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Working Paper Series Vol. 2006-27  
December 2006

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# **Robust Determinants of Income Growth in the Philippines <sup>1</sup>**

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## **ABSTRACT**

Recent researches using econometric models fitted to cross-country data show that demographic transition is fundamental to explaining economic growth for developing countries. A study by Mapa and Balisacan (2004) finds that the Philippines is paying a high price for its unchecked population growth. This paper studies the relationship between population dynamics and income growth in the Philippines using data from 74 provinces for the period 1985-2003. Simulation techniques were used to quantify the effect of population dynamics on the differences in income of the provinces. It also examines the robustness of the explanatory variables to determine “deep” determinants of income growth. The study shows that population variable is robustly related with growth and while it is not the sole culprit for the dismal growth performance over the years, it shows that the opportunities associated with the demographic transition are real and can provide the stimulus needed by the country.

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<sup>1</sup> Part of this research was conducted while Dennis S. Mapa and Kristine Joy S. Briones were project leader and research associate, respectively, of the Population-Growth-Poverty (PGP) Nexus Part II project under the Asia Pacific Policy Center (APPC) with support from Philippine Center for Population and Development (PCDP). This version of the paper was completed while the first author was a Visiting Research Fellow at the International Center for the Study of East Asian Development (ICSEAD) in Kitakyushu, Japan. The authors are grateful to Arsenio M. Balisacan, Rosemarie G. Edillon, Susumu Hondai, Eric Ramstetter, Erbiao Dai, Kazuhiko Yokota, Sadayuki Takii and the participants at the seminars held at the School of Economics, University of the Philippines, Diliman and ICSEAD, Kitakyushu, Japan for their comments and suggestions. The usual disclaimer applies.

## **I. Population Debate and the Demographic Transition**

The population issue has been dynamic as well as contentious, especially in the Philippines, where it borders on being hostile. The debate centers on the consequences of population growth on economic development, specifically whether population growth curtails, promotes or is independent of economic growth. On one hand, there are strands of evidence suggesting a negative impact of population growth on economic growth. Most probably, the first economist to hypothesize this is the Reverend Thomas Malthus who, more than 200 years ago, argued that high population growth would strain food supply and limit the standard of living of the masses. This notion on the negative effect of population growth on the economic well-being is often referred to as the “Malthusian population trap.” This constricting effect of population growth on economic growth is supported empirically by the study of Barro and Sala-i-Martin (2004). Using 87 countries from 1960 to 2000, they showed that a one-standard deviation decline in the log fertility rate is estimated to raise average growth rate by 0.006. On the other hand, there is an even more popular side to this debate saying that population growth is independent of economic growth, and points to other culprits – notably the “rule of law” or “quality of public/economic institutions” as the most important determinant of economic growth (Norton; 2003). The thesis that institution is the “deep” determinant of growth is supported by studies of Easterly and Levine (2002) and Acemoglu, Johnson and Robinson (2001). Other researchers, notably Simon (1981) and Boserup (1998) even ascribed more than a neutral effect of population growth arguing that there are benefits associated with population growth such as “inducing technological change and stimulating innovation” and therefore, that it positively impacts on economic growth.

In the 1990s, the debate on the effect of population growth on economic growth shifted from the issue of population growth per se to the age structure of the population, that is, the way in which the population is distributed across the various age groups. Since individuals have different economic behaviors at different stages in life, the nation’s age structure has an important impact on its economic performance (Bloom, Canning and Sevilla (BCS: 2001). Cross-country data, covering several decades and made available in the recent years, motivated researchers to revisit the relationship between population and economic growth, this time, emphasizing on demographic transition as the process crucial to economic growth in most developing countries.

BCS (2001) describes demographic transition as “a change from a situation of high fertility and high mortality to one of low fertility and low mortality.” Demographic transition results in sizable changes in the age distribution of the population. The changes in the age structure are due to two reasons: (1) Initial decline in mortality, due to better health practices, that is concentrated among young individuals, notably infants, or those at the lower end of the age pyramid and (2) decline in fertility with impact entirely at age zero. The low mortality and low fertility create a bulge in the age pyramid that will move over time from young people (infants and children) to prime age (workers) for productive work, saving and reproduction, and eventually to old age (elderly). Depending on the position of this bulge on the age pyramid, the value of output per capita, the most widely used measure of economic performance,

will change correspondingly. The change from high to low mortality and fertility rates can create the so-called “demographic dividend.”

Demographic transition has three phases and each phase has a different impact on the economy. Phase one is triggered by an initial decline in infant mortality but fertility remains high resulting in the swelling of the youth dependency group (aged 0 to 14) as well as demand for basic education and primary health care. This phase creates a big challenge to the economy as it may impede economic growth.

In the second phase of the transition, these “baby boomers” enter the adult labor market (some 20 years later) and if the market is able to absorb them, they can accelerate the phase of economic growth. This is the phase when the proportion of working-age population is highest and the age dependency ratio or the ratio of young dependents (0 to 14 years) and elderly (65 years and above) over the working age (15 to 64 years) is lowest, thereby creating the so called “demographic dividend.”

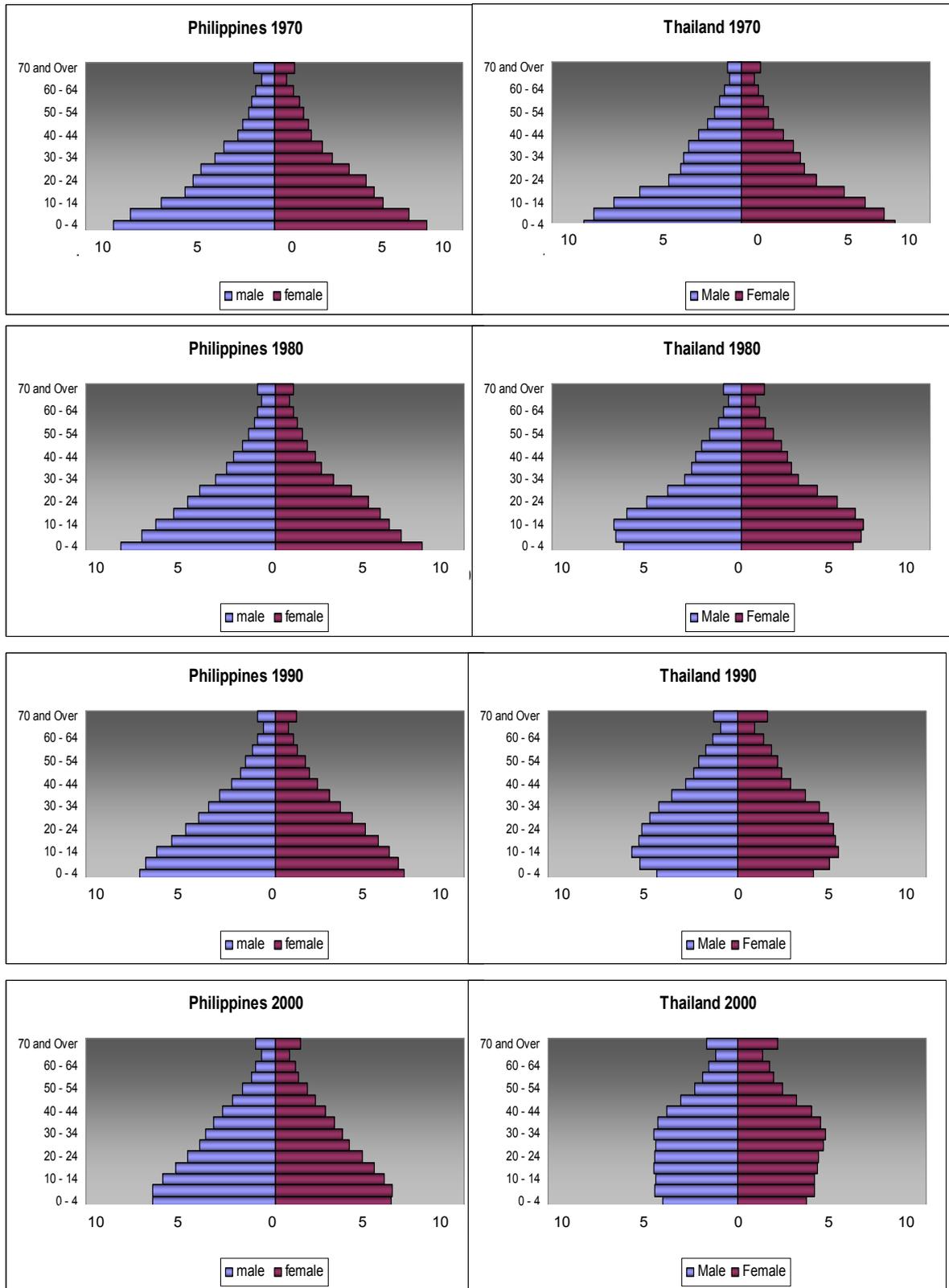
The last phase of the transition is when the elderly cohort swells. This phase may or may not burden economic growth. It appears from empirical analyses that a rising elderly share neither depresses nor elevates the rate of economic growth since, although they are “dependent”, they either live using their own savings or are being supported by their families and/or the state.

BCS (2003) points out that countries entering demographic transition face significant challenges, especially during the first phase of the transition. However, these countries could take advantage of the appealing opportunities for economic growth, which happens during the second phase of the transition and could last up to 50 years. It should be pointed out that the “demographic dividend”, while essential to economic growth, is not automatic. It should be given the right kind of policy environment to produce a sustained period of economic growth. The critical policy areas are public health, family planning, education and economic policies promoting labor-market flexibility, openness to trade and saving. The growing number of adults during the second phase of the transition will be productive only when there is flexibility in the labor market to allow expansion. Therefore, governments play a vital role to guarantee the creation of this “demographic dividend.”

It is interesting to note that the age structure of the Philippines’ population in 2000 represents Phase One of the demographic transition. This is in contrast with Thailand, where its 2000 age structure demonstrates Phase Two of the demographic transition, thereby enjoying the benefits of a higher economic growth, while Japan’s 2000 age structure is near (if not there yet) Phase Three of the demographic transition.

A comparison of the age structure between the Philippines and Thailand from 1970 to 2000, provided in figure 1, shows that while Thailand’s population age structure have moved from Phase One to Phase Two of the demographic transition during the period, that of the Philippines is still glued to Phase One in the last 30 years. This partly explains why Thailand’s Gross Domestic Product (GDP) per person (in Purchasing Power Parity) grew at an amazing rate of 8.8 percent per year from 1975 to 2000 and managed to double its income per person after only 8 years, while the Philippines GDP per person only increased by 4.1 percent during the same period.

**Figure 1. Comparison of Age Structure: Philippines vs. Thailand (1970 to 2000)**



Note: X-axis denotes percentage to total population.

## **Demographic Transition and Economic Growth: Cross-Country Experiences**

Bloom, Canning and Malaney (1999), in studying the population dynamics and economic growth in Asia, concluded that the “demographic dividend” was essential to the success of East Asia’s economic “tigers” during the period 1965 to 1990. They pointed out that the working-age population of East Asian countries was 57 percent in 1965 and 65 percent in 1990, increasing four times compared with the number of dependents. In contrast, the Philippines, using census data from 1980 to 2000, had a working-age population of below 60 percent, with 52 percent in 1980, 55 percent in 1990, 56 percent in 1995 and 58.5 percent in 2000.

The effect of demographic transition on economic growth was studied by several authors, notably Radelet, Sachs and Lee (1997). In their paper, “Economic Growth in Asia”, they analyze the dramatic economic growth experienced by Asia using cross-country data during the period 1965-1995 and the authors pointed out that “demographic changes following World War II worked in favor of more rapid growth in East Asian countries.” Bloom and Williamson (1997) and later on Bloom, Canning and Malaney (1998) studied the effects of the demographic transition and the economic miracles in emerging Asia using cross-country data and the researchers concluded that “a sizeable portion, about one-third, of East Asia’s economic success is attributable to demographic influences.”

More recently, Mapa and Balisacan (2004) investigated the impact of demographic transition on economic growth and poverty using more updated data sets. The demographic transition in their model is explained by two population growth variables: average population growth and average workers’ (15-64 years) population growth rates. The authors’ econometric results showed that population growth rates have opposing effects on economic growth, as expected. On one hand, total population growth has a negative and significant effect on economic growth. On the other hand, the workers’ population growth is positively correlated and significant to economic growth, supporting the concept of the “demographic dividend”. Aside from its main effects, population growth also affects economic growth through an interaction with another variable, the illiteracy rate – a variable used to proxy for human capital. The econometric result shows that at a fixed level of illiteracy rate, a higher level of population growth constricts economic growth.

The authors made simulations to estimate the impact of population growth on the overall economic growth of the Philippines. Simulation exercises done by the two authors showed that difference in the population growth rates between the Philippines and Thailand accounted for about 0.768 percentage point of forgone growth for the Philippines. This implies that had the Philippines followed Thailand’s population growth path during the period 1975 to 2000, the average income per person in the Philippines would have been 0.768 percentage point higher every year. Thus, the reduction in the population growth results in a cumulative increase of about 22 percent in the average income per person for the year 2000, adding some US\$ 253 to the average income per person in the Philippines, to US\$ 1404 from US\$ 1151.

Moreover, the authors estimated the effect of the population dynamics to poverty reduction via the increase in economic growth that is primarily due to a reduction in population growth. In particular, they evaluated the impact on poverty reduction had

the Philippines followed Thailand's population growth path. The reduction in poverty headcount due to the estimated increase in the mean income per capita of about US\$ 253, had the Philippines followed the population growth of Thailand during the period 1976-200, is about 4.03 million in the year 2000. This is equivalent to an average of 161,200 Filipinos taken out of poverty per year during the said period. The poverty reduction in terms of the number of households is 678,000 for the same period or equivalent to 56,500 households per year for 25 years.

This paper follows the same track used in the Mapa and Balisacan (2004) cross-country study wherein an econometric model will be used to estimate the impact of population dynamics on income (economic) growth, this time using the Philippines' provincial data from 1985 to 2003. Simulation techniques will again be used to quantify the effects of the population dynamics on income of the provinces and its effects on headcount and household poverty. The paper will show that indeed the country is paying a high price for its unsustainable high population growth.

The remainder of the paper is organized as follows: Section 2 presents the theoretical framework of the growth model used in the intra-country analysis. Section 3 presents the empirical results of the study including the robustness test applied. Section 4 presents simulation results on additional income growth and poverty reduction made based on the econometric exercise and section 5 concludes.

## **II. Population Dynamics – Economic Growth Nexus: Intra-Country Analysis**

The cross-country analysis in the Mapa and Balisacan (2004) study is extended, this time using provincial data of the Philippines, instead of cross-country data. Similarly, an econometric model is built to study the relationship between population growth and the demographic transition (population dynamics) on economic growth, controlling for other determinants of economic growth, using provincial data from 1985 to 2003. In doing this study, the authors hope to make empirical contributions to the population dynamics-economic growth debate. First, the data set of provinces covering a period of 18 years is quite a rich country level data sufficient to study the determinants of income growth. Second, the Philippine data is collected using uniform definitions of the variables. And third, there is no exchange rate variation between the provinces and price variation across provincial domains is smaller than across countries. Moreover, while the analysis of regional/provincial economic growth has been popular, only few authors have incorporated in their models population dynamics as determinant of income growth. Most authors have focused on neighborhood effects (spatial dependence) in their analyses of the determinants of economic growth. Similar to the cross-country analysis of Mapa and Balisacan (2004), simulation techniques are to be used in this study to quantify the effects of population growth in the differences in income per person of the provinces.

Monchuk, D. et. al. (2005) examine the economic forces that underlie economic growth at the county level for the period 1990 to 2001. Their study shows that initial population (1990) has a positive and significant impact on the average growth rate of county income. Moreover, using the population dynamics variables, the authors show that "the percentage of population over 65 years in 1990 has a negative and significant impact on the growth rate of income" (which is something that is expected), while the

share of population between 20 to 34 years in 1990 has negative and significant effect on income growth (something that is unexpected). Finally, their econometric model shows that the share of population under 20 (youth population) has positive but insignificant impact on income growth. Using a proxy variable for distance to a metro county, the authors find this variable has a positive and significant impact on income growth, supporting the notion of neighborhood effects.

Demurger, S., et. al. (2002) provide evidence for the distinct roles of geography and policy to economic growth in China's 25 interior provinces for the period 1979 to 1998. Their paper suggests that geography (access to the sea and elevation/slope) and proposed alternative measures for preferential treatment given to some provinces have positive and significant effect on the average growth rate of per capita GDP during the period. Moreover, they show that the proportion of provincial workforce with post-primary education has a positive and significant effect on economic growth.

### **Theoretical Framework of the Model**

This paper uses an intra-country income growth equation derived from the neoclassical Ramsey-Cass-Koopmans model similar to the approaches used by Bloom and Williamson (1997), Bloom, Canning and Malaney (1999) and Radelet, Sachs and Lee (1997). The model assumes that consumers maximize utility over infinite horizon subject to a budget constraint. Moreover, the standard No-Ponzi-Game restriction applies, i.e., firms take wages and the interest rate as given. We assume a Cobb-Douglas production function of the form  $Y = AK^\alpha L^{1-\alpha}$ , where Y is the total output, K represents capital, L represents labor, and A represents total factor productivity.

It is also assumed that the production per worker,  $y = Y/L$ , takes the form  $y = f(k) = Ak^\alpha$ , where  $k = K/L$ . Using the Ramsey-Cass-Koopmans model, the average growth rate of output per worker, denoted by  $g_y$ , between any time, say  $T_1$  and  $T_2$ , is proportional to the log of the ratio of income per worker in the steady state ( $y^*$ ) and the income per worker at time  $T_1$  (the initial condition). Thus, the model is given by,

$$g_y = \frac{1}{T_2 - T_1} \log \left( \frac{y_{T_2}}{y_{T_1}} \right) = \alpha \log \left( \frac{y^*}{y_{T_1}} \right). \quad (1)$$

The model given in (1) is consistent with the empirical growth theory, especially explaining the concept of conditional convergence Barro and Xala-i-Martin (1995), Romer, D. (1995) and Obstfeld and Rogoff (1996).

For this paper, three modifications are made with the model in (1). First, following Radelet, Sachs and Lee (1997), the steady output is expressed as a function of the determinants of the steady state, that is,  $y^*$  will be expressed as,

$$y^* = \underline{X}\underline{\beta}, \quad (2)$$

where  $\underline{X}$  is a vector consisting of the determinants of the steady state.

The vector  $\underline{X}$  includes the initial conditions, education and health variables (proxy for human capital), inequality, measure of local good governance, and neighborhood effects.

The second modification introduced into the model involves changing the model from output per worker ( $y$ ) to output per capita ( $y^0$ ). Note that,

$$y^0 = \frac{Y}{P} = \frac{Y L}{L P} = y \frac{L}{P}, \quad (3)$$

where  $P$  is the total population,  $L$  is the number of workers,  $y$  is the output per worker and  $y^0$  is the output per capita.

The equation given in (3) can be converted to growth rates by taking the natural logarithm and then the derivative with respect to time, resulting in,

$$g_{y^0} = g_y + g_{\text{workers}} - g_{\text{population}} \quad (4)$$

Substituting equations (1) and (2) into (4) and adding a stochastic term,  $\varepsilon$ , to account for other factors that may affect the growth rate, econometric model will then be,

$$g_{y^0} = X\beta - \alpha \log(y_{T_1}) + \phi_1 g_W + \phi_2 g_P + \varepsilon. \quad (5)$$

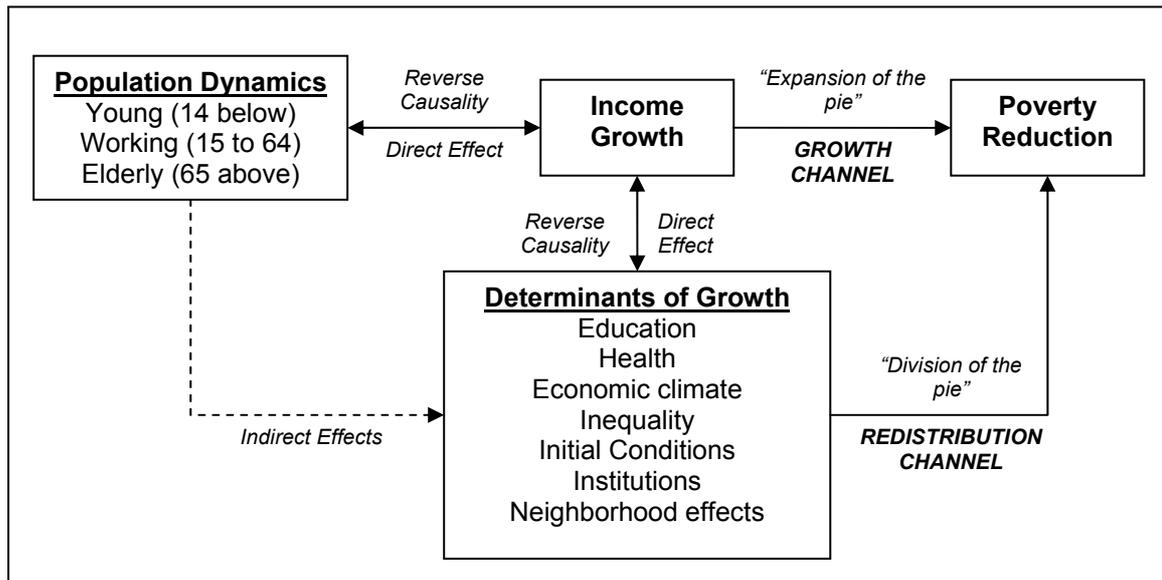
The final modification involves expressing the logarithm of the initial income per worker into income per capita and workers per capita. Thus, the final econometric model is given by,

$$g_{y^0} = X\beta - \alpha \log(y_{T_1}^0) + \alpha \log(L/P) + \phi_1 g_W + \phi_2 g_P + \varepsilon. \quad (6)$$

Bloom and Williamson (1997) point out that theoretically,  $\phi_1 = -\phi_2 = 1$  in (6). That is, for a stable population, the growth rate of the workforce should be the same as the growth rate of the population, therefore making the net demographic effect zero. However, during a dynamic transition, wherein the population is unstable, the demographic effects might matter.

The framework of the econometric model is given in figure 2. The econometric model estimates the direct effect of the population dynamics, particularly the impact of the young population (0 to 14 years), on economic growth (the impact of the first box on the second box). At the same time, the model also estimates the effects of other determinants of economic growth (the impact of the lower box on the second box). The reverse causality is represented by the arrow coming from growth (box 2) going to the population dynamics (box 1) and the other determinants of growth, notably education (lower box). This reverse causality creates a problem in the estimation of the regression model, resulting to biased and inconsistent estimates. This problem is remedied through the introduction of instrumental variables into the regression equation.

**Figure 2. Theoretical Framework**



### III. Empirical Analysis of the Model

The data set consists of 74 provinces with variables recorded for the period 1985 to 2003, covering 18 years<sup>2</sup>. The objective of this study is to determine long run effects of the determinants of income growth, particularly the provinces population dynamics. The complete list of provinces included in the study is provided in Table 1.

**Table 1: Provinces in the Intra-Country Econometric Models**

|                  |                 |                    |                     |
|------------------|-----------------|--------------------|---------------------|
| Metro Manila     | Capiz           | Maguindanao        | Rizal               |
| Abra             | Catanduanes     | Marinduque         | Romblon             |
| Agusan del Norte | Cavite          | Masbate            | Samar               |
| Agusan del Sur   | Cebu            | Misamis Occidental | Siquijor            |
| Aklan            | Davao           | Misamis Oriental   | Sorsogon            |
| Albay            | Davao del Sur   | Mt. Province       | South Cotabato      |
| Antique          | Davao Oriental  | Negros Occidental  | Southern Leyte      |
| Basilan          | Eastern Samar   | Negros Oriental    | Sultan Kudarat      |
| Bataan           | Ifugao          | Cotabato           | Sulu                |
| Batanes          | Ilocos Norte    | Northern Samar     | Surigao del Norte   |
| Batangas         | Ilocos Sur      | Nueva Ecija        | Surigao del Sur     |
| Benguet          | Iloilo          | Nueva Vizcaya      | Tarlac              |
| Bohol            | Isabela         | Mindoro Occidental | Tawi-Tawi           |
| Bukidnon         | Kalinga Apayao  | Mindoro Oriental   | Zambales            |
| Bulacan          | La Union        | Palawan            | Zamboanga del Norte |
| Cagayan          | Laguna          | Pampanga           | Zamboanga del Sur   |
| Camarines Norte  | Lanao del Norte | Pangasinan         | Aurora              |
| Camarines Sur    | Lanao del Sur   | Quezon             |                     |
| Camiguin         | Leyte           | Quirino            |                     |

<sup>2</sup> Note that the data set includes only 74 provinces, instead of the current 79 provinces. The geographical boundaries of the provinces were kept constant throughout the period 1985 to 2003.

## **Data and Variable Specification**

The dependent variable of the econometric model is the average growth rate of provincial per capita income, as estimated from the FIES, from 1985 to 2003, measured in 1997 pesos and adjusted for price differences in the provinces. The explanatory variables comprise of a set representing initial economic, demographic and institutional conditions, a set of time-varying policy variables and neighborhood effects. These variables are defined as follows:

- (a) *Initial economic conditions*: (i) initial mean per capita income, (ii) initial human capital stock as measured by average years of schooling of the household head, (iii) mortality rate per 1,000 of 0 to 5 year-old children, (iv) infrastructure index measured as the average of binary variables indicating presence of street pattern, highway, telegraph, postal service, community waterworks and electricity, and (v) expenditure GINI ratio and its square, as a measure of inequality;
- (b) *Initial geographical conditions*: (i) an indicator variable, landlock, with value 1 if the province is landlocked and 0 otherwise, (ii) an indicator variable for the provinces of ARMM, namely, Basilan, Lanao del Sur, Maguindanao, Sulu and Tawi-Tawi, and (iii) the average annual number of typhoons;
- (c) *Initial demographic conditions*: (i) proportion of young dependents in 1985 defined as the ratio of the population aged 0 to 14 to the total population and (ii) net migration defined as the number of within country net migrants that is, the in-migrants less the out-migrants relative to the province during the period 1985 to 1990;
- (d) *Time-varying policy variables* (variables that measure the difference of specific policy variables from 1988 to 2003): (i) electricity access defined as the change in the proportion of households with access to electricity, (ii) change in road density defined as the proportion of roads (adjusted for quality differences), and (iii) the Comprehensive Agrarian Reform Program implementation defined as the cumulative CARP accomplishment to 1990 potential land reform area; and,
- (e) *Neighborhood effects*: a variable measuring the average growth rate of per capita income of the neighboring provinces (1985 to 2003) using a contiguity measure.

The identified determinants of economic (income) growth included in this study, together with the data sources, are presented in Table 2. The population variable used in this study is the proportion of young dependents to the total population in 1985. This variable is chosen to explain the effects of the population dynamics on income growth due to the fact that the Philippines have not entered into the second phase of the demographic transition. This study will therefore measure the effects of having a big bulge at the bottom of the age pyramid on the provincial income growth.

**Table 2: Variable Definitions and Data Sources**

| <b>VARIABLE NAME</b>                        | <b>DEFINITION</b>  | <b>SOURCE OF BASIC DATA</b> |
|---|--|-----------------------------|
| <b>Actual per capita income growth rate</b> | Average growth rate of provincial per capita income from 1985 to 2003; Income is measured in 1997 pesos and adjusted for price differences in the provinces.         | FIES; 1985 and 2003         |
| <b>Log of initial income</b>                | Natural logarithm of the initial mean per capita income adjusted for provincial cost of living differences   | FIES; 1985                  |
| <b>Education</b>                            | Average education of the household heads measured by the average years of schooling  | FIES; 1994                  |
| <b>Proportion of young dependents</b>       | Defined as the ratio of young dependents (population aged 0 to 14 years) to the total population   | FIES; 1985                  |
| <b>ARMM</b>                                 | Variable for the provinces of ARMM (namely, Basilan, Lanao del Sur, Maguindanao, Sulu, and Tawi-Tawi)  |                             |
| <b>Change in CARP</b>                       | Change in the proportion of cumulative CARP (DENR and DAR) accomplishments to 1990 Potential Land Reform Area from 1988 to 2003                                      | DENR and DAR; 1988 and 2003 |
| <b>Change in electricity</b>                | Change in the proportion of households with access to electricity from 1988 to 2003  | FIES; 1988 and 2003         |
| <b>Change in road</b>                       | Change in road density from 1988 to 2003   | DPWH and NSO; 1988 and 2003 |
| <b>Expenditure GINI and its square</b>      | Measure of expenditure inequality  | FIES; 1985                  |
| <b>Infrastructure index</b>                 | Provincial average of binary variables indicating presence of street pattern, highway, phone, telegraph, postal service, community waterworks system and electricity | CPH; 1990                   |
| <b>Landlock</b>                             | Variable with value 1 if the province is landlocked and 0 otherwise  |                             |
| <b>Mortality rate</b>                       | Mortality rate per 1,000 of 0 to 5 year-old children   | NSO; 1991                   |
| <b>Neighborhood effect</b>                  | Measured by the average growth rate of per capita income of the neighboring provinces using a contiguity measure   | FIES; 1985 and 2003         |
| <b>Net migration</b>                        | The number of within country net migrants computed as in migration less out migration (x 1000); 1985 to 1990   | CPH; 1990                   |

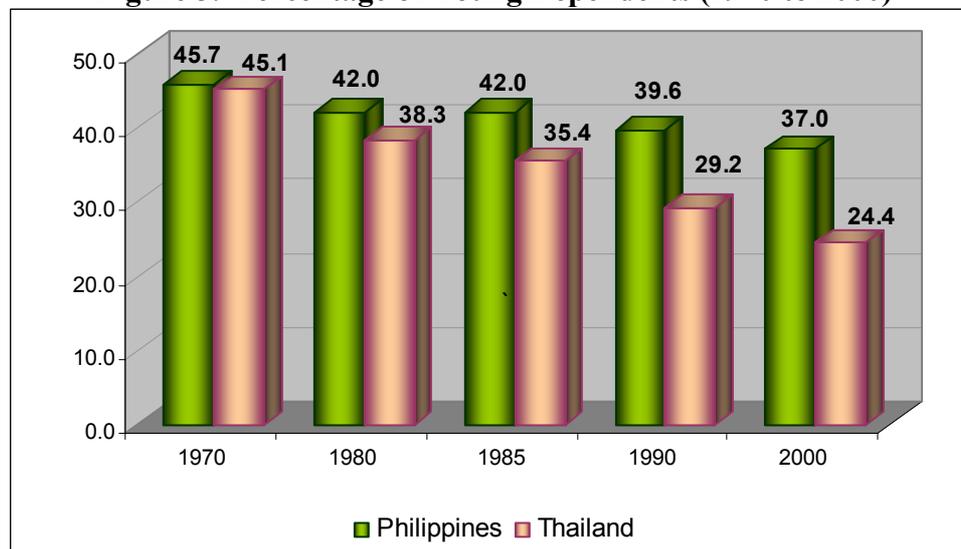
The summary statistics of the variable of interest and the hypothesized determinants of income growth are provided in table 3. Two interesting values stand out: on one hand, the dismal economic performance of the country during the past years is highlighted by the fact that the average growth rate of provincial per capita income from 1985 to 2003 is only 1.87 percent. This measly income growth performance suggests that it will take about 38 years before average (real) income per person

doubles. This means there is a high likelihood that most people will not experience the doubling of their real income in their lifetime!

**Table 3. Summary Statistics of the Variables in the Econometric Model**

| VARIABLE                                    | Mean  | Maximum | Minimum | Standard Deviation | Number of Observations |
|---|-------|---------|---------|--------------------|------------------------|
| Growth rate of provincial per capita income | 1.87  | 5.66    | -1.36   | 1.36               | 74                     |
| Log of initial income                       | 9.73  | 10.40   | 9.07    | 0.29               | 74                     |
| Education                                   | 6.60  | 9.80    | 3.40    | 1.05               | 74                     |
| Proportion of young dependents              | 41.56 | 48.92   | 33.15   | 3.47               | 74                     |
| ARMM  | 0.07  | 1.00    | 0.00    | 0.25               | 74                     |
| Change in CARP                              | 0.80  | 1.00    | 0.26    | 0.14               | 73                     |
| Change in electricity                       | 21.92 | 67.92   | -13.25  | 16.50              | 74                     |
| Change in road                              | 0.12  | 2.47    | -0.08   | 0.29               | 74                     |
| Expenditure GINI                            | 0.34  | 0.49    | 0.19    | 0.06               | 74                     |
| Square of expenditure GINI                  | 0.12  | 0.24    | 0.04    | 0.04               | 74                     |
| Infrastructure index                        | 0.41  | 0.91    | 0.08    | 0.16               | 74                     |
| Landlock                                    | 0.20  | 1.00    | 0.00    | 0.40               | 74                     |
| Mortality rate                              | 0.85  | 1.21    | 0.56    | 0.15               | 73                     |
| Neighborhood effect                         | 1.83  | 3.52    | 0.21    | 0.63               | 74                     |
| Net migration                               | 0.00  | 39.63   | -83.52  | 21.61              | 74                     |
| Typhoon                                     | 0.50  | 1.55    | 0.00    | 0.38               | 74                     |

**Figure 3. Percentage of Young Dependents (1970 to 2000)**



On the other hand, the mean proportion of young dependents in 1985 is 41.56 percent, with some provinces having a proportion close to 50 percent. It should be noted that while the proportion of young dependents has been decreasing over the years, its decline is very slow compared to that of Thailand, as shown in figure 3. This large proportion in the young cohort implies that the resources of the provinces had to be allocated to social investments like health and education instead of economic investments, such as infrastructure. While it is said that the young cohort's education and health are future investments, a continuing high and unsustainable population

growth resulting in a population with a large proportion of young dependents will surely strain the resources of the national and provincial governments both in the short and long terms.

### **Determinants of Income Growth**

The results of the intra-country regression models are given in Table 4. The regression models (in two variants) are representative specifications from the growth literature that includes initial income, human capital variable (education), measure of inequality, geographical factor, institutional conditions and demographic variables.

**Table 4: Determinants of Provincial per Capita Income Growth Rate (a)**

Regression results explaining income growth.

Dependent variable is average provincial per capita income growth rate from 1985 to 2003.

| Variable                       | MODEL 1     |                   | MODEL 2     |                   |
|--------------------------------|-------------|-------------------|-------------|-------------------|
|                                | Coefficient | s.e. <sup>α</sup> | Coefficient | s.e. <sup>α</sup> |
| Log of initial income          | -3.0720***  | 0.429             | -2.4620***  | 0.493             |
| Education                      | 0.1483      | 0.164             | -           | -                 |
| Proportion of young dependents | -0.0912***  | 0.031             | -0.0752*    | 0.040             |
| Expenditure GINI               | 43.0895**   | 19.018            | 46.9507**   | 20.720            |
| Square of expenditure GINI     | -64.1636**  | 26.271            | -69.3848**  | 28.292            |
| ARMM dummy                     | -2.2910***  | 0.668             | -2.1451***  | 0.671             |
| Net migration                  | -0.0080*    | 0.004             | -           | -                 |
| Neighborhood effect            | -0.3257*    | 0.176             | -0.4381**   | 0.211             |
| Infrastructure index           | -           | -                 | 1.6724**    | 0.793             |
| Change in electricity          | -           | -                 | 0.0091      | 0.008             |
| Constant                       | 28.2902***  | 5.365             | 21.2817***  | 7.049             |

\*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%;

α: standard errors are White's heteroscedasticity consistent standard errors

N

74

74

R-squared

0.5599

0.5657

Note: In both models, estimation is by least squares.

The magnitude of the coefficient of the natural logarithm of initial income (at -3.0720 for model 1) implies that (conditional) convergence of provincial income occurs at the rate of about 3% per year<sup>3</sup>. This result is congruent with the expectation of conditional convergence, that is, the economy grows faster the further it is from its own steady state level of income. Thus, on the average, provinces with higher income per capita at the start of the sample period (1985) experienced a lower average growth rate from 1985 to 2003 relative to provinces with lower initial income per capita, all other things being equal. In other words, poorer provinces can catch up with richer provinces. Note, however, that this convergence is conditional in that it predicts a higher growth in response to a lower starting provincial income per person if the other

<sup>3</sup> This estimate of the rate of conditional convergence of the model is lower than that previously estimated by Balisacan (2005) at 4% per year and Balisacan and Fuwa (2004) which was 9% per year for the Philippines provincial data. The figure is closer to the estimates of regional income convergence for Japan, the United States and Europe, clustering at about 2% per year estimated by Barro and Sala-i-Martin (2004).

explanatory variables are held constant. At a conditional convergence rate of 3%, it would take about 23 years before half the initial gap, between the average income per person (in 1985) and the steady state income per person, will be eliminated (half life of convergence). In other words, the average provincial per capita income is currently (in 2006 – 21 years from 1985) about halfway between the average per capita income in 1985 and its steady state per capita income.

From both models, the population variable, proportion of young dependents, has a negative and significant effect on income growth. The estimated coefficient of -0.09 (for model 1) implies that a one-percentage point reduction in the percentage of young dependents in 1985 results in an estimated 9 basis points increase on the average growth rate of income per person from 1985 to 2003, all things being the same. The absolute figure of 9 basis points might be small at first glance but it should be considered that the estimated increase in income growth, as provided by the model, is cumulated over 18 years which can result in a significant increase in the 2003 per capita income, as what the succeeding section will show using simulation techniques. Moreover, the percentage of young dependents in the Philippines in 1985 is quite high at 42 percent, compared to that of Thailand's figure of 35 percent – a huge gap of 7 percentage points. This implies that reducing the proportion of young dependents by this amount (in 1985), the estimated increase on average per capita growth per year would be 0.63, surely not a small value.

The results support the earlier studies of Mapa and Balisacan (2004) and other researchers (notably Bloom, Williamson and Sachs), using cross-country data, that a country with a large proportion of young dependents will experience constricting effects on its economic growth during the first phase of the demographic transition and that the only way to enjoy the “demographic bonus” of positive growth in the medium term is to enter into the second phase of the demographic transition.

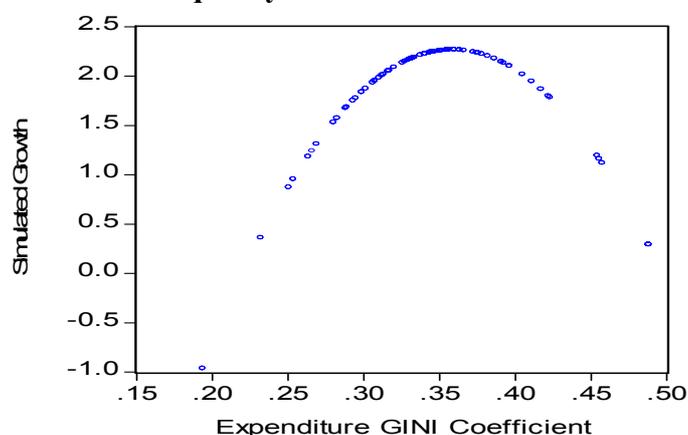
The measures of initial inequality (in the models expenditure Gini and its square were used instead of income or land (asset) Gini) are both significant but with opposite signs. The coefficient of inequality has a positive sign, while its square has a negative sign, all things being the same. The opposite signs of the coefficients imply that the relationship between inequality and income growth follows that of an inverted U shape, similar to the one given in figure 4.<sup>4</sup> In particular, low levels of inequality do not create hindrance for growth, but high levels of inequality are associated with lower income growth. In fact, there is a “turning point” where below this value, inequality has a positive effect on income growth but above this value it has a negative effect on income growth. This “turning point” is estimated to be 0.34, which is about the same as the average GINI for the 74 provinces. It means that GINI values below 0.34 (GINI coefficient is between 0 and 1) have positive effects on the average income growth while GINI values higher than 0.34 have constricting effects on income growth. Out of the 74 provinces in the sample, only 35 provinces have Gini

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<sup>4</sup> The result from the regression model is similar to the results of Banerjee and Dulfo (2003) where the researchers found a similar inverted U relationship between growth and changes in equality in cross country regression models. The positive sign for the measure of inequality was also established in the models of Balisacan and Fuwa (2004) where they find significant and positive effects of the initial inequality in farm distribution (asset inequality) on income growth. However, the authors did not include a quadratic specification in their models.

coefficient values of less than 0.34, while 39 provinces have values greater than 0.34. This tells us that the net effect of inequality on income growth, using the results of the regression model, is negative for majority of provinces in the Philippines.

**Figure 4. Inverted U-shaped Relationship between Inequality and Income Growth**



The location variable ARMM has a negative and significant impact on the average provincial income growth suggesting that these provinces have been experiencing “growth discount” over the years, relative to the other provinces. Provinces in the ARMM region have lower average per capita income growth of about 2.29 percentage points compared to that of the average of the other provinces, all things being equal.

Net migration has a negative and significant effect on average provincial growth rate.<sup>5</sup> The estimated coefficient implies that for every 10,000 net migrants entering the province during the period 1985 to 1990, the estimated average growth rate per person decreases by 0.08 percentage point (or 8 basis points) all things being the same. The negative coefficient for net migration is consistent with the Solow-Swan theory of growth where expansion of the supply of in-migrants lowers the steady-state capital intensity of the domestic economy primarily because the in-migrants come with relatively little physical capital (Barro and Sala-i-Martin; 2004).

To capture potential spillover effects which indicates how the average growth rate of per capita income in the province is affected by its neighboring provinces, after conditioning for the initial level of income per person, a “neighborhood effect” is introduced in the regression model. This variable is computed as the average growth rate of the neighboring provinces (from 1985 to 2003) where the “neighbors” are identified using a contiguity measure. The inclusion of this spatial variable, neighborhood effect, into the growth regression model, conforms to the spatial autoregressive model discussed by Anselin (1988). The basic premise of spatial econometrics in regional/provincial economic growth studies is that regional/provincial data can be spatially ordered since similar regions tend to cluster and that econometric models must take into account the fact that economic

<sup>5</sup> The regression models of Barro and Sala-i-Martin (2004) show that net migration variable has a negative, albeit insignificant, effect on the growth rate of per capita income in their study using the U.S., Japan and 5 European countries data.

phenomenon may not be randomly distributed on an economically integrated regional space (Baumont, Ertur, Le Gallo; 2001). By introducing a “spatial variable” the dynamics of how the regions/provinces’ economic performance interact with each other can be better understood.

The negative and significant effect of the neighborhood variable in the regression model signifies a negative spatial correlation among the neighboring provinces. As the average growth rate of per capita income of the neighbors increase, the average growth rate of per capita income in the home province decreases.<sup>6</sup> One possible explanation to this is that the neighboring provinces are competing with each other in terms of investment for the province. This “beggar thy neighbor” phenomenon experienced by the provinces in the Philippines is highlighted in the case of the province of Cebu where the home province (Cebu) has a higher growth rate than the national average (3.21% vs. 1.86%), while its neighbors’ average income growth is lower than the national average (1.71% vs. 1.86%).

The education variable, measured by the number of years of schooling of the household head, is included in the model to measure human capital. However, the education coefficient (0.1483 for model 1), while positive, is not significant in explaining variations in the average provincial income growth in the Philippines. The insignificant result is in contrast to the results established in the cross-country regressions where education is a positive determinant of economic growth. One possible explanation is that the education variable in the model was not able to capture very well the level of human capital in the provinces. One potential improvement in the choice of proxy for human capital is to estimate the average number of years of schooling of individuals 15 years and above, representing the working group, similar to the work of Barro and Lee (2001), instead of using the years of schooling of the household head.<sup>7</sup>

In model 2, two time-varying policy variables, infrastructure index and change in electricity, are included while the variables education and net migration are excluded. The result for the population variable remains significant, although slightly lower than the result in model 1. A one-percentage point decrease in the proportion of young dependents in 1985, increases the estimated mean provincial per capita income from 1985 to 2003 by about 7.5 basis points, all things being equal. The time-varying policy variables have positive signs, as expected. However, of the two, only the infrastructure index is a significant determinant of income growth, while improvement in the access to electricity is not. A 10 percentage points increase in infrastructure index, results to an increase of 0.17 percentage point (or 17 basis points) in the estimated average provincial per capita income, all things being the same.

Since some of the explanatory variables, particularly education and the proportion of young dependents, are not strictly exogenous variables, the models are estimated

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<sup>6</sup> Similar studies using European regions (Baumont, Ertur and Le Gallo (2001)) and US States/Countries show that the neighborhood effect is positive.

<sup>7</sup> Mankiw, Romer and Weil (1992) used the percentage of working-age population that is in secondary school as their proxy for human capital and found this to be positive and significantly correlated with growth. Barro and Sala-i-Martin (2004) used the average years of male secondary and higher schooling (referred to as upper-level schooling) as their proxy.

again, this time using instrumental variables in the regression. Table 5 shows the results of the model 1 specification, re-estimated using two stage least squares (model 3) and the generalized method of moments (model 4). These two estimation procedures are better than the ordinary least squares since they provide consistent estimates of the coefficients.

**Table 5: Determinants of Provincial per Capita Income Growth Rate (b)**

Regression results explaining income growth.

Dependent variable is average provincial per capita income growth rate from 1985 to 2003.

| Variable                       | MODEL 3 <sup>α</sup> |            | MODEL 4 <sup>β</sup> |            |
|--------------------------------|----------------------|------------|----------------------|------------|
|                                | Coefficient          | Std. Error | Coefficient          | Std. Error |
| Log of initial income          | -3.1957***           | 0.4839     | -3.4786***           | 0.419215   |
| Education                      | 0.1360               | 0.1869     | 0.2715*              | 0.150888   |
| Proportion of young dependents | -0.1306**            | 0.0534     | -0.1011**            | 0.040808   |
| Expenditure GINI               | 49.1290**            | 21.9622    | 68.4040***           | 13.90763   |
| Square of expenditure GINI     | -73.1441**           | 29.6190    | -99.7146***          | 19.75772   |
| ARMM dummy                     | -2.2077***           | 0.6602     | -1.1409***           | 0.340229   |
| Net migration                  | -0.0051              | 0.0069     | -0.0060*             | 0.003346   |
| Neighborhood effect            | -0.3640*             | 0.2139     | -0.3852**            | 0.175629   |
| Infrastructure index           | -                    | -          | -                    | -          |
| Change in electricity          | -                    | -          | -                    | -          |
| Constant                       | 30.2969***           | 7.1310     | 27.4932***           | 5.435676   |

\*\*\* significant at 1%; \*\* significant at 5%; \* significant at 10%

|                    |        |        |
|--------------------|--------|--------|
| N                  | 74     | 74     |
| R-squared          | 0.5944 | 0.5640 |
| Adjusted R-squared | 0.5404 | 0.5059 |

<sup>α</sup>: Estimation is by two-staged least squares.

<sup>β</sup>: Estimation is by generalized method of moments.

NOTE: For both models, instruments are actual values of all variables including lagged values of education and proportion of young dependents.

The coefficient of the proportion of young dependents is negative and significant for both procedures. Moreover, the magnitude of the coefficient is larger than that of the two previous models. This is one indication that the proportion of young dependents is a robust determinant of income growth.

### **Robustness Procedures – Bayesian Averaging of the Classical Estimates (BACE)**

The main argument in empirical growth econometrics is the choice of control variables--which explanatory variables are to be included or excluded in the regression models. The problem is that variables, such as population growth, may be a significant determinant of income growth depending on which other variables are held constant. The question now is, “Which variables should be included in the growth regression?” (Barro and Sala-i-Martin: 2004). The very first of these robustness procedures was the extreme bound analysis (EBA) suggested by Leamer (1983) and used by Levine and Renelt (1992) to test the robustness of the variables in the growth regression using cross country data. But since Levine and Renelt’s test is considered too strong by some researchers for any variable to really pass it, Sala-i-Martin (1997) suggests moving away from the extreme bound test and instead assign some level of

confidence to each of the variables. One way to do this is to look at the whole distribution of the estimators.

On the other hand, Sala-i-Martin, Doppelhofer and Miller (SDM; 2003) used the Bayesian approach in averaging across models, while following the classical spirit.<sup>8</sup> This paper uses the BACE approach to determine the variables that are strongly or robustly related to income growth. The discussion as to how this procedure is applied in this paper is provided in the appendix. In testing for the robustness of the 14 explanatory variables defined in table 2, it is assumed that the logarithm of initial mean income (initial condition) and education (proxy for human capital) are always present in the model (12 variables remain in the pool). The number of explanatory variables for every model is pegged at 7, a typical number for a growth regression model. In the process, a total of 792 models were run, with each of the 12 variables in the pool appearing 330 times. The two fixed variables (initial condition and education) appear 792 times in the regression runs. The result of the robustness procedure is provided in table 6.

**Table 6: Robustness of the Coefficients  
Bayesian Averaging of Classical Estimates (BACE)**

| VARIABLE                              | Mean Beta     | Mean Standard Error | Sign Certainty Probability<br>(one side of 0/ + or -) | Remark        |
|---------------------------------------|---------------|---------------------|---|---------------|
| <b>Log of initial income</b>          | <b>-2.81</b>  | <b>0.28752</b>      | <b>1.00</b>   | <b>robust</b> |
| Education                             | 0.16          | 0.03103             | 0.82  | not robust    |
| <b>Proportion of young dependents</b> | <b>-0.09</b>  | <b>0.00140</b>      | <b>0.99</b>   | <b>robust</b> |
| <b>ARMM dummy</b>                     | <b>-2.15</b>  | <b>0.62946</b>      | <b>1.00</b>   | <b>robust</b> |
| Change in CARP                        | -1.12         | 1.19384             | 0.85  | not robust    |
| Change in electricity                 | 0.01          | 0.00010             | 0.84  | not robust    |
| Change in road                        | 0.25          | 0.94198             | 0.60  | not robust    |
| <b>Expenditure GINI</b>               | <b>43.76</b>  | <b>397.2149</b>     | <b>0.99</b>   | <b>robust</b> |
| <b>Square of expenditure GINI</b>     | <b>-65.21</b> | <b>719.2251</b>     | <b>0.99</b>   | <b>robust</b> |
| Infrastructure index                  | 1.21          | 1.00117             | 0.89  | not robust    |
| Landlock                              | 0.42          | 0.09433             | 0.91  | not robust    |
| Mortality rate                        | 0.15          | 1.49960             | 0.45  | not robust    |
| Neighborhood effect                   | -0.36         | 0.03827             | 0.97  | marginal      |
| Net migration                         | -0.01         | 0.00003             | 0.97  | marginal      |
| Typhoon                               | 0.29          | 0.15905             | 0.77  | not robust    |

The determinants of income growth are listed in column 1, while the means and standard errors of the coefficients computed from all the models, are given in columns 2 and 3, respectively. The fourth column provides the sign certainty probability, or the probability that the estimated coefficient is on one side of zero (positive or negative). In the table, the estimated mean of all the coefficients of the logarithm of initial mean income (initial condition) is -2.81 which is very close to the value in model 1 (given in table 4) previously discussed. The probability that such coefficient will always be negative using the BACE is 1.00 (with certainty). Thus, the logarithm of initial mean income can be considered as strongly or robustly correlated with

<sup>8</sup> The BACE procedure is highly technical and will not be discussed in details in this paper. However, interested readers are referred to the paper of SDM (2003) for full discussion of the procedure.

income growth. This result is not surprising because of the concept of conditional convergence.

### **Variables Strongly or Robustly Correlated with Income Growth**

Aside from the initial income, the other variables that are strongly correlated with income growth are the ARMM variable which is negatively correlated with growth with certainty (100 percent probability), the inequality measures, Gini coefficients (positively correlated with growth) and its square (negatively correlated with growth), and the proportion of young dependents (negatively correlated with growth). All three variables have certainty probability of 99%.

### **Variables Marginally Correlated with Growth**

The author next identifies variables whose certainty probability is less than 97.5% but greater than 95% (significant at the 10% level). These variables are the net migration and neighborhood effects and are said to be marginally correlated with income growth.

### **Variables not robustly related with Growth**

The rest of the variables show little evidence of robust partial correlation with income growth using the empirical test. These variables that are considered as weak determinants are education, change in CARP, change in the proportion of households with electricity, change in the quality of roads, infrastructure index, the indicator variable landlock, mortality rate, and the number of typhoons.

## **IV. Population Dynamics-Income Growth-Poverty Reduction Nexus**

### **From Population Dynamics to Income Growth**

Once the impact of a reduction in the proportion of young dependents on income growth has been estimated, using the econometric models given in the previous section, the next step is to simulate the average provincial per capita income growth rate that could have been achieved had the proportion of young dependents of the provinces in 1985 been lower than the actual, particularly at the level equivalent to the average of the ten (10) provinces with the lowest proportion of young dependents. This simulation exercise will present what could have been the income growth picture under a lower population scenario that yields a lower proportion of young dependents. Table 7 provides the ten (10) provinces with the lowest proportion of young dependents in 1985. The average value for these 10 provinces is 35.89 percent.<sup>9</sup>

The estimated coefficient taken from model 2 (Table 4) showed that a one percentage point reduction in the proportion of young dependents in 1985 results in an estimated 7.5 basis points increase on the average provincial per capita income growth rate.<sup>10</sup>

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<sup>9</sup> This value is almost the same as the proportion of young dependents of Thailand in 1985 which is 35.4 percent.

<sup>10</sup> This reduction is the lowest of the four models presented (models 1 to 4) and even lower than the mean of the 330 estimated coefficients of proportion of young dependents used the BACE reported

Under the lower proportion of young dependents scenario, had the provinces with high percentage of young dependents reduced their proportion to 35.89 percent in 1985, the estimated national average per capita income in year 2003 (18 years later) would have been higher by 1,620 pesos (from 27,443 pesos to 29,063; all in 1997 prices), or this would mean an increase of 7.12% in national average per capita income. The graph showing the actual average income per person and the simulated income per person under the lower proportion of young dependents scenario is given in Figure 8. Adjusting for inflation, this amount corresponds to an additional increase of 2,227 pesos on the average income per person in 2003.

**Table 7. Lowest 10 Provinces in terms of Proportion of Young Dependents (1985)**

| Province       | Proportion of Young Dependents |
|----------------|--------------------------------|
| Metro Manila   | 33.15                          |
| Cavite         | 34.39                          |
| Ilocos Norte   | 35.76                          |
| Siquijor       | 35.96                          |
| Nueva Vizcaya  | 36.34                          |
| Quirino        | 36.38                          |
| Zambales       | 36.44                          |
| Bulacan        | 36.62                          |
| Camiguin       | 36.83                          |
| Southern Leyte | 37.08                          |
| Average        | 35.89                          |

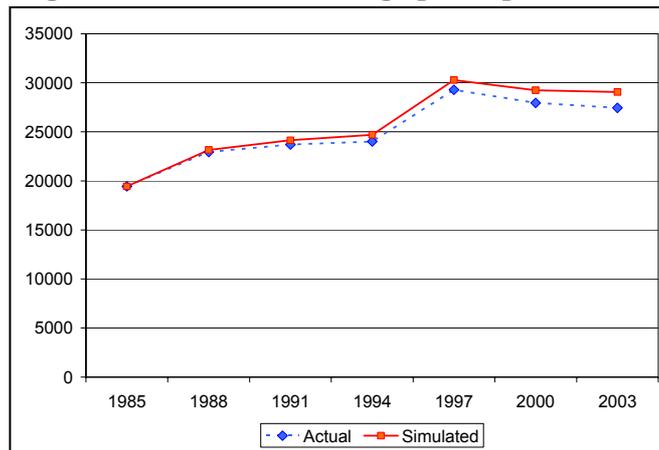
### **A Higher Income per Person in some Provinces**

The potential increase in average per capita income is larger for provinces where the proportion of young dependents is somewhat large in 1985. These are the cases of Camarines Norte with 47.03%, Camarines Sur (45.86%) and Davao Oriental (44.37%), to name a few. The following figures illustrate the actual average income per person as well as the simulated average income per person, if these provinces had a low level of proportion of young dependents in 1985, equivalent to 35.89. The figures show that Camarines Norte's income per person in 2003 would have been 3,297 pesos higher (in 1997 prices) or an increase of 16.18% in the province's per capita income. Camarines Sur's average income per person would have been higher by 2,764 pesos (an increase of 14.37%) and Davao Oriental's higher by 2,152 pesos (12.11%) in 2003

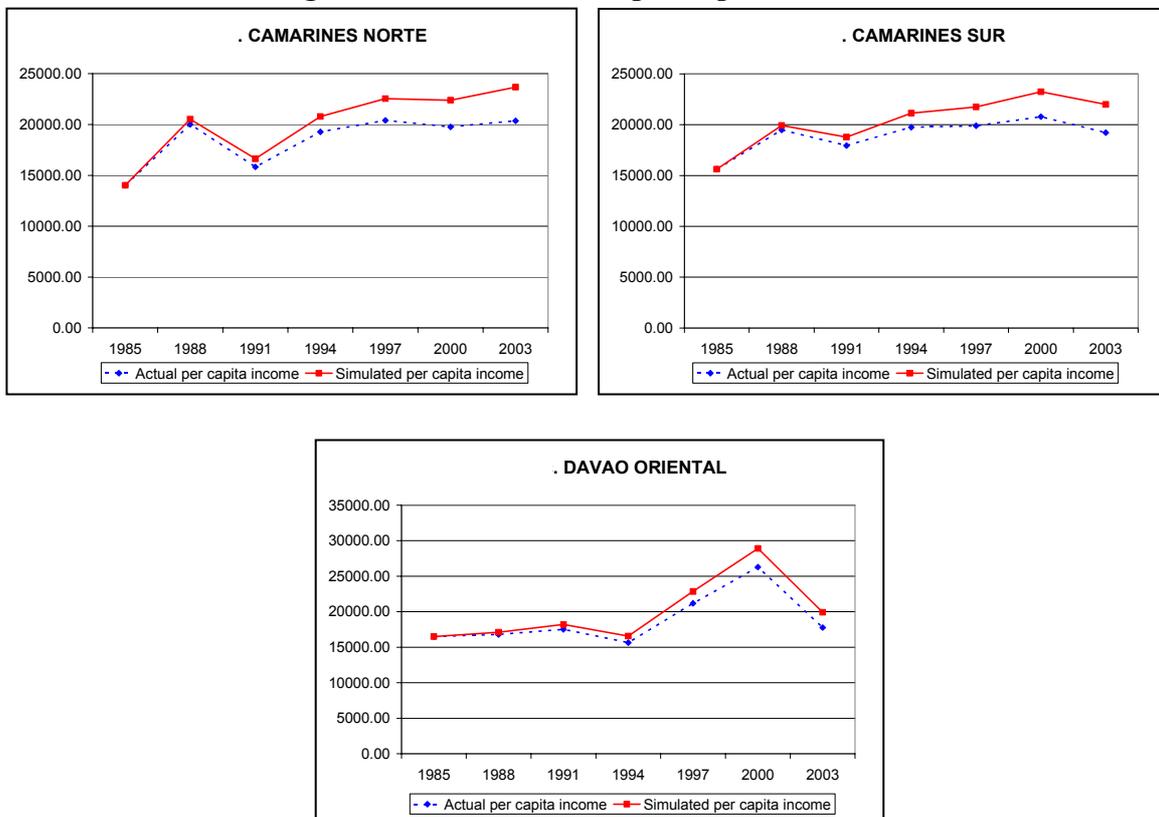
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in table 6. The corresponding increase in mean per capita income reported here is more likely at the lower end of the figure.

**Figure 5. Simulated Average per capita Income**



**Figure 6a – 6c. Simulated per capita Income**



**Growth Accounting: Population dynamics explains large component of provincial growth differentials**

To determine the reasons for the relatively low growth rate of the average income per person in certain provinces and how the population dynamics explains such low growth, the estimates from the econometric model is used to account for the growth differentials of selected provinces. These provinces were selected in such a way that the values of the other determinants of income growth based on the model are more or

less the same, except for the population dynamics in order to isolate the would be contribution to income growth of having a lower proportion of young dependents. Table 8 reports a growth accounting comparison between Camarines Norte, with per capita income growth of 2.10 percent, and Misamis Occidental, with a higher per capita income growth of 3.30 percent.

**Table 8. Why Some Provinces Grew Slow:  
Camarines Norte vs. Misamis Occidental**

| Variable                                    | Camarines Norte | Misamis Occidental | Forgone growth |
|---|-----------------|--------------------|----------------|
| <b>INITIAL CONDITION</b>                    |                 |                    |                |
| Log of initial income                       | 9.55            | 9.39               | 0.40           |
| <b>POPULATION DYNAMICS</b>                  |                 |                    |                |
| Proportion of young dependents              | 47.03           | 39.34              | 0.58           |
| <b>INEQUALITY</b>                           |                 |                    |                |
| Expenditure GINI                            | 0.29            | 0.38               | 4.37           |
| Square of expenditure GINI                  | 0.08            | 0.15               | -4.33          |
| <b>LOCATION DUMMY</b>                       |                 |                    |                |
|   | 0               | 0                  | 0              |
| <b>NEIGHBORHOOD EFFECT</b>                  |                 |                    |                |
|   | 1.93            | 1.48               | 0.20           |
| <b>INFRASTRUCTURE</b>                       |                 |                    |                |
| Infrastructure index                        | 0.39            | 0.39               | -0.01          |
| Change in electricity                       | 1.28            | 34.11              | 0.30           |
| <b>Actual per capita income growth rate</b> |                 |                    |                |
|   | 2.10            | 3.30               | 1.20           |

The first column of Table 8 identifies the variables used in the model. The second column corresponds to the actual values of these variables for Camarines Norte while the third column reports the values for the comparator province – Misamis Occidental. The last column uses the estimates from the model to compute for the additional growth rate that Camarines Norte would have enjoyed if it had the values of Misamis Occidental. Thus, the last column provides us with the estimates of the forgone income growth for Camarines Norte.

The values from column 4 of Table 8 show that differences in the proportion of young dependents between the two provinces (47.03% vs. 39.34%) accounts for about 0.58 percentage point of the forgone growth for Camarines Norte, the largest component we find in the table. This figure implies that had the proportion of young dependents in Camarines Norte been the same as that in of Mindoro Occidental in 1985, the provincial average income per person would have been 0.58 percentage point higher every year. Differences in the proportion of young dependents account for about 48% of the total growth differential between the two provinces.

A similar comparison is made between the provinces of Camarines Sur (where the 1985 proportion of young dependents is 45.86%) and Nueva Ecija (with low proportion of young dependents at 37.98%). The forgone growth rate for Camarines Sur, due to its high proportion of young dependents in 1985, is about 0.59. In other words, had Camarines Sur's proportion of young dependents been only 37.98% (equivalent to Nueva Ecija), its average income growth per person would have been 0.59 percentage point higher. The growth accounting exercise shows that indeed the proportion of young population matters to the provincial per capita income growth and having a higher proportion of the young constricts income growth.

**Table 9. Why Some Provinces Grew Slow:  
Camarines Sur vs. Nueva Ecija**

| Variable                                    | Camarines Sur | Nueva Ecija | Forgone growth |
|---|---------------|-------------|----------------|
| <b>INITIAL CONDITION</b>                    |               |             |                |
| Log of initial income                       | 9.66          | 9.52        | 0.33           |
| <b>POPULATION DYNAMICS</b>                  |               |             |                |
| Proportion of young dependents              | 45.86         | 37.98       | 0.59           |
| <b>INEQUALITY</b>                           |               |             |                |
| Expenditure GINI                            | 0.39          | 0.34        | -2.38          |
| Square of expenditure GINI                  | 0.15          | 0.12        | 2.57           |
| <b>LOCATION DUMMY</b>                       |               |             |                |
|   | 0             | 0           | 0              |
| <b>NEIGHBORHOOD EFFECT</b>                  |               |             |                |
|   | 2.38          | 2.49        | -0.05          |
| <b>INFRASTRUCTURE</b>                       |               |             |                |
| Infrastructure index                        | 0.48          | 0.52        | 0.06           |
| Change in electricity                       | 19.08         | 24.96       | 0.05           |
| <b>Actual per capita income growth rate</b> |               |             |                |
|   | 1.16          | 1.85        | 0.70           |

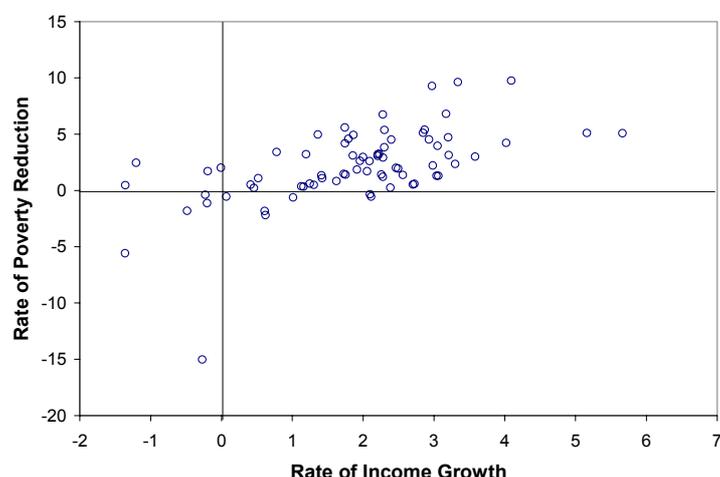
### **From Income Growth to Poverty Reduction**

The final step in the simulation exercise is to estimate the effect of the population dynamics to reduction in poverty, via the growth channel (or the “expansion of the pie”). Previous empirical studies (notably Balisacan (2005) and Balisacan and Pernia (2003) and Balisacan and Fuwa (2002)) have shown that the growth factor is an important determinant of poverty reduction.<sup>11</sup> The scatter plot of the average growth rate of per capita income and rate in reduction of headcount poverty, from 1985 to 2003, for the provinces in the data set is given in figure 7. The graph illustrates a positive relationship between average per capita income growth rate and the rate of headcount poverty reduction. The “growth elasticity” is estimated by running a regression model with the rate of poverty reduction as the dependent variable and rate

<sup>11</sup> Balisacan (2005) equation on poverty reduction showed that once growth is incorporated, no other variable is significant in explaining poverty reduction.

of income growth as the explanatory variable. The result of the regression model is given in table 10. The growth elasticity of poverty reduction is estimated at 1.45%, that is, a one percent increase in the rate of average income growth increases the rate of poverty reduction by roughly 1.45%.<sup>12</sup>

**Figure 7. Scatter plot of Average Growth Rate of Per capita Income and Rate of Reduction of Headcount Poverty**



**Table 10. Provincial Poverty Reduction Results  
(Dependent variable is annual rate of poverty reduction)**

| Variable                                 | Coefficient | P-value |
|--|-------------|---------|
| Constant                                 | 0.5295      | 0.4957  |
| Growth rate of average per capita income | 1.4531      | 0.0000  |
| N  | 74          |         |
| R-squared                                | 0.3495      |         |
| Adjusted R-squared                       | 0.3405      |         |

To estimate the reduction in headcount poverty as a result of a lower proportion of young dependents, the result from the econometric model is used. Recall that the model estimates that the national average per capita income would have been higher by 7.12% had the provinces, with high proportion of young dependents in 1985, followed the average of the ten provinces with the lowest proportion (at 35.89%). We then apply the growth elasticity of poverty reduction of 1.45%. Table 11 shows that under the status quo (high proportion of young dependents) scenario, the poverty headcount in 2003 is estimated at about 20.47 million Filipinos, representing about 26.12% of the entire population. Under the low proportion of young dependents scenario, the poverty headcount in 2003 is estimated at 17.65 million, lower by about 2.82 million individuals, or lower by 3.60 percentage points, from 26.12% to 22.52%.

<sup>12</sup> This estimate of the growth elasticity is closer to the figure from the study of Balisacan and Fuwa (2002) using provincial data from 1988 to 1997 where the estimated growth elasticity is 1.6%. However, this value is lower than the growth elasticity of poverty reduction observed in other developing countries such as China (2.9%), Indonesia (3.0%) and Thailand (3.5%) according to a study made by Cline (2004). Balisacan (2005) noted that the growth elasticity in the Philippines is low by international standard.

The reduction in poverty headcount is due to the estimated increase in the mean income per person of about 2,227 pesos in 2003. This reduction corresponds to an average of 156,000 Filipinos taken out of poverty every year beginning 1985, surely a large number to be serious about.

**Table 11. Reduction in Poverty**

| Scenarios                               | Poverty Headcount (Individuals) |       |
|---|---------------------------------|-------|
|   | Number                          | %     |
| Status quo                              | 20,465,409                      | 26.12 |
| With low proportion of young dependents | 17,646,631*                     | 22.52 |
| Difference                              | 2,818,778                       | 3.60  |

\* assuming the same population in 2003

## V. Conclusion

The provincial per capita income growth in the Philippines can be considered as generally dismal in the last two decades. While there are provinces where per capita income growth has been moderately high (more than 5%), majority of the provinces have income growth that is comparable with the poorest countries in the world. This paper looks at the relationship between the population dynamics, particularly the proportion of young dependents, and income growth and poverty reduction. The paper is able to show that indeed population dynamics play an important role in both the country's national income growth and provincial income growth. The opportunities associated with the demographic transition are real and can provide stimulus for additional income growth through the demographic dividend. While this paper does not cite population dynamics as the only reason for the poor economic performance of majority of the provinces, tests done in this study show that the proportion of young dependents is a robust determinant of income growth and can explain a significant portion of the growth differentials between provinces with high proportion of young dependents and those with low proportion of young dependents.

This paper supports the earlier conclusion made by Mapa and Balisacan (2004) in their cross-country analysis wherein the authors concluded that the Philippines pays a high price for its unchecked high population growth. The results from this study reiterate the call for a clear population policy backed by strong government support. In identifying key drivers of income growth and poverty reduction, young population matters. And contrary to the cliché, more is not necessarily merrier.

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## Appendix: Bayesian Averaging of the Classical Estimates (BACE)

Represent a model,  $M_j$ , as a length  $K$  binary vector in which a one indicates that a variable is included in the model and a zero indicates that it is not. Then the prior probability of model  $j$ , as specified by the researcher, is given as:

$$P(M_j) = \left[ \prod_{i=1}^{k_j} M_{ji} \frac{\bar{k}}{K} \right] \left[ \prod_{i=1}^{k_j} (1 - M_{ji}) \left( 1 - \frac{\bar{k}}{K} \right) \right] \quad (i)$$

where  $k_j$  is the number of included variables in model  $j$ ,  $\bar{k}$  is the prior mean model size, and  $M_{ji}$  is the  $i$ th element of the vector.

In the case of equal prior inclusion probabilities for each variable, the prior probability of model  $j$  given above is simplified to:

$$P(M_j) = \left( \frac{\bar{k}}{K} \right)^{k_j} \left( 1 - \frac{\bar{k}}{K} \right)^{1-k_j}, \quad \forall j = 1, \dots, J \quad (ii)$$

Furthermore, if there are 14 potential variables ( $K$ ), and the number of variables included in every model ( $k_j$ ) is fixed to 7 with 2 of these variables present in every model, then, from equation (2), the prior probabilities of all the  $J = \binom{2}{2} \binom{12}{5} = 792$  models would be the same. That is:

$$P(M_j) = P(M) = \left( \frac{\bar{k}}{14} \right)^7 \left( 1 - \frac{\bar{k}}{14} \right)^{1-7}, \quad \forall j = 1, \dots, 792. \quad (iii)$$

The weights can then be computed using the prior probabilities. The weight of a given model is normalized by the sum of the weights of all possible models with  $K$  possible regressors:

$$P(M_j | y) = \frac{P(M_j) T^{-k_j/2} SSE_j^{-T/2}}{\sum_{i=1}^{2^K} P(M_i) T^{-k_i/2} SSE_i^{-T/2}}, \quad \forall j = 1, \dots, J \quad (iv)$$

where  $T$  is the sample size and  $SSE_i$  is the OLS sum of squared errors under model  $i$ . From equation (iii), equation (iv) becomes:

$$P(M_j | y) = \frac{SSE_j^{-T/2}}{\sum_{i=1}^{792} SSE_i^{-T/2}}, \quad \forall j = 1, \dots, 792. \quad (v)$$

The normalized weight for models where the number of included variables in every model is fixed is just a function of the OLS sum of squared errors of the models.

Therefore, the posterior mean of  $\beta$ ,

$$E(\beta | y) = \sum_{j=1}^{2^K} P(M_j | y) \hat{\beta}_j \quad (\text{vi})$$

where  $\hat{\beta}_j = E(\beta | y, M_j)$  is the OLS estimate for  $\beta$  with the regressor set that defines model  $j$ , is computed as the weighted average of the OLS estimates using the OLS sum of squared errors:

$$E(\beta | y) = \sum_{j=1}^{792} \left( \frac{SSE_j^{-T/2}}{\sum_{i=1}^{792} SSE_i^{-T/2}} \right) \hat{\beta}_j \quad (\text{vii})$$

Moreover, the posterior variance of  $\beta$  given by:

$$Var(\beta | y) = \sum_{j=1}^{2^K} P(M_j | y) Var(\beta | y, M_j) + \sum_{j=1}^{2^K} P(M_j | y) [\hat{\beta}_j - E(\beta | y)]^2 \quad (\text{viii})$$

is also a function of the OLS sum of squared errors:

$$Var(\beta | y) = \sum_{j=1}^{792} \left( \frac{SSE_j^{-T/2}}{\sum_{i=1}^{792} SSE_i^{-T/2}} \right) Var(\beta | y, M_j) + \sum_{j=1}^{792} \left( \frac{SSE_j^{-T/2}}{\sum_{i=1}^{792} SSE_i^{-T/2}} \right) [\hat{\beta}_j - E(\beta | y)]^2. \quad (\text{ix})$$