of Land Reform in the different provinces is represented by our next explanatory variable based on VHLSS which estimates the share of agricultural households that already hold LUCs proportional to all agricultural households. This variable can also be seen as an indicator of the quality of provincial institutions.³¹ The structural variables computed from VHLSS are the Share of Ethnic Minorities in the provincial population, as poverty is strongly correlated with belonging to an ethnic minority³² and the degree of urbanization in each province calculated as the Share of Urban Population in total provincial population.

A dummy variable was created to account for a possible structural effect due to the different historical experience of Vietnam's provinces. Provinces which are located south to the border that had been created by the Geneva accords in 1954 between Quang Binh

²⁶The poverty line is a national one that reflects national average price changes. The individual expenditure data in the VHLSS that we use for our analysis, however, have already been corrected to make them comparable to this national average by correcting for price differences among rural and urban areas and among regions. So there are no proper provincial poverty lines but we can use the general one with our spatially adjusted expenditure data.

²⁷All the variables calculated from the VHLSS include this individual sampling weight to adjust for the population size, or the household sampling weight to represent the number of households.

²⁸Due to missing price deflators no real expenditures could be calculated for these two variables.

²⁹The question in the survey used for this computation asked only if the households managed or used land, not if they owned it.

³⁰The land market increased up to 15 percent for whole Vietnam in 2002. In 1993 only 5 percent of households participated in such land transactions (World Bank 2003).

³¹Do and Iyer 2004.

³²Our Ethnic Minorities variable comprises all Vietnamese ethnics except for Kinh and Chinese which made up 85 per cent of the population in 1998 but are on the decline because of decreasing fertility rates among those two races.

and Quang Tri and which had thus been part of the capitalist and free-market oriented Republic of South Vietnam until 1975 are given a dummy value of 1. This concerns 32 of the 61 provinces.

The variable which measures Private Business Implementation stems from a database that has been created in the joint CIEM/UNDP project VIE 01/025 "Private sector development and poverty alleviation in Vietnam" (CIEM 2002). It measures the provincial distribution of newly registered enterprises under the Enterprise Law which was enacted in 2000.

The Share of Agriculture and of Industry in Provincial GDP in 2000 (both at 1994 constant prices) are taken from the database compiled by Chinh (2002). This database makes necessary adjustments so that the adjusted output data of the 61 provinces sum up to the national GDP and that the regional implicit price indexes are compatible with the national implicit price indexes.

Openness in 2000 is calculated from data on export and import values and on provincial GDP coming from the compilation of "Socio-economic statistical data of 61 provinces and cities in Vietnam" (GSO 2001). This is so far the only available source for export and import data on the level of provinces; however these data have not been undergone a consistency check as the Chinh (2002) data.

Government Consumption and Inter-provincial Transfers in 2002, Average PIP Investment per capita between 1996 and 2000 as well as the data on the Hunger Eradication and Poverty Reduction (HEPR) programme and commune-level investments under the so-called Programme 135 were provided to us by Rob Swinkles from the World Bank Hanoi office. These data have been used by the World Bank for the VDR 2005. The available data on the two national targeted programmes (NTPs) cover allocations for the year 2003. We use these as a proxy for earlier spending, though, since the current planning period for the NTPs is 2001-2005 and the yearly allocations should not vary much within this period.

Several variables (Population without Access to Safe Water, Sanitation, and Electricity in 1999 (in per cent), Public Expenditure on Education and on Health (both in 1998), Crude Birth Rate in 1998 (in per mill), Adult Literacy Rate, Infant Mortality Rate, and Life Expectancy at birth (all in 1999) are taken from the Vietnam National Human Development Report 2001. This is the first report to cover a broad range of human development indicators at the level of Vietnam's provinces.

Data on Private, Public and Foreign Investment come from the 2003 Statistics of Investment in Vietnam by the Ministry of Planning and Investment (MPI).

All other variables rest upon data which are provided by the General Statistical Office (GSO) and are published either in the annual Statistical Yearbooks of Vietnam or on the GSO website.

5 Methodology

5.1 Motivation

As with empirical work on growth determinants, the evaluation of the most effective poverty reduction strategies is exposed to severe criticism based on the inherent uncertainty of which explanatory variables to include. The lacking theoretical guidance has led to the increasing use of Bayesian Model Averaging (BMA) to deal with model uncertainty within a formal framework based on sound statistical theory.³³ In particular, BMA does not require selecting a subset of the regressors, that is a special model. All inference is averaged over models, using the corresponding posterior model probabilities as weights. First, given a set of potential explanatory variables, BMA separately identifies models that are expedient to explain poverty reduction strategies, by allowing for any subset of the explanatory variables to combine in a regression and to estimate the posterior probability of any such combination of regressors. Second, conditional on the posterior model probabilities, the issue of model uncertainty concerning the most efficient means of poverty alleviation can be resolved by estimating the posterior probabilities of all possible explanatory variables commonly used.

The methodology of this paper follows the seminal work of Fernández, Ley and Steel (henceforth FLS) (2001) but additionally indicates not only the posterior model probabilities of the ten best models but discloses as well the regressors of some of the best models as in Masanjala and Papageorgiou (2004). These combinations of regressors yield high explanatory probabilities and are therefore important for guiding provincial poverty alleviation in Vietnam.

³³According to Koop (2004) Bayesian econometrics is of particular benefit when doing model averaging as classical econometrics does not treat models (or their truth) as random variables and, thus, the concept of averaging over models cannot be given a rigorous statistical foundation. There are, however, various ad hoc frequentist methods of model averaging as for example Levine and Renelt (1992) or Sala-i-Martin (1997).

5.2 BMA

We have data for N provinces. The dependent variable, the provincial poverty rate, is grouped in vector y , and there are $j = 1, \dots, J$ models, denoted by M_j , which are all linear regression models that differ in their explanatory variables and contain an intercept, α . All the explanatory variables are stacked in a design matrix X of dimension $N \times K$. We assume that $\text{rank}(\iota_N : X) = K + 1$, where ι_N is an N -dimensional vector of ones,³⁴ and β is defined as the full K -dimensional vector of regression coefficients. With the submatrix X_j ($N \times k_j$), containing the regressors of model M_j , and the corresponding regression coefficients $\beta_j \in \mathfrak{R}^{k_j}$ ($0 \leq k_j \leq K$), each model is represented by:

$$y = \alpha \iota_N + X_j \beta_j + \varepsilon \quad (1)$$

where ε follows an N -dimensional Normal distribution with zero mean and identity covariance matrix. Although normality is not necessary for consistency, it guarantees good finite sample properties (FLS, 2001b). Within this methodology, alternative models will be defined through the set of regressors they include which means that there are 2^K possible models whereas the effect of variables not contained in X_j is assumed to be zero.

This Bayesian framework needs to be completed with a prior distribution for the parameters in each model M_j which are α, β_j and the scale parameter σ . While the inclusion of prior information is a particular feature of Bayesian inference, in the context of model uncertainty the choice of this distribution can have substantial impact on the posterior model probabilities (PMPs). Furthermore, in a context where there are many potential explanatory variables but one cannot be sure about which ones to include this prior information is rare. Accordingly, non-informative priors would be preferable. However, PMPs cannot be meaningfully calculated with improper non-informative priors for parameters that are not common for all models. Thus, many researchers have attempted to develop proper priors which can be automatically used without requiring subjective input or fine tuning for each individual model. Here, we use the *benchmark prior* developed in FLS (2001b) that has little influence on posterior inference as the incorporation of substantive prior information is not necessary. For the two parameters common to all models this leads to

$$p(\sigma) \propto \sigma^{-1} \quad (2)$$

$$p(\alpha) \propto 1 \quad (3)$$

³⁴The design matrix will be transformed by subtracting the mean, so that $\iota_N' X = 0$.

To make absolutely certain that the non-informative prior for the intercept has the same implications for every model, we will standardize all regressors by subtracting off their means as recommended by FLS (2001b). This will have no effect on the slope coefficients, β_j , but ensures that the intercept can be interpreted in the same manner in every model as measuring the mean of y .³⁵ The prior for α implies that all its values, from minus infinity to infinity, are equally plausible and the prior for σ implies that all values for $\ln(\sigma)$ are given equal prior weight. Furthermore, this distribution is the only one that is invariant under scale transformations as for example a change in the units of measurement.

We now only need a prior for β_j and, according to FLS (2001b), we choose a g-prior structure³⁶

$$p(\beta_j | \alpha, \sigma, M_j) \sim N(0_{k_j}, \sigma^2 [g_j X_j' X_j]^{-1}) \quad (4)$$

As it is common practice to center priors over the hypothesis that explanatory variables have no effect on the dependent variable - especially when there are many regressors but it is suspected that many of them may be irrelevant - we set the mean of $\beta_j = 0_{k_j}$. Therefore, one only has to elicit the scalar hyperparameter g_j , and following FLS (2001), we choose

$$g_j = \begin{cases} \frac{1}{K^2} & : N \leq K^2 \\ \frac{1}{N} & : N > K^2 \end{cases} \quad (5)$$

Finally, the $K - k_j$ components of β which do not appear in M_j are exactly equal to zero. As we have to deal not only with parameter but as well with model uncertainty, we need to choose a prior distribution over the space \mathcal{M} of all 2^K possible models. As we allocate equal prior model probability to each model, we set

$$p(M_j) = 2^{-K} \quad (6)$$

which yields a Uniform distribution on the model space. This implies that the prior probability of including a regressor is $\frac{1}{2}$, independently of the regressor included in the model.³⁷

³⁵To be precise, if regressors are measured as deviations from means then, by construction, they will have mean zero. Since the error also has mean zero, this implies the mean of the dependent variable is the intercept.

³⁶This prior is slightly unusual as it depends upon X_j , the regressor matrix. However, as we are later conditioning on X_j in the likelihood function and the posterior as well, we are not violating any rule of probability by conditioning on X_j in the prior already.

³⁷Some authors recommend different choices for $p(M_j)$. For instance, many researchers prefer parsimony, and feel that simpler models should be preferred to more complex ones, all else being equal. This could be done by allowing $p(M_j)$ to depend upon k_j , see e.g. Chipman (1996).

Within the Bayesian framework, one can handle model uncertainty automatically by not choosing a special model but simply averaging the results of all models using the PMPs as weights. Thus, the marginal posterior probability of including a certain variable is simply the sum of the posterior probabilities of all models containing this variable. Formally, the posterior distribution of any quantity of interest, say θ , is an average of the posterior distributions of that quantity under each of the models with weights given by the PMPs:

$$p(\theta | y) = \sum_{j=1}^{2^K} p(\theta | y, M_j) p(M_j | y) \quad (7)$$

This procedure is typically referred to as BMA and it follows from direct application of Bayes' theorem to the model and priors specified.³⁸ While $p(\theta | y, M_j)$, the posterior distribution of θ under model M_j , is typically of standard form, we have to compute PMPs due to model uncertainty. Using the standard way allocating equal prior model probabilities, this yields

$$p(M_j | y) = \frac{p(y | M_j)}{\sum_{j=1}^{2^K} p(y | M_j)} \quad (8)$$

where $p(y | M_j)$ is the marginal likelihood of Model M_j . This is given by

$$p(y | M_j) = \int p(y | \alpha, \beta_j, \sigma, M_j) p(\alpha) p(\sigma) p(\beta_j | \alpha, \sigma, M_j) d\alpha d\beta_j d\sigma \quad (9)$$

with $p(y | \alpha, \beta_j, \sigma, M_j)$ the sampling model corresponding to equation (1) and $p(\alpha)$, $p(\sigma)$ and $p(\beta_j | \alpha, \sigma, M_j)$ the priors defined in equations (2), (3) and (4), respectively. Since this marginal likelihood can be derived analytically³⁹, the same holds for the PMP given in (8) and the distribution given in (7).

In practice, however, computing the relevant posterior distributions is still subject to challenges as the number of models to be estimated increases with the number of regressors at the rate 2^K . Furthermore, the derivation of the integrals implicit in (9) may be difficult because the integral may not exist in closed form. As we have 38 possible regressors in our analysis, we would thus need to calculate the posterior probabilities for each of the 2^{38} models and average the required distributions over all these models. Given these difficulties, we will approximate the posterior distribution on the model space \mathcal{M} by simulating a sample from it, applying the Markov Chain Monte Carlo Model Composition (MC^3) methodology by Madigan and York (1995).

³⁸See e.g. Leamer 1978.

³⁹For the case with demeaned regressors, FLS (2001a) derive it in their equation (8), on p. 566.

5.3 Implementation

In Bayesian econometrics, models are random variables (albeit discrete ones), just like parameters. Hence, posterior simulators which draw from the model space (i.e. the posterior distributions of the models) can be derived. These algorithms do not need to evaluate every model, but rather focus on the models of high PMP. The name Markov Chain Monte Carlo Model Composition (or MC^3) is motivated by the fact that the algorithm is drawing from model space. The most common MC^3 algorithm is based on a Random Walk Chain Metropolis-Hastings algorithm which draws candidate models from regions of the model space in the neighbourhood of the current draw and then accepts them with a certain probability.

It simulates a chain of models, which we denote by M^s for $s = 1, \dots, S$, and M^s is the model drawn at replication s (i.e. M^s is one of M_1, \dots, M_J). A candidate model, M^* , is proposed which is drawn randomly (with equal probability) from the set of models, including (i) the current model, $M^{(s-1)}$, (ii) all models which delete one explanatory variable from $M^{(s-1)}$, and (iii) all models which add one explanatory variable to $M^{(s-1)}$. In the common case where equal prior weight is allocated to each model, the prior model probabilities are the same (i.e. $p(M^*) = p(M^{(s-1)})$) and therefore can be omitted when calculating the acceptance probability which ensures that the chain moves in the appropriate direction. If the candidate model M^* is not accepted, then the chain remains at the current model (i.e. $M^s = M^{(s-1)}$).

Posterior results based on the sequence of models generated from the MC^3 algorithm can be calculated by averaging over the draws. As with other Markov Chain Monte Carlo algorithms, a starting value for the chain, M^0 , must be chosen and S_0 burn-in replications should be discarded to eliminate the effects of this choice.⁴⁰

It is important to verify convergence of the algorithm and to estimate the accuracy of approximations such as the posterior mean. FLS (2001b) suggest a simple way of doing this: based on a reduced set of models, for example every model visited by the MC^3 algorithm, calculate the PMP first analytically and then using the algorithm. If the algorithm has converged, then these two ways should yield the same results. The relationship between the analytical and MC^3 results give an idea of approximation error and simple diagnostics can be constructed to check for convergence. For instance, FLS (2001b) suggest calculating the correlation between the analytical and MC^3 PMPs and taking enough replications to ensure this correlation is above 0.99.

⁴⁰With superscripts we denote draws and with subscripts blocs.

6 Estimation Results

6.1 Posterior probabilities

The following results are based on taking 2,500,000 draws and discarding the first 500,000 as burn-in replications. As a test for convergence of the algorithm and as a diagnostic that the model performance is satisfactory, we checked for the correlation coefficient between visit frequencies and posterior probabilities which is 0.9998 and therefore lies above the threshold of 0.99.

Dealing firstly with the inherent model uncertainty and with the significance of a particular regressor in the presence of other regressors, we report the PMPs for the ten best models and their respective regressors in Table 1 at the end of the document. All these models do have a PMP of at least 5 per cent which is quite high compared to the studies on growth regressions by FLS (2001a), Masanjala et al. (2004). Those ten best models alone account for more than 8 per cent of the total posterior mass.

Looking secondly at the importance of the regressors in affecting poverty, the second column of Table 2 at the end of the document reports the BMA posterior probability (or probability of inclusion) for each of the 38 explanatory variables. It can be interpreted as the probability that the respective regressor should be included in the evaluation as it exerts some influence on the dependent variable. We ranked the variables according to their probability of inclusion and will discuss their respective effects in the next section. As there is no theoretical justification for any threshold of posterior probability, over which to call a regressor 'very important'⁴¹ we base our discussion on the eight regressors with the highest posterior probabilities including all those regressors used in one of the ten best models (which not exert a high posterior probability themselves). This number stems from the estimated mean number of regressors in all of the models which is 7.9 which reproduces exactly the number of at least seven regressors in growth regressions suggested by Sala-i-Martin (1997). The regressors with a relatively high posterior probability do have an important role in explaining poverty as they should be included in a poverty regression regardless of which other explanatory variables are used.

6.2 Discussion and policy implications

Our BMA leads to some rather remarkable results concerning the actual effectiveness of the potential determinants of poverty in Vietnam. Among the regressors with the highest

⁴¹FLS (2001b) call a variable which has a posterior probability over 0.90 "highly effective".

posterior probabilities we find variables from every of our relevant groups, structural, distributional, pro-growth and pro-poverty variables.

The by far most relevant regressor is the Expenditure Gini with a posterior probability of 0.9653. Its relevance stems from the various links between inequality, growth and poverty reduction mentioned in section 2.1.⁴² In particular, high inequality could harm future poverty reduction significantly via its negative effects on human capital formation, agricultural productivity, and on the (political) support for further growth strategies. As we can see growing inequality of income and expenditure in Vietnam⁴³ this result becomes even more important for future poverty reduction.

The second most important regressor with a probability of inclusion of 0.8015 is the Land Gini. The interpretation of this result is in accordance with the fact that the distribution of the asset land usually exempts harmful effects on growth and poverty reduction through various channels, e.g. credit market imperfections and reduced investment.⁴⁴ In Vietnam, the distribution of land to rural households, initiated in 1988, was remarkably egalitarian but since then, the tendency towards the concentration of land is clearly visible.⁴⁵ Therefore, any sustainable future poverty reduction should deal with the growing inequality of the asset land. Closely related to this regressor is the variable Implementation of Land Reform. It exerts no big influence on poverty itself in our estimation but is included as a regressor in the last of the ten best model. This could be interpreted by the fact that it was exactly this land reform that initiated the distribution of the formerly collectivised land. Key among the reform was the allocation of farm land, which granted households LUCs and which thus induced the emergence of a land market. Combined with the liberalisation of the markets for agricultural products, this led to a strong supply response and not only increasing economic efficiency but also diversification of rural livelihoods and production whereby rural poverty was reduced.⁴⁶

Third ranks the regressor Birth Rate that has a posterior probability of 0.6278. It is not difficult to explain the high importance of the Birth Rate for poverty in Vietnam, which despite impressive achievements in the past is still high for some ethnic minorities in Vietnam.⁴⁷ Theoretical considerations on the links between high fertility and its effects on human capital formation, growth and poverty reduction show that "the comparative

⁴²The relevant literature is mentioned there as well.

⁴³See the discussion in section 3.1. and in the VDR 2004.

⁴⁴See e.g. Binswanger and Deininger 1997; Deininger and Squire 1998; Deininger and Olinto 2000; Erickson and Vollrath 2004.

⁴⁵Ravallion and van de Walle 2001; World Bank 2003.

⁴⁶See e.g. Deininger and Jin 2003; Benjamin and Brandt 2003.

⁴⁷World Bank 2003.

advantage of the poor in child quantity” (Ahituv and Moav 2003, p. 82) is characterised by low investments in human capital, low capital ratios and low income.

Our fourth determinant of poverty is one of the NTPs, the Programme 135, with a posterior probability of 0.5137. We will discuss this together with the sixth important regressor, the HEPR, which has a probability of inclusion that is notably smaller than the one of Programme 135: 0.3972.⁴⁸ These programmes exert a high influence on poverty as they favour or compensate households or communes to explicitly alleviate poverty. Programme 135, which offers a range of local investment programs to communes, has a broad coverage as it reaches one fifth of all communes. Coverage varies across the individual components of HEPR but the fraction of the poor benefiting from some of those components is not irrelevant.⁴⁹ The effects of all components are very diverse, though, as they are more or less suitable for sustainable poverty reduction and are widely distributed among the Vietnamese provinces.⁵⁰ Finally, there has been evidence of a significant lack of efficiency in these important pro-poor policies.⁵¹

Not to forget the fifth important regressor of our poverty determinants, which is the Share of Urban Population with a posterior probability of 0.4938. This influence mirrors the transformation from an agricultural based to an industrial-service based economy during economic development and its associated effects on growth and poverty reduction.⁵² In Vietnam, this development and its positive impacts are reflected in the poverty profiles of the different provinces. Those provinces that are metropolitan areas, contain big urban centres or are proximate to such provinces register not only the highest growth rates but also the largest poverty reduction (e.g. the provinces of the Red River Delta comprising Hanoi, the region South Central with Danang or the South East containing Ho Chi Minh City). Those changes particularly were affected by the rise in (unskilled) off-farm activities which should be expanded in the more rural regions and provinces as well.⁵³

The next important regressor is the Share of Centrally Managed SOEs with a posterior probability of 0.3588. Those firms do have a much higher relative firms size and employ much more workers than locally managed SOEs (another regressor that was included in the BMA but seems to exert no real influence on poverty). Given the intensive restructuring in the state owned sector in Vietnam over the last decade, the higher competitiveness of the

⁴⁸Be aware of the fact that our data for these variables originate from 2003 and we use them as a proxy for the 2002 allocations only. The estimation should be repeated with appropriate data when available.

⁴⁹World Bank 2003, 2004.

⁵⁰World Bank 2003, 2004; Swinkels and Turk 2004.

⁵¹See e.g. van de Walle 2004.

⁵²See e.g. Fujita et al. 1999; Henderson 2004.

⁵³World Bank 2003.

surviving firms and the hardening of the budget constraint faced by SOEs have improved their productivity.⁵⁴ Therefore, they provide many of the needed off-farm employments and are able to pay higher wages thereby increasing the income of poor households. The negative poverty effects of the high number of lay-offs which stand on the other side of the restructuring process in Vietnam's public production sector do not seem to be a serious problem any longer.

The last important determinant of poverty in our estimation is the Relative Size of Perennial Farm Land, whose probability of inclusion is notably smaller than the others' with 0.2824. It is especially the land for perennial crops that is needed for sustained diversification and commercialisation of agriculture as the higher yields of this sort of land provide higher incomes for rural households. Unfortunately, the distribution of this type of land is especially biased towards the rich in some of the poorer provinces.⁵⁵ Therefore, it is at first important to increase the share of perennial land poor households own in total landholdings, and then to expand the size of it to guarantee a better living of rural households.⁵⁶

Next, we briefly want to discuss the variables that are included as regressors in some of the ten best models. Albeit they are no influencing determinants of poverty as they exhibit only small posterior probabilities, these explanatory variables exert a non-negligible influence on poverty in combination with other regressors. The first of these variables is per capita Public Expenditure on Health, which serves as regressor in the fourth and seventh best model. This variable can be interpreted as being important for providing the foundation for successful human capital accumulation and productive labour. Relevant in this context is especially the public expenditure as many poor households cannot afford private expenditure on health. The second regressor included in those two models is Private Business Implementation. It serves as an indicator for Vietnam's transformation to a market based economy and the varying implementation of market structures across different provinces. Private enterprises play a significant role for the future development of the country and the ongoing poverty reduction as they make the necessary off-farm activities available and exert pressure on the SOEs to become even more productive.

Another variable that is included as a regressor in the seventh best model is Private Investment and it shows that the private sector plays an important role not only for growth

⁵⁴World Bank 2003, 2004.

⁵⁵For example, in the provinces of the Central Highlands or the North West, the richest fifth of the rural households have 2.5 times and 11 times respectively more perennial crop land than the poorest fifth (World Bank 2003, p. 39).

⁵⁶World Bank 2003, 2004; Swinkels and Turk 2004.

but also for poverty reduction. The inclusion of the Share of Agriculture in the eighth of the ten best models reflects the importance of larger and especially more productive farms in order to further reduce poverty. As the majority of the poor lives in rural areas and depends on agriculture, the level of poverty declines with growth in agricultural production. Furthermore, off-farm employment is assumed to increase with agricultural productivity which could evoke a virtuous circle in escaping poverty.⁵⁷ The Vietnamese government created a decade ago the national extension system for agricultural services, aimed at facilitating farmers' access to information on production techniques and market developments. According to the VDR 2004, this system "has the potential to improve the well-being of rural households" (World Bank 2003, p. 71), though it is not yet operating throughout the country and its effectiveness varies across provinces and income groups. Finally, the South Dummy included in the same model seems to indicate that the historical experience with a market based economy is still an advantage for providing the basis for economic growth and poverty reduction.

What are the insights that policy makers can draw from our investigation based on the BMA approach? Firstly, our findings are strongly supportive of some policy measures which already rank high in Vietnam's CPRGs approach. These include birth control, support for private sector development, effective restructuring of large SOEs and a further implementation of the land reform in order to make to most effective use of the available land. Secondly, we see that the increase in income inequality since the beginning of the *doi moi* reforms constitute an increasing obstacle for a further reduction of poverty. Therefore, one should focus more on the distributional aspects of pro-growth policies. Thirdly, our results confirm the high influence on poverty of the existing instruments of pro-poor policy. The effects of all the different components of the two NTPs are very diverse, though, as they are more or less suitable for sustainable poverty reduction and are widely distributed among the Vietnamese provinces. Finally, there has been evidence of a significant lack of efficiency in these important pro-poor policies.⁵⁸ Therefore, the two NTPs should be reformed to contribute to the prevention of further poverty and especially the Public Investment Programme (PIP) needs to be redesigned basically to influence poverty substantially. More decentralized approaches in the application of targeted pro-poor policies might be one possible way to overcome the existing inefficiencies.⁵⁹

⁵⁷See e.g. Ravallion 2001; World Bank 2003.

⁵⁸World Bank 2003, 2004; Swinkels and Turk 2004; van de Walle 2004.

⁵⁹World Bank 2003, 2004; Bonschab and Klump 2004; Swinkels and Turk 2004; van de Walle 2004.

7 Conclusion

Our paper is motivated by the apparent problems that the policy relevance of empirical development research faces because of parameter and model uncertainty. We propose BMA as a powerful method to deal with these problems in a sound statistical way by 'unconditioning' the dependence of the parameter estimate for a given variable on the model in which it was estimated. Based on the high importance of global development policy for poverty reduction, we estimated the posterior probability of a large number of potential explanatory variables and regression models for explaining poverty in Vietnam on a sub-national level. We selected Vietnam as a case study because this country has been very successful in reducing national poverty but is still characterized by pronounced poverty differences in the regions and provinces. We use data for Vietnam's 61 provinces to explain poverty levels in 2002 by a series of possible determinants that can be regrouped in four clusters: structural variables, initial distribution, pro-growth policies and pro-poor policies.

We find that poverty in Vietnam is best explained by variables coming from all clusters. Regarding policy conclusions, we find support for birth control, private sector development, SOE restructuring, promoting metropolitan areas, and a further implementation of the land reform as important instruments of poverty reduction. Income equality starts to become an obstacle for further poverty reduction. Finally, our results seem to indicate — given a high degree of data uncertainty — that the currently existing NTPs are useful for poverty reduction but, nevertheless, should be reformed. Especially the PIP should be further improved to reduce poverty on a sustainable basis.

Future research in this field should deal with the improvement of the Vietnamese data basis. Having better and/or more reliable data on investment, FDI, and openness, for example, could lead to even more reliable results on the effectiveness of the numerous poverty determinants. If the next VHLSS actually exhibits the announced panel dimension with the VHLSS 2002, panel data analysis across Vietnam's provinces could test not only the level but also the development of poverty and its determinants. Furthermore, BMA on the determinants of poverty should be applied to other (developing) countries, be it on the sub-national level for another country, be it for a group of countries. Cross-country studies would also allow to include variables that cannot be disaggregated on the sub-national level, as for example determinants of macroeconomic stability. As could be shown, BMA seems to be a reasonable methodology to treat parameter and model uncertainty appropriately and, thus, to reassess the robustness of existing empirical development research.

8 References

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9 Tables

Table 1: PMP and regressors of ten best models

Model	Regressors	PMP (in per cent)
1	HEPR, Pr. 135, Birth rate, Exp. Gini, Land Gini, Urbanisation	16.18
2	Pr. 135, Birth rate, Exp. Gini, Land Gini, Rel. size per. land, Urbanisation	14.39
3	Pr. 135, Central SOEs, Birth rate, Exp. Gini, Land Gini,	12.96
4	HEPR, Birth rate, Exp. Gini, Land Gini, Rel. size per. land, Urbanisation	11.15
5	Public exp. on health, Exp. Gini, Rel. size per. land, Urbanisation, Priv. business impl.	10.30
6	HEPR, Birth rate, Exp. Gini, Land Gini, Urbanisation	9.94
7	Priv. investment, Public exp. on health, Exp. Gini, Rel. size per. land, Priv. business impl.	8.13
8	Pr. 135, Central SOEs, Birth rate, Exp. Gini, Land Gini, Share agri. in prov. GDP, South Dummy	5.97
9	HEPR, Central SOEs, Birth rate, Exp. Gini, Land Gini,	5.71
10	Pr. 135, Birth rate, Exp. Gini, Land Gini, Impl. of land reform	5.28

Table 2: Comparison of regressor's posterior probabilities

	Regressors	BMA Post. prop.
1	Expenditure Gini	0.9653
2	Land Gini	0.8015
3	Birth Rate	0.6278
4	Programme 135	0.5137
5	Share urban population	0.4938
6	HEPR	0.3972
7	Share centrally managed SOEs	0.3588
8	Relative size of perennial farm land	0.2824
9	South Dummy	0.1999
10	Implementation of land reform	0.1947
11	Public expenditure on health	0.1935
12	Share agriculture in provincial GDP	0.1832
13	Private business implementation	0.1665
14	Average PIP investment rate	0.1537
15	Life expectancy	0.1460
16	Household expenditure on education	0.1148
17	Share locally managed SOEs	0.1026
18	Private investment	0.0951
19	Share ethnic minorities	0.0809
20	Literacy rate	0.0776
21	No. of FDI projects licensed	0.0664
22	Public investment	0.0559
23	Share FDI sector in provincial GDP	0.0529
24	Infant mortality rate	0.0507
25	population without access to sanitation	0.0506
26	Quality of roads	0.0488
27	Share industry in provincial GDP	0.0480
28	Population without access to electricity	0.0462
28	Public expenditure on education	0.0421
30	Share graduates to all candidates (primary level)	0.0373
31	Openness	0.0370
32	Population without access to safe water	0.0369
33	Land market	0.0340
34	Share graduates to all candidates (lower secondary level)	0.0337
35	Inter-provincial transfers	0.0335
36	Government consumption	0.0312
37	Share graduates to all candidates (upper secondary level)	0.0308
38	Household expenditure on health	0.0283