Investigating the Presence of Regional Economic Growth Convergence in the Philippines using Kalman Filter

Dennis S Mapa and Monica Flerida B Sandoval and David Joseph Emmanuel B Yap

School of Statistics University of the Philippines Diliman

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Dennis S. Mapa
Associate Professor, School of Statistics, University of the Philippines
Diliman, Quezon City 1101 Philippines
csmapa@up.edu.ph, cdsmapa@yahoo.com

Monica Flerida B. Sandoval
Research Associate
GMA Networks
Quezon City, Philippines
monica_flerida@yahoo.com

David Joseph Emmanuel B. Yap II
Lecturer, School of Statistics, University of the Philippines
Diliman, Quezon City 1101 Philippines

ABSTRACT

This paper investigates the presence of stochastic and dynamic convergence of the 14 regional economies in the Philippines in terms of per capita Gross Regional Domestic Product (GRDP) using regional panel data from 1988 to 2007. Stochastic convergence, which indicates convergence of regions in the long-run, is tested using Levin, Lin & Chu (LLC) and Im, Pesaran & Shin (IPS) panel unit root tests. The presence of convergence, on one hand, indicates that the economically laggard regions are gaining on the economically better-performing regions with respect to per capita GRDP. On the other hand, the lack of convergence indicates a need to reevaluate existing regional and national economic policies on development. Dynamic convergence reveals several convergence characteristics of individual regions over time. Dynamic convergence is determined by the time-varying parameter (TVP) model derived using the Kalman Filter. The paper proceeds to examine the individual convergence behavior of each region based on the value of the estimate of the parameter of the TVP. The results show that out of the 14 regions studied, seven regions are found to converge towards the average of the national per capita GDP growth rate over 1988 to 2007 while six regions lag behind the average of the national per capita GDP growth rate over the same period. No region converges towards the economic growth rate of National Capital Region, the lead region used in the study.

Key words: Panel Unit Root Test, Time-varying Parameter (TVP) Model, Kalman Filter, Stochastic Convergence, Dynamic Convergence

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I. INTRODUCTION

The study of regional economics concerns with the spatial distribution of economic activity across geographic areas within a country and it now considered as a forefront of development issues. The development of a country is contingent on the growth of its economy and the strength of a national economy is derived from the strength of its regional economies. An understanding of the nuances of the regional economies is thus crucial to any effort geared towards national development. As noted by the economist Paul Krugman, "…one of the best ways to understand how the international economy works is to start by looking at what happens inside nations. If we want to understand differences in national growth rates, a good place to start is by examining differences in regional growth" (Krugman 1991;3).

In the case of the Philippines, the level of regional economic activity has been predominantly unequal through the years where majority of the economic output is concentrated on the National Capital Region (NCR) and the two adjacent regions of Central Luzon and Southern Tagalog, with these three regions (out of the 17 regions as of 2007) producing about 55 percent of the total national output (Balisacan, Hill and Piza 2007;1). This rather high level of economic disparity across the regions gave rise to the national economic agenda unveiled by President Gloria Macapagal-Arroyo in her 2006 State of the Nation Address (SONA) where she committed government resources, mainly through various infrastructure projects, to enhance the competitive advantage of the natural geographic composition of the regions. The creation of the five "Super Regions[2]" aims to fast track development initiatives in North Luzon as Agribusiness Quadrangle,

[2] Critics argue, however, that the size of the funding commitment for all the infrastructure projects mentioned was simply too large for the government's financial position.

Metro Luzon as Urban Beltway, Central Philippines as excellent tourist destination, Mindanao as a centre of agribusiness investment and the Cyber Corridor which will link all the 17 regions through infrastructure and communications technology (ICT).

The primary concern of this study is to examine the economic growth behavior of the Philippine regions in terms of its per capita Gross Regional Domestic Product (GRDP)[3] over the time period of 1988 to 2007. The study aims to determine if Philippine regions converge to a particular economic growth path or diverge into different growth paths.

The study investigates two types of convergence: stochastic and dynamic convergence. Both types of convergence are essential in characterizing the behavior of regional economies. The presence of stochastic convergence implies long-run convergence. It implies that the differences of the GRDP of the regions are decreasing over time. Dynamic convergence investigates the short-run convergence of each region. Dynamic convergence reveals if the regions converge towards the overall average growth rate or towards the growth rate of the lead region. It also provides information regarding the specific nature of the convergence of each region. Dynamic convergence reveals details about the direction and degree of convergence.

Stochastic convergence is tested using Levin, Lin & Chu (LLC) and Im, Pesaran & Shin (IPS) panel unit root tests[4]. Both of these tests work under the null hypothesis of

[3] Per capita GRDP is part of the *Regional Accounts* that measures level of economic development of a region.

[4] LLC and IPS tests are DF-type tests proposed by Levin, Lin & Chu (2002) and Im, Pesaran & Shin (2003), respectively.

unit root. Rejection of the null hypothesis implies stationarity and the presence of stochastic convergence. Non-rejection of the null hypothesis means non-stationarity and that the regions are divergent in the long run. As argued by Win Lin Chou (2006), the presence of convergence suggests that laggard regions are catching up with the economically better performing regions in terms of per capita GRDP while the lack of convergence indicates a need for the creation and implementation of alternative regional policies. Divergence also indicates that all regions do not approach a common steady state growth path in the long run. It is, however, important to note that this does not mean total lack of convergence among several regions. Dynamic convergence enables the analysis of these possible regional convergence sub-groupings. The dynamic properties of convergence are explored via time-varying parameter (TVP) model using Kalman filter. The individual convergence behavior of a particular region is governed by the corresponding value and sign of the time-varying parameter maximum likelihood estimate. We explore the possibility that the region may 1) converge towards the average of the national per capita GDP growth rate, to serve as national benchmark, 2) converge towards growth rate of lead region, which is found to be the National Capital Region (NCR), or 3) diverge from the average national per capita GDP growth rate. These ideas of investigating both stochastic and dynamic convergence as well as the use of LLC and IPS panel unit root tests and TVP model using the Kalman filter are patterned from the work of Canales (2007) regarding the study of the stochastic and dynamic convergence of selected commercial banks in the Philippines with respect to tax collection with the use of Kalman filter.

The determination of the convergence behavior of Philippine regional economies would identify the regions that require immediate attention. A profile of the convergence behavior of regional economies could also lead to the discovery of effective regional economic configurations. These are crucial to the development and implementation of economic policies for sustainable economic growth.

The rest of the paper is organized as follows. Section 2 presents an overview of the Philippine regional settings. We then expound the process of performing LLC and IPS panel unit root tests and estimation of time-varying parameters using Kalman filter in Section 3. The results of the tests as applied to Philippine regional data are then presented in Section 4 followed by the conclusions in the last section.

II. PHILIPPINE REGIONAL SETTINGS

The data set used is a regional panel data consisting of 14 Philippine regions[5] with per capita GRDP recorded for the period 1988 to 2007.[6] The list of regions in the study is provided in the Table 1.[7] Figure 1 is a map of the Philippines showing the 14 regions.

[5] The data set consists of 14 regions, instead of the current 17 regions, for data consistency.
[6] Figures are in 1985 prices. Adjustments were made to all Mindanao regions for the years 1994-2007 due to changes in regional classification
[7] Source of basic data: NSCB; 1988 to 2007

Table 1– Philippine Regions included in the study

REGION	NAME	REGION	NAME
1	Ilocos Region	8	Eastern Visayas
2	Cagayan Valley	9	Western Mindanao
3	Central Luzon	10	Northern Mindanao
4	SouthernTagalog*	11	Southern Mindanao
5	Bicol Region	12	Central Mindanao **
6	Western Visayas	13	National Capital Region (NCR)
7	Central Visayas	14	Cordillera Administrative (CAR)

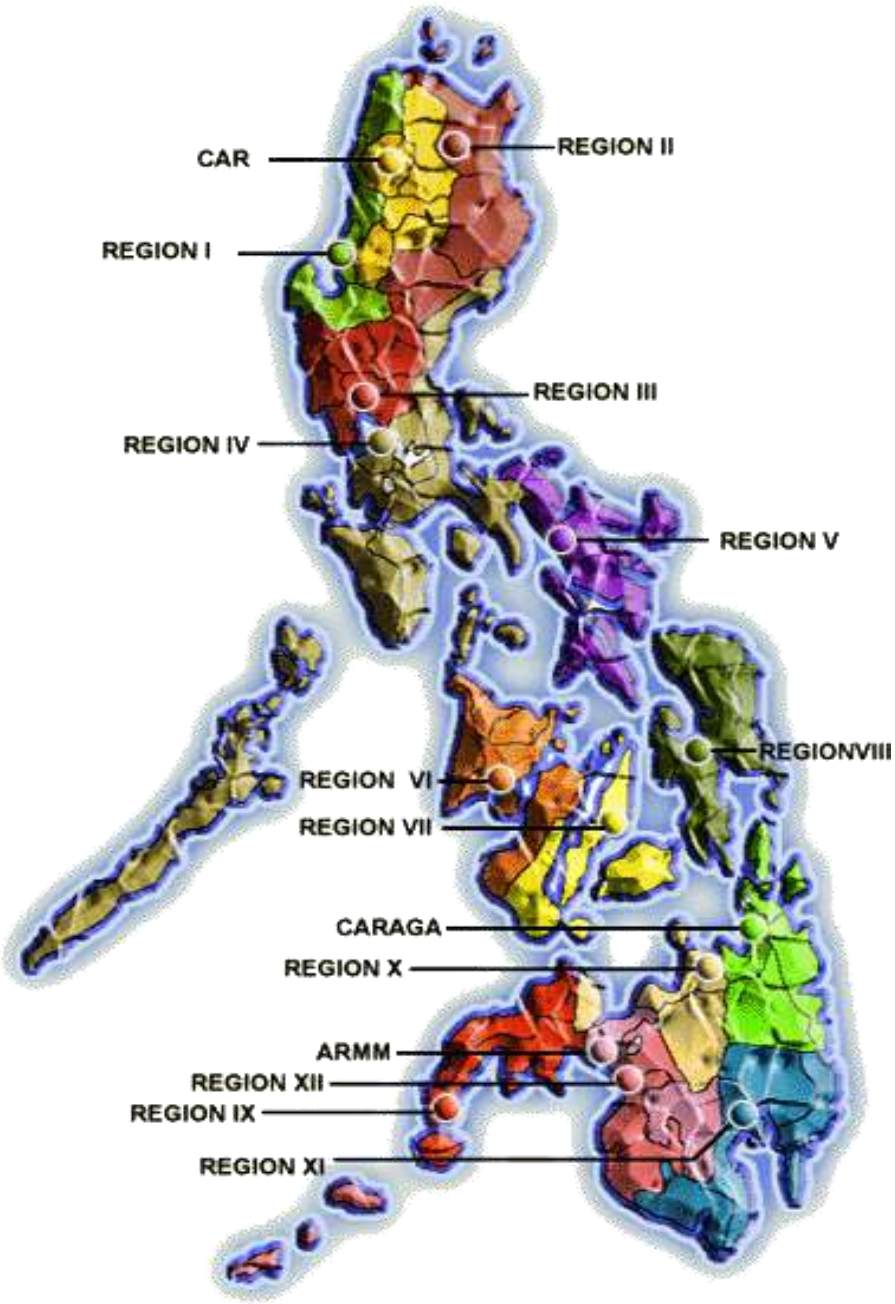
* The old Region IV (Southern Tagalog) is now composed of two regions: Region IV-A and IV-B
** Most of Central Mindanao now belongs to the Autonomous Region of Muslim Mindanao (ARMM)

The mean of the national per capita GDP[8] over the period 1988 to 2007, as shown in table 2, is about Php12396.00 and growing at an average of 1.73% per year.[9] The National Capital Region (NCR), considered as the lead region, had an extremely high average per capita GRDP of Php 29,669 as compared to the other regions, and average yearly growth rate of about 2.37%. The Cordillera Administrative Region (CAR), however, has the highest mean yearly per capita GRDP growth rate of 3.04%. The Bicol Region has the lowest mean per capita GRDP, amounting only to roughly Php 5,620. The high income disparity in the country is highlighted by the fact that the average per capita income in Metro Manila (or NCR) is around 2.4 times the average per capita income of the whole country and about 5.2 times the average per capita income of the poorest region (Bicol Region).

Using the national average as a benchmark, only three (3) out of the 14 regions have average income higher than the national average: National Capital Region (NCR), Cordillera Administrative Region (CAR) and Southern Tagalog (Region IV).

[8] Measured in 1985 constant prices.
[9] The average per capita growth rate for the entire country during this period is less than 2%. At this growth rate, it will take about 35 years before real per capita income doubles.

Figure 1 – Map of the Philippines[10]



[10] Source: www.da.gov.ph

Table 2 – Descriptive Statistics of per capita GRDP of 14 regions: 1988 to 2007

Region	Region Name	Mean per capita GRDP (in 1985 Pesos)	Mean per capita Growth Rate (%)	Mean per capita RGDP Index (National=100)
1	Ilocos Region	6,607	2.09	53.30
2	Cagayan Valley	6,816	2.13	54.99
3	Central Luzon	10,943	0.69	88.28
4	Southern Tagalog	13,260	0.75	106.97
5	Bicol Region	5,620	2.12	45.34
6	Western Visayas	10,425	2.6	84.10
7	Central Visayas	11,307	2.31	91.21
8	Eastern Visayas	5,809	1.44	46.86
9	Western Mindanao	8,169	2.83	65.90
10	Northern Mindanao	10,543	1.5	85.05
11	Southern Mindanao	12,069	1.81	97.36
12	Central Mindanao	7,505	0.15	60.54
13	NCR	29,669	2.37	239.34
14	CAR	14,766	3.04	119.12
	National GDP	12,396	1.73	100.00

Sources: National Statistical Coordination Board (NSCB); Authors' computations

In terms of socioeconomic indicators, the poverty incidence in table 3 proves that location really matters. In 2006, poverty incidence for the entire country is estimated to be 33 percent. [11] A large disparity appears once we examines poverty incidence across the regions. On one hand, the poverty incidence in the National Capital Region is only 10.40%, while the two adjacent regions of Central Luzon (Region 3) and Southern Tagalog (Region IV-B) have poverty incidence of 20.70% and 20.90%, respectively. On the other hand, the Autonomous Region of Muslim Mindanao (ARMM)[12] has the highest poverty incidence of about 62%.

[11] With the rising food prices, experienced since the start of the year 2008, economists have predicted that the poverty incidence will increase further in 2008.

[12] The Autonomous Region in Muslim Mindanao is the region of the Philippines that is composed of all the Philippines' predominantly Muslim provinces (used to be called Central Mindanao), namely: Basilan (except Isabela City), Lanao del Sur, Maguindanao, Sulu and Tawi-Tawi, and the Philippines' only

Table 3. Regional Headcount Poverty (Years 2000, 2003, 2006)

Region	2000	2003	2006
Region I	35.30	30.20	32.70
Region II	30.40	24.50	25.50
Region III	21.40	17.50	20.70
Region IV-A	19.10	18.40	20.90
Region IV-B	45.30	48.10	52.70
Region V	52.60	48.50	51.10
Region VI	44.50	39.20	38.60
Region VII	36.20	28.30	35.40
Region VIII	45.10	43.00	48.50
Region IX	44.80	49.20	45.30
Region X	43.80	44.00	43.10
Reion XI	33.30	34.70	36.60
Region XII	46.80	38.40	40.80
CAR	37.70	32.20	34.50
ARMM *	60.00	52.80	61.80
CARAGA	51.20	54.00	52.60
NCR	7.80	6.90	10.40
Philippines	33.00	30.00	32.90

Source: National Statistical Coordination Board (NSCB)

In Figures 2 and 3, the transitions of per capita GRDP of the regions as well as that of the national per capita GDP over 1988 to 2007 are illustrated. NCR's extremely well-off status relative to the other regions, even relative to the national benchmark, is clearly revealed in Figure 2. NCR continues to have by far the highest per capita income; and its increasing income differential relative to the national average and to those of the other regions persists over the period 1988 to 2007. The national per capita GDP and the per capita GRDP of the remaining regions do not seem to converge towards the per capita GRDP of NCR over time. In Figure 3, NCR is excluded in the plot to better examine the relative transitions of per capita GRDP of the remaining regions and that of the national

predominantly Muslim city, the Islamic City of Marawi. The regional capital is at Cotabato City, although this city is outside of its jurisdiction.

GDP. Also, the plot would show the trend if the individual paths tend to fluctuate around the national benchmark or move towards a common limit. In general, some of the regions appear to follow the path of the national per capita GDP, but the overall economic progress of the regions differ substantially as the paths of their per capita GRDP do not follow a common trend nor show any evidence of convergence through time. More so, some of the paths depict high volatilities in per capita GRDP.

Figure 2- Per Capita National GDP and Per Capita GRDP of 14 Regions: 1988 to 2007

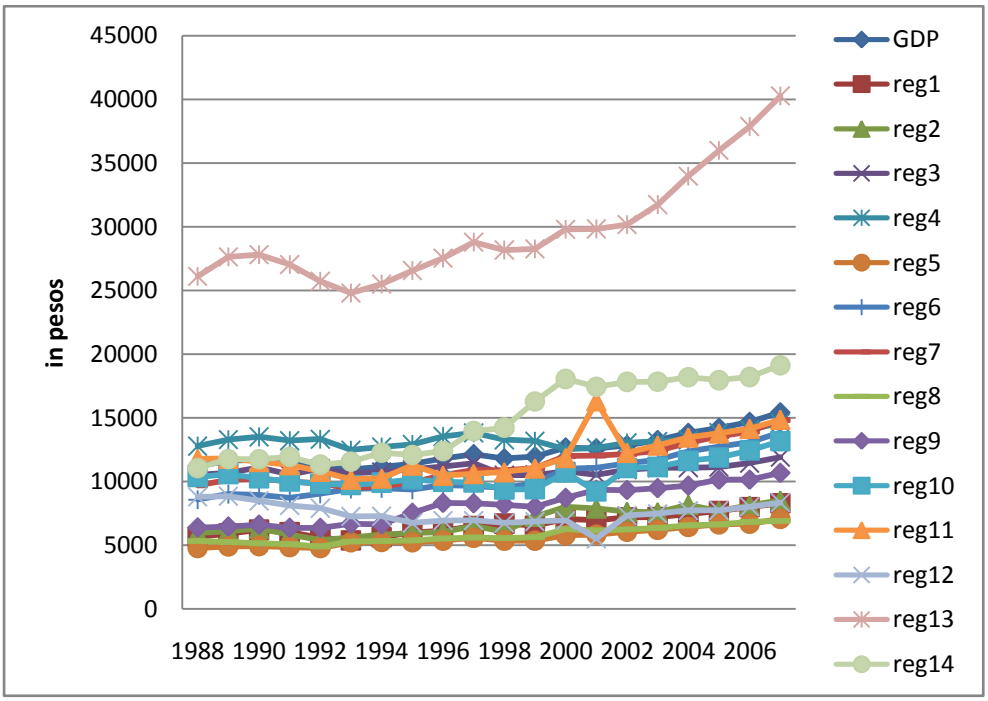
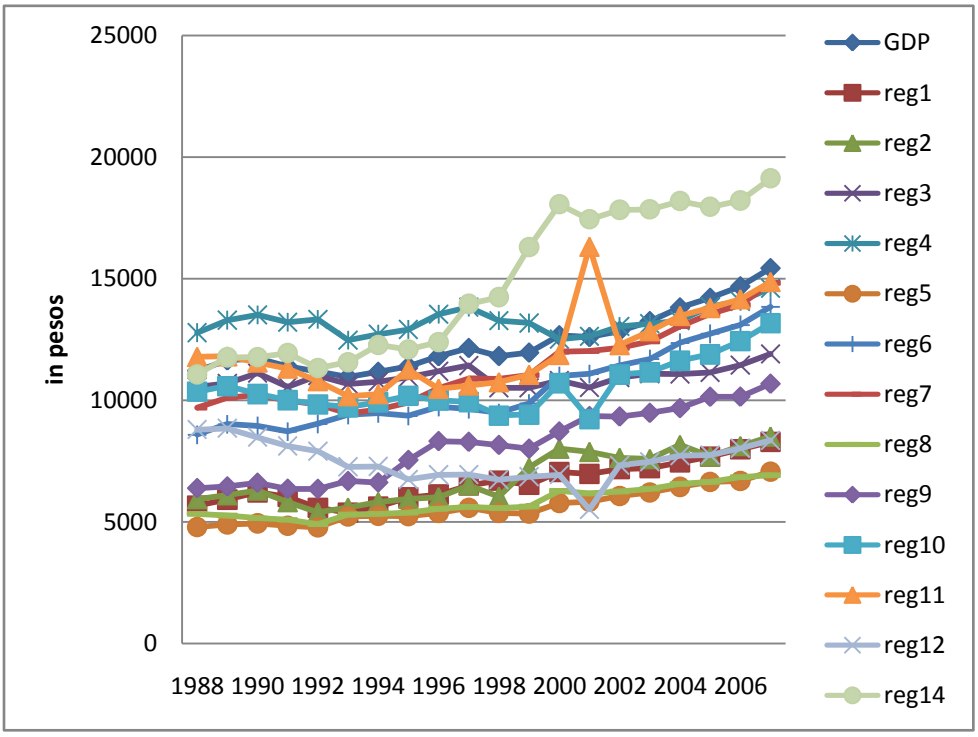
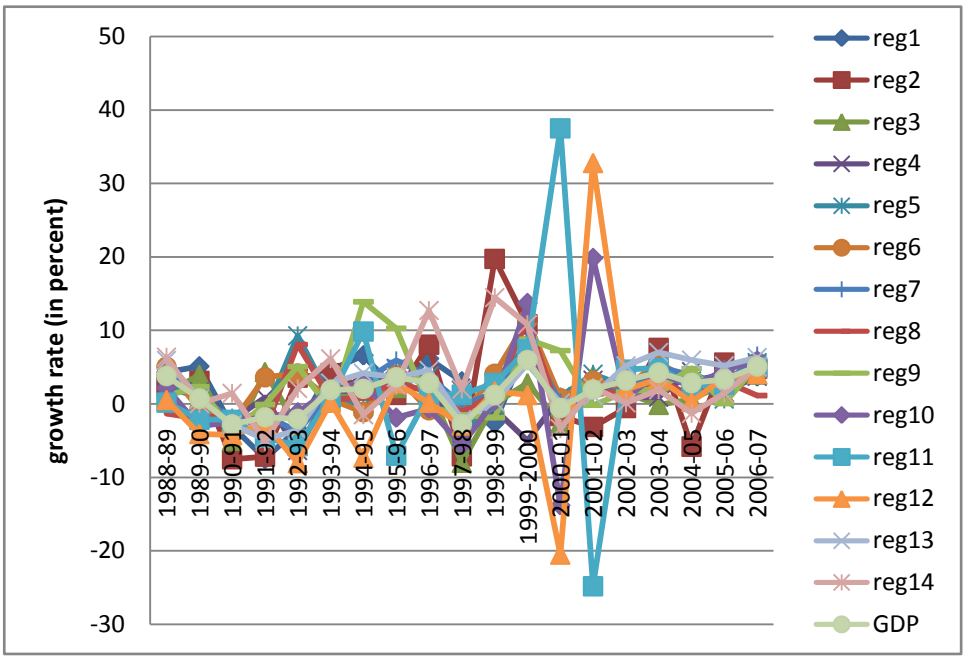


Figure 3 - Per Capita National GDP and Per Capita GRDP of Regions Excluding NCR: 1988 to 2007



The growth rates of national per capita GDP and those of per capita GRDP of the 14 regions over 1988 to 2007 in Figure 4, however, may suggest fluctuations around some common path. Though per capita GRDP growth rates of a few regions depict high volatilities; in general, the trends relatively suggest the possibility of convergence over time with the national benchmark and among regions.

Figure 4 – Growth Rates of National Per Capita GDP and of Per Capita GRDP of 14 Regions: 1988 to 2007



III. STOCHASTIC AND DYNAMIC CONVERGENCE

A. Stochastic Convergence

Stochastic convergence is tested using Levin, Lin & Chu (LLC) and Im, Pesaran & Shin (IPS) panel unit root tests. LLC assumes a common unit root process, i.e., common autoregressive (AR) structure for all series whereas IPS assumes individual unit root process, i.e. AR structure varies across cross-sections. Nonetheless, both have a null hypothesis of unit root and rejection of the null implies stochastic convergence, which, according to Win Lin Chou (2006), indicates that disparities in per capita GRDP among

regions follow a stationary process and lack of stationarity might lead to permanent deviations from the equilibrium level of per capita GRDP.

Before performing panel unit root tests, the study first examines the individual convergence behavior of regions using Augmented Dickey-Fuller (ADF) Test.[13] As provided in the work of Win Lin Chou (2006), if an individual series is stationary, it is said to achieve stochastic convergence. Hence, the study carries out univariate unit root test for each region using the *log* of per capita GRDP of a region to the national per capita GDP at a particular year. The rejection of unit root indicates convergence of per capita GRDP of the region to the national benchmark.

The works of Levin, Lin, and Chu (2002) and that of Im, Pesaran, and Shin (2003), however, reveal that panel unit root tests are more powerful than univariate tests of unit root when working with panel data. The study, thus, performs the LLC and IPS tests to see if all 14 regions achieve stochastic convergence.

In performing the panel unit root tests, the study first gets the *log* of per capita GRDP of each region to the national per capita GDP at a given year. The study then uses the resulting values as the input series in the tests.

B. Dynamic Convergence

To measure the dynamic process of convergence in GRDP of the regions over the sample period, the study makes use of the following Time-varying Parameter (TVP) Model, based on the formulation of Win Lin Chou (2006):

[13] ADF Test is one of the many popular univariate tests for presence of unit root.

$$(GR_b - GR_i) = \alpha_i(t) + \beta_i(t)[GR_b - GR_{BASE}] + \varepsilon_{it} \quad (1)$$

where GR = growth in GRDP, *b* = national GDP, *i* = particular region, *t* = time (year), and *BASE* = region with the highest average yearly GRDP in the series and is taken to be NCR.

In estimating the time-varying parameters $\alpha_i(t)$ and $\beta_i(t)$, Kalman filter is used. It is specified by a state-space model with two types of equation, namely state and measurement (signal) equations. We thus have the following state-space representation of (1) as provided by Win Lin Chou (2006):

State equation:

(i) $\alpha_i(t) = F_\alpha \alpha_i(t-1) + \nu_{i\alpha t}$, with $\text{var}(\nu_{i\alpha t}) = \sigma^2_{i\nu\alpha}$ (2)

(ii) $\beta_i(t) = F_\beta \beta_i(t-1) + \nu_{i\beta t}$, with $\text{var}(\nu_{i\beta t}) = \sigma^2_{i\nu\beta}$ (3)

Measurement equation:

$$y_{it} = \alpha_i(t) + x_t \beta_i(t) + \omega_{it}, \text{ with } \text{var}(\omega_{it}) = \sigma^2_{i\omega} \quad (4)$$

where y_t and x_t are $(GR_b - GR_i)$ and $(GR_b - GR_{BASE})$ from (1), respectively. F_α and F_β are the corresponding coefficients of the state-space equations, and $\nu_{i\alpha t}, \nu_{i\beta t}$ and ω_{it} are measurement errors. Win Lin Chou (2006), though, noted that since growth rates are used in equation (1), we expect $\alpha_i(t)$ coefficients to be zero. Hence, convergence will be assessed through $\beta_i(t)$ coefficients only.

The estimates of the time-varying parameter $\beta_i(t)$ will dictate the convergence or divergence behavior of region *i*. The study accomplishes this by first estimating the

smoothed $\beta_i(t)$ coefficients for each region over the sample period and computing for the corresponding means and standard deviations of these coefficients per region. If the region's GRDP growth converges towards the growth rate of the national per capita GDP, the expected mean of $\beta_i(t)$ for this particular region is zero. If, however, the region's growth in GRDP converges towards NCR, the lead region, the expected mean of $\beta_i(t)$ for that particular region is one. A negative value for the mean of $\beta_i(t)$ signifies that the region is lagging behind the growth rate of the national benchmark. The estimated standard deviation of $\beta_i(t)$ would indicate volatility of the estimated $\beta_i(t)$ coefficients for a given region, which, in turn, provides an overview of how a region's GRDP fluctuates relative to that of the other regions' over time. Furthermore, the regions are subdivided into groups based on the estimated mean $\beta_i(t)$ coefficient, and the dynamic behaviors of regions within and across groups are analyzed in the same manner.

IV. RESULTS

Results of ADF regressions as well as LLC and IPS panel unit root tests are summarized in Table 4. The individual ADF tests for Bicol Region, Central Visayas, and Southern Mindanao are significant at the 5% level, as indicated by the corresponding p-values, implying presence of stochastic convergence and that the per capita GRDP of the respective regions converges towards the national per capita GDP over time. The ADF tests for remaining regions, on the other hand, show presence of unit root denoting lack of convergence towards the national benchmark through time. The results of the LLC and

IPS panel unit root tests, nonetheless, indicate lack of convergence of the 14 regions in the long run.

Table 4 – Unit Root Tests on Stochastic Convergence

REGION NAME	ADF t-stat	P-value
Ilocos Region	-2.0273	0.5504
Cagayan Valley	-1.9768	0.5762
Central Luzon	-1.8989	0.6157
Southern Tagalog	-2.4648	0.3391
Bicol Region	-6.9728	0.0003
Western Visayas	-3.4317	0.0784
Central Visayas	-4.9418	0.0070
Eastern Visayas	-2.0131	0.5577
Western Mindanao	-1.3670	0.8372
Northern Mindanao	-3.0987	0.1344
Southern Mindanao	-3.7684	0.0421
Central Mindanao	-2.6039	0.2823
National Capital Region	-1.9031	0.6115
Cordillera Administrative	-1.3553	0.8386
Panel Unit Root Test	LLC t-stat/ IPS w-stat	P-value
LLC	-0.0360	0.4856
IPS	0.6030	0.7267

Though there is absence of stochastic convergence, this does not imply that there is total lack of convergence among regions. It may be possible that convergence exists within subgroups of regions; or some other regions converge either towards the national per capita GDP growth rate or towards the growth rate of the lead region, NCR, over the sample period. The assessment of the dynamic process of convergence of individual regions is determined via the TVP model, specified in the previous section, using Kalman filter. NCR is disregarded in the subsequent analyses as it is the lead region.

The smoothed $\beta_i(t)$ coefficients for 13 regions over 1988 to 2007 are provided in Table 5. The mean and standard deviations of these smoothed coefficients for each region have also been provided. Since the estimated values of the $\beta_i(t)$ coefficients are close to zero, it would be essential to test if the coefficients are significantly different from zero or

not. The t-statistics and p-values of the one-sided test under the null hypothesis that the mean of the $\beta_i(t)$ coefficients is not significantly different from zero at the 5% level are also provided in Table 5.

From the results, we see that seven regions obtained mean $\beta_i(t)$ coefficients that indicate convergence towards the growth rate of the national per capita GDP over the sample period. The remaining six regions, however, gained negative mean $\beta_i(t)$ coefficients that are significantly different from zero indicating that these six lag behind the growth rate of the national benchmark over 1988 to 2007. None of the regions converge towards the lead region, NCR. The region with the highest $\beta_i(t)$ standard deviation is Region 2, Cagayan Valley. This suggests high volatility for smoothed $\beta_i(t)$ coefficients; hence greater instability in per capita GRDP growth rate of the region relative to the growth rate of national per capita GDP.

Table 5 – Smoothed $\beta_i(t)$ Coefficients of 13 Regions from 1988 to 2007

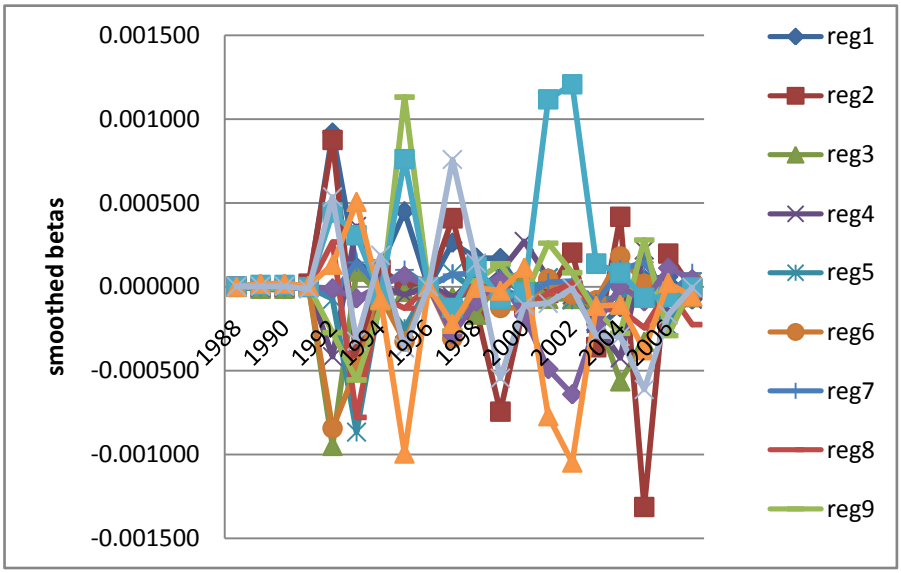
Year	Ilocos Region	Cagayan Valley	Central Luzon	Southern Tagalog	Bicol Region	Western Visayas	Central Visayas
1988	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
1989	-0.000016	-0.000009	-0.000012	-0.000003	-0.0000005	0.000006	-0.000002
1990	-0.000016	-0.000009	-0.000012	-0.000003	-0.0000005	0.000006	-0.000002
1991	0.000001	0.000018	0.000008	-0.000002	-0.000003	-0.000001	-0.000002
1992	0.000918	0.000874	-0.000948	-0.000418	-0.000075	-0.000843	-0.000046
1993	0.000117	-0.000441	0.000090	0.000359	-0.000867	-0.000485	0.000145
1994	0.000122	0.000101	-0.000045	0.000001	-0.000056	-0.000057	-0.000010
1995	0.000449	0.000011	-0.000031	-0.000050	-0.000250	-0.000326	0.000100
1996	-0.0000004	-0.000001	-0.0000003	0.00000025	-0.0000002	0.00000007	0.00000048
1997	0.000262	0.000408	-0.000059	-0.000058	0.000079	-0.000307	0.000074
1998	0.000172	-0.000139	-0.000166	-0.000038	-0.000030	0.000033	0.000079
1999	0.000170	-0.000745	0.000052	0.000086	0.000069	-0.000125	-0.000012
2000	-0.000050	-0.000111	0.000074	0.000269	-0.000048	-0.000124	-0.000063
2001	-0.000022	-0.000037	-0.000072	0.000050	0.000053	0.000047	0.000026
2002	-0.000037	0.000203	-0.000073	-0.000049	-0.000080	-0.000046	0.000034
2003	-0.000258	-0.000360	-0.000161	-0.000221	-0.000079	-0.000080	-0.000097
2004	-0.000122	0.000416	-0.000564	-0.000425	-0.000065	0.000181	0.000102
2005	0.000044	-0.001313	-0.000328	0.000218	0.000039	0.000019	0.000146
2006	0.000059	0.000198	-0.000054	-0.000153	-0.000236	-0.000039	-0.000054
2007	-0.000077	-0.000017	-0.000062	-0.000076	0.000030	0.000032	0.000081
Mean	0.000086	-0.000048	-0.000118	-0.000026	-0.000076	-0.000106	0.000025
S.D.	0.000246	0.000446	0.000245	-0.000190	0.000205	0.000230	0.000068
t-stat (p-value)	1.560 (0.064)	-0.477 (0.318)	-2.158 (0.019)	-0.603 (0.275)	-1.657 (0.053)	-2.051 (0.024)	1.631 (0.056)

(cont.) Smoothed $\beta_i(t)$ Coefficients of 13 Regions from 1988 to 2007

Year	Eastern Visayas	Western Mindanao	Northern Mindanao	Southern Mindanao	Central Mindanao	CAR
1988	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
1989	0.000011	-0.000006	0.000014	0.000011	0.000019	0.000003
1990	0.000011	-0.000006	0.000014	0.000011	0.000019	0.000003
1991	-0.000005	0.000003	-0.000001	-0.000002	0.000005	-0.000015
1992	0.000266	-0.000273	-0.000010	0.000443	0.000131	0.000534
1993	-0.000780	-0.000556	-0.000070	0.000306	0.000506	-0.000326
1994	-0.000059	-0.000124	0.000006	-0.000047	-0.000077	0.000187
1995	-0.000128	0.001132	0.000064	0.000760	-0.000995	-0.000366
1996	-0.00000012	0.000001	-0.000001	-0.000002	-0.00000018	-0.00000024
1997	-0.000110	-0.000263	-0.000287	-0.000126	-0.000221	0.000758
1998	0.000050	0.000036	-0.000089	0.000120	-0.000006	0.000141
1999	-0.000005	0.000137	0.000034	-0.000071	-0.000024	-0.000546
2000	-0.000124	-0.000066	-0.000175	-0.000034	0.000113	-0.000110
2001	-0.000042	0.000261	-0.000492	0.001118	-0.000772	-0.000099
2002	0.000022	0.000084	-0.000642	0.001207	-0.001048	-0.000010
2003	-0.000139	-0.000150	-0.000226	0.000138	-0.000114	-0.000292
2004	-0.000135	-0.000277	0.000004	0.000083	-0.000107	-0.000296
2005	-0.000246	0.000279	-0.000088	-0.000066	-0.000379	-0.000613
2006	-0.000021	-0.000291	0.000111	-0.000061	0.000023	-0.000168
2007	-0.000226	0.000008	0.000044	-0.000005	-0.000057	-0.000005
Mean	-0.000083	-0.000003	-0.000089	0.000189	-0.000149	-0.000061
S.D.	0.000198	0.000333	0.000192	0.000393	0.000381	0.000323
t-stat (p-value)	-1.876 (0.034)	-0.047 (0.481)	-2.087 (0.022)	2.152 (0.019)	-1.754 (0.044)	-0.847 (0.201)

We plot the smoothed $\beta_i(t)$ coefficients of the 13 regions as shown in Figure 5. The plot clearly reveals large fluctuations in per capita GRDP over the sample period for a number of regions, specifically those for Regions 2, 11, and 12.

Figure 5 – Smoothed $\beta_i(t)$ coefficients of 13 regions over 1988 to 2007



The study then subdivides the 13 regions based on the calculated smoothed $\beta_i(t)$ coefficients. The first group consists of those regions that converge towards the growth rate of national per capita GDP, the national benchmark; while the second group consists of those regions that lag behind the national benchmark. The groupings are provided in Table 6. Figures 6 and 7 illustrate the behaviors of the regions within subgroups with respect to per capita GRDP growth rate over the sample period. In Figure 6, the high volatilities exhibited by Regions 2 and 11 are further emphasized. But, in general, per capita GRDP growth rates of the seven regions tend to fluctuate around a common path and would further suggest convergence with respect to per capita GRDP beyond 2005. For the lagging regions in Figure 7, Regions 3, 6 and 8 exhibited extreme declines in per capita GRDP growth rate around the years 1991 to 1993. Region 12, similarly, may have had experienced significant declines in per capita GRDP in the years 1995, 2001 and 2002. More so, by 2006, the six laggards clearly show lack of convergence in per capita GRDP growth rate.

Table 5 – Regional Subgroups based on smoothed $\beta_i(t)$ coefficients

Regions converging towards mean GDP growth rate	Diverging Regions
Ilocos Region	Central Luzon
Cagayan Valley	Western Visayas
Southern Tagalog	Eastern Visayas
Central Visayas	Northern Mindanao
Western Mindanao	Central Mindanao
Southern Mindanao	Bicol Region
CAR	

Figure 6 – Smoothed $\beta_i(t)$ coefficients of 7 regions converging towards growth rate of national per capita GDP over 1988 to 2007

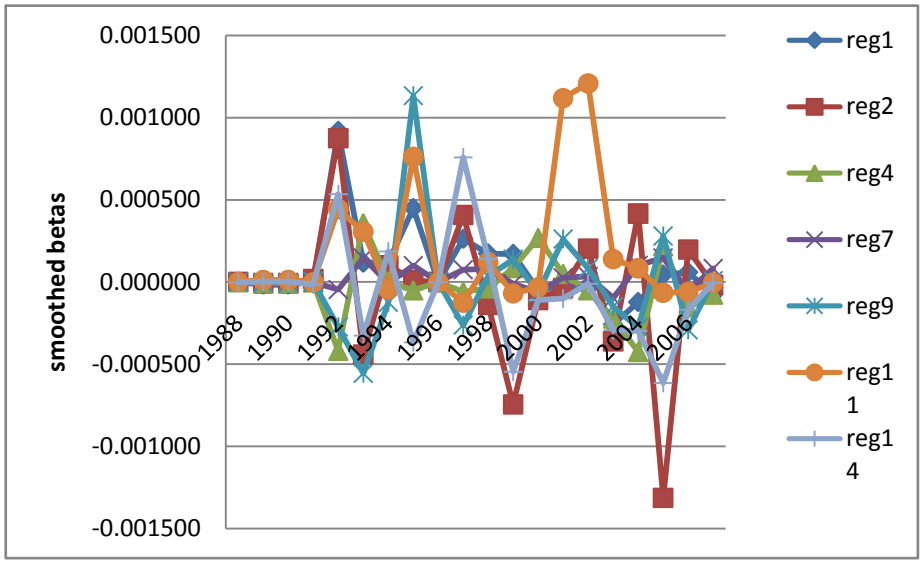
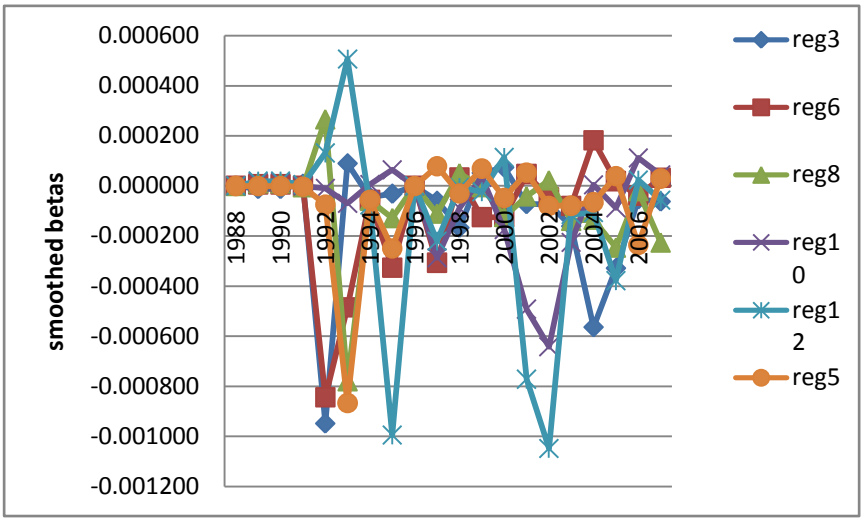


Figure 7 – Smoothed $\beta_i(t)$ coefficients of 6 lagging regions over 1988 to 2007



V. CONCLUSIONS

The panel unit root tests for stochastic convergence revealed that the 14 regions do not converge in the long run. The analyses of dynamic convergence, however, revealed that seven regions converge towards the growth rate of national per capita GDP and that six regions lag behind and do not converge towards the growth rate of the national benchmark. The analyses also revealed that none of the remaining 13 regions converge towards the growth rate of the National Capital Region.

These results reiterate the need to improve the socio-economic infrastructure of regions other than the National Capital Region. The fact that no region is converging towards the growth rate of the NCR is a reminder of the severe systemic imbalance and the staggering amount of untapped economic potential. The creation and implementation

of economic policies that seek to generate economic growth outside of the NCR should be pursued by national and regional leaders.

The results also indicate that almost half of Philippine regions are growing slowly relative to the overall growth rate of Philippine regions. Furthermore, these regions are also believed to be incapable of significantly improving their economic condition because of the generated regional convergence profile. It is thus incumbent upon regional and national leaders to immediately develop and implement socio-economic policies that are aimed at generating appreciable and sustainable economic growth in these six regions.

The Philippine Regions (1988)

Region I: Ilocos
Benguet
Ilocos Norte
Ilocos Sur
La Union
Mt. Province
Pangasinan

Region II:
Cagayan Valley
Batanes
Cagayan
Isabela
Nueva Vizcaya
Quirino

Region III:
Central Luzon
Bataan
Bulacan
Nueva Ecija
Pampanga
Tarlac
Zambales

Region IV:
Southern Tagalog
Aurora
Batangas
Cavite
Laguna
Marinduque
Occidental Mindoro
Oriental Mindoro
Palawan
Quezon
Rizal
Romblon

Region V: Bicol
Albay
Camarines Norte
Camarines Sur
Catanduanes
Masbate
Sorsogon

Region VI:
Western Visayas
Iloilo
Capiz
Aklan
Antique
Negros Occidental

Region VII:
Central Visayas
Bohol
Cebu
Negros Oriental
Siquijor

Region VIII:
Eastern Visayas
Leyte
Southern Leyte
Northern Samar
Western Samar
Eastern Samar

Region IX
Western Mindanao
Basilan
Sulu
Tawi – Tawi
Zamboanga del Norte
Zamboanga del Sur

Region X:
Central Mindanao
Agusan del Norte
Agusan del Sur
Bukidnon
Camiguin
Misamis Occidental
Misamis Oriental
Surigao del Norte

Region XI:
Southern Mindanao
Davao del Norte
Davao del Sur
Davao Oriental
South Cotabato
Surigao del Sur

Region XII:
Central Mindanao
Lanao del Norte
Lanao del Sur
Maguindanao
North Cotabato
Sultan Kudarat

Region XIII:
National Capital Region
(NCR)

Cordillera Autonomous
Region (CAR)
Abra
Ifugao
Kalinga
Apayao
Benguet
Mt. Province

The Philippine Regions, 2007

Region I: Ilocos
Ilocos Norte
Ilocos Sur
La Union
Pangasinan

Region II:
Cagayan Valley
Batanes
Cagayan
Isabela
Nueva Vizcaya
Quirino

Region III:
Central Luzon
Aurora
Bataan
Bulacan
Nueva Ecija
Pampanga
Tarlac
Zambales

Region IVa: Calabarzon
Cavite
Laguna
Batangas
Rizal
Quezon

Region IVb: Mimaropa
Mindoro Oriental
Mindoro Occidental
Marinduque
Romblon
Palawan

Region V: Bicol
Albay
Camarines Norte
Camarines Sur
Catanduanes
Masbate
Sorsogon

Region VI:
Western Visayas
Iloilo
Capiz
Aklan
Antique
Negros Occidental

Region VII:
Central Visayas
Bohol
Cebu
Negros Oriental
Siquijor

Region VIII:
Eastern Visayas
Leyte
Southern Leyte
Northern Samar
Western Samar
Eastern Samar

Region IX:
Western Mindanao
Zamboanga del Sur
Zamboanga del Norte
Zamboanga Sibugay

Region X:
Northern Mindanao
Bukidnon
Camiguin
Misamis Occidental
Misamis Oriental

Region XI:
Southern Mindanao
Davao del Norte
Davao del Sur
Davao Oriental
Compostela Valley

Region XII:
Central Mindanao
Lanao del Norte
North Cotabato
Sultan Kudarat
Sarangani
South Cotabato

National Capital Region
(NCR)

Cordillera Adm.
Region (CAR)
Abra
Apayao
Benguet
Ifugao
Kalinga
Mt. Province

Autonomous Region
of Muslim Mindanao
(ARMM)
Basilan
Sulu
Tawi – Tawi
Lanao del Sur
Maguindanao

Caraga
Agusan del Norte
Agusan del Sur
Surigao del Norte
Surigao del Sur

Sources: National Statistical Coordination Board (NSCB); Balisacan and Hill (2007)

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