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by

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The Economic Transition and Growth of Philippine Regions[1]

Dennis S. Mapa[2] and Monica Flerida B. Sandoval[3]

ABSTRACT

The paper applies the economic transition models and econometric convergence tests proposed by Phillips and Sul (2006) using data on per capita Gross RegionalDomestic Product (1988-2008) to determine if 14 Philippine regional economies converge to a steady state path over a period of time. The paper explores modeling and analyzing the economic transition behavior of the regions. Regional relative transition paths are investigated to generate a graphical overview of the behavior of the regional economies. The log t convergence test, which is constructed from a transition differential decay model, is used to establish if a region converges to a steady state path or diverges from a steady state path. The test basically provides the basis for a stepwise clustering algorithm in finding convergence clusters and analyzing transition behavior between clusters. The paper identifies convergence clubs and determines divergent regional economies using a recursive procedure that revolves around the log t convergence test.

Key Words: log t convergence test, convergence clubs

I. INTRODUCTION

This paperproposes to use the economic transition models and econometric convergence test designed by Phillips and Sul (2006) to sift through Philippine regional economic data and identify the regions that have exhibited sustained economic growth in the past decades. The works of the said authors are the main basesof the tests and results provided in this paper.The goalis to measure individual income growth of regionsand to map out similarities and differences in income over time.The determination of such patterns in income transition and evolution would aidour regionaleconomies in their decisions and policy-making. Our aim is for the initial results and conclusions obtained here to serve as bases for further research and studies thatwould lead towards the betterment and improvement of each of our regions and our nation as a whole.The paper seeks to determine if Philippine regional economies converge at a common steady state growth path in the long run. One of the objectives is to learn about the actual transitional behavior of regions by estimating individual patterns

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[1]Draft paper, comments are welcome. The views and opinions expressed in this paper are the authors' and do not necessarily reflect those of their respective institutions.

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of transition.Economic transition is modeled through the examination of the transition dynamics of log per capita Gross Regional Domestic Product (GRDP)[4]of regions. The relative transition parameter, as defined by Phillips and Sul (2006), served as a measure of economic transition. This relative transition parameter measures the transition of each individual region relative to the average per capita output of all regions. The parameter, thus, captures individual economic transitions. It also provides a measure of a region's relative departure from the common steady state growth path.

The paper also investigates the long term growth patterns across regions. The Log t Convergence Test of Phillips and Sul (2006) served as the core basis in establishing an empirical evidence for growth convergence across regions and in the determination of convergence clubs wherein regions within a club are assumed to possess similar convergence characteristics.The motivation is to test the hypothesis that all of the Philippine regional economies converge over time. In theory, there is a possibility that such will not occur and thus, the paper provides a test for convergence within subgroups of regions.The test will also show if the regions are divergent. Divergent behavior implies slow growth rate and economic performance relative to the average performance. This means significant incomeand output disparity between the divergent region and the rest of the regions with convergent behavior. This condition also implies that those divergent regions are really not better off than the rest and are in need of vital attention for economic improvement.

The classificationof convergent and divergentregions would aid us in detecting possible reasons and factors behind theseregions' respective behaviors. This would serve as the basis for identifying the sets of potential socio-economic characteristics of the regionsthat are inclinedto prosperity. The discovery of these socio-economic characteristics would then be extremely useful in the development of regional and national economic policies. The identification of key industries will prompt the diversion of regional resources into the endeavors and industries that would generate the most economic growth. The identification of integral institutions and programs will enable regionaleconomies to implement policies that would sustain economic growth. The identification of such indicators would allow the potential of each region to be realized.

The paper is organized as follows. Section 2 presents the data used and some descriptive summaries of the data. A general overview of the behavior of the per capita output of regionsis provided to establish evidence on convergence and growth of regions over the time period of the data. Formalization of economic transition and Log t Convergence test is presented in Section 3. The results of the test – the identified convergence clubs – are then provided in Section 4. Section 5 is allotted for the conclusions and some recommendations and motivation for further research and investigation.

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

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 2008.[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.

Table 1– Philippine Regions included in the study

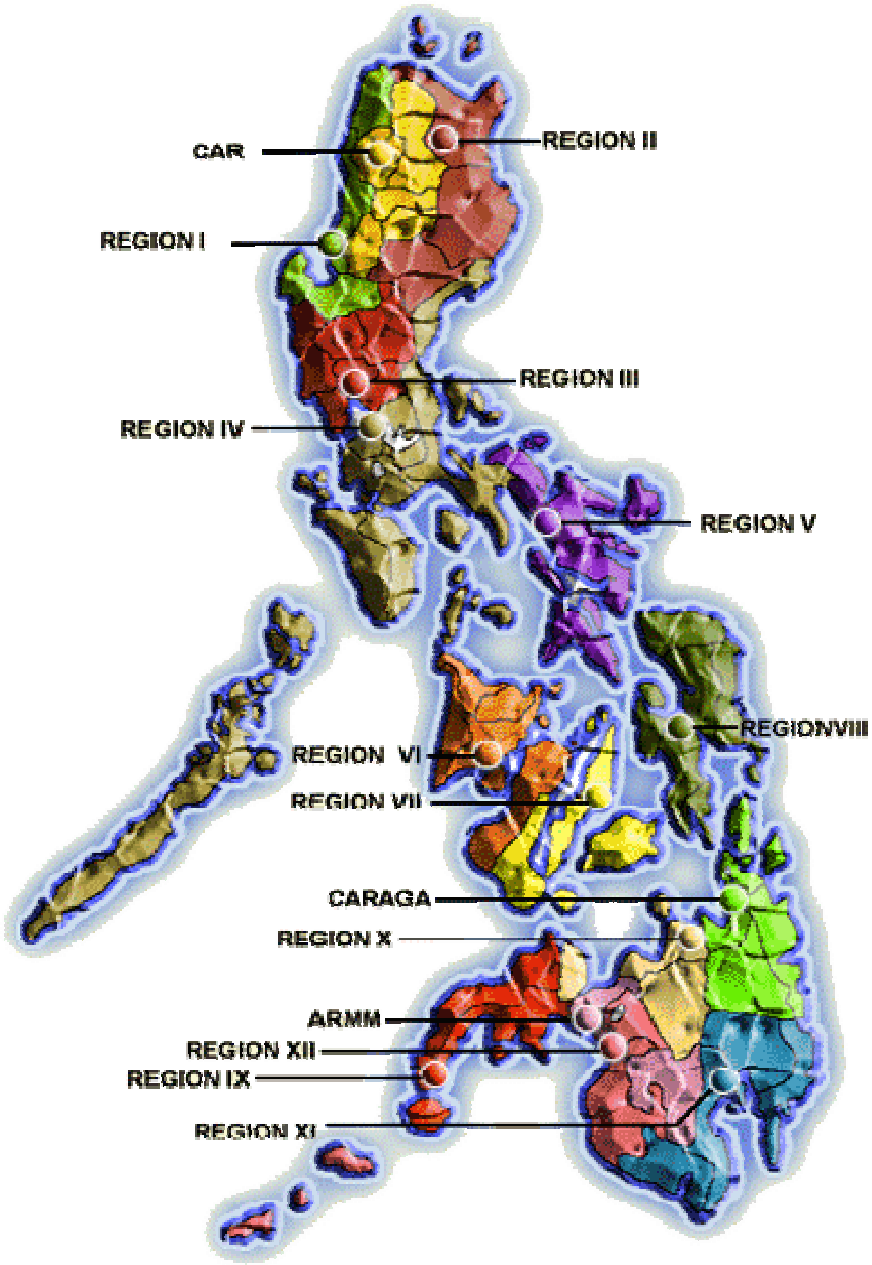
REGION	NAME	REGION	NAME
1	Ilocos Region	8	Eastern Visayas
2	Cagayan Valley	9	Western Mindanao
3	Central Luzon	10	Northern Mindanao
4	SouthernTagalog*	11	Southern Mindanao
5	Bicol Region	12	Central Mindanao **
6	Western Visayas	13	National Capital Region (NCR)
7	Central Visayas	14	Cordillera Administrative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

Since our objective is to estimate output growth of regions and determine differences in per capita output over time, we first took a look at the nature of the distribution of per capita GRDP of the 14 regions over 1988 to 2008. Figure 2 shows the plot of per capita GRDP of the regionsacross time. The plot clearly reveals the significant output gap persisting between the NCR and the rest of the regions since 1988, and that the said output differential continues to increase through time.It could be deduced that the average performance of NCR is considerably higher than the average performance of all regions. The remaining regions happen to cluster, descriptively, around the average national performance.

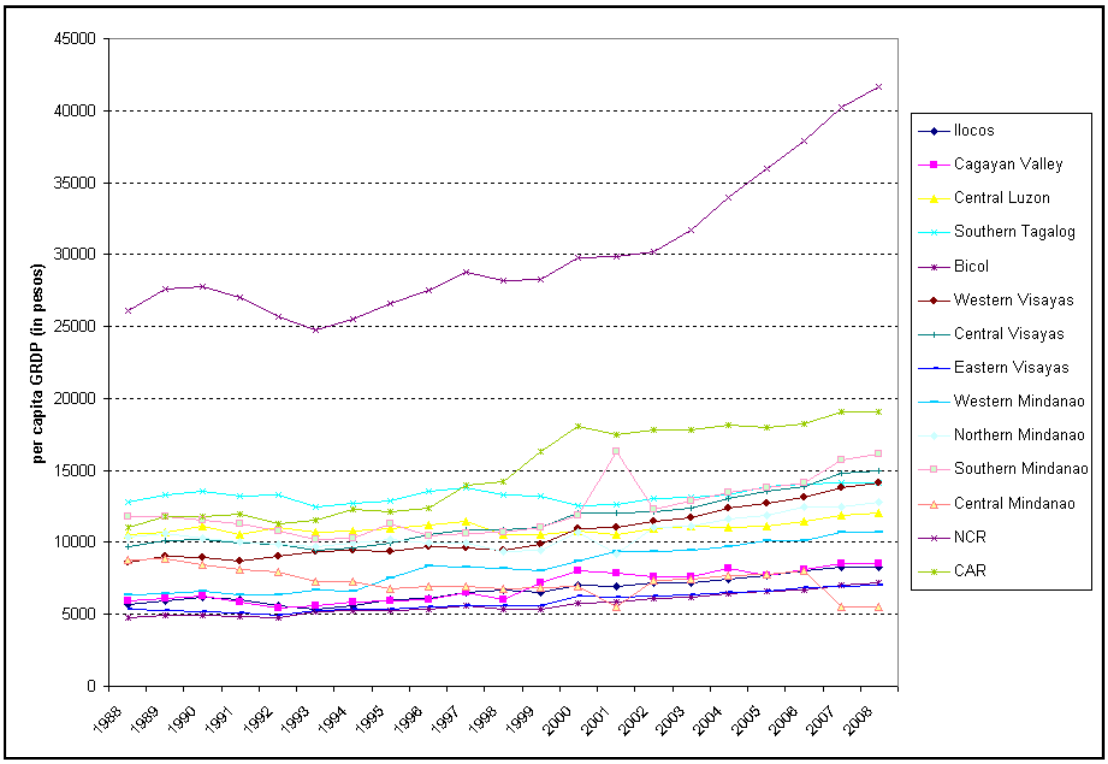
[5] The data set consists of 14 regions, instead of the current 17 regions, for data consistency.
[6] Figures are in 1985 prices. Adjustments were made to all Mindanao regions for the years 1994-2008 due to changes in regional classification
[7] Source of basic data: NSCB; 1988 to 2008

Figure 1 – Map of the Philippines[8]



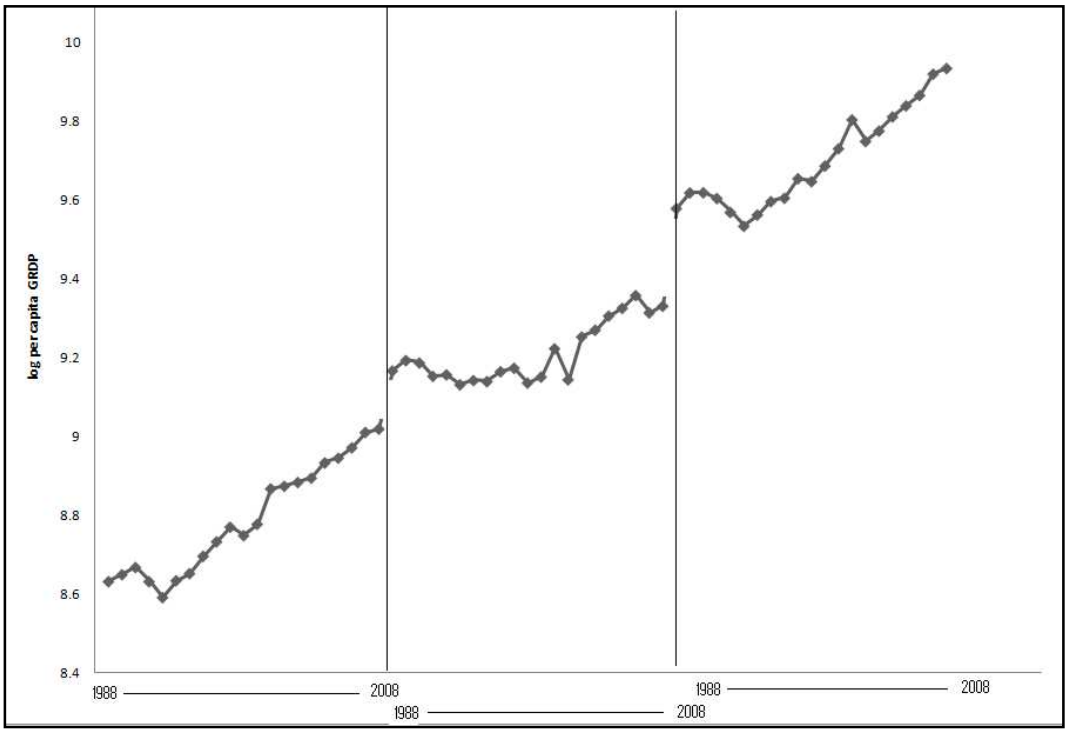
[8] Source: www.da.gov.ph

Figure 2 – Per capita GRDP of 14 regions: 1988 to 2008



The interest now lies on whether it is possible for the low-income regions to catch up with the high-income ones, chiefly NCR, and achieve sustained income growth in the long run – the possibility that income disparity between that of the majority of typical regions and that of the wealthiest regionsdeclines over time, and the odds that the poorest regionsprogress and catch up with the rest.We then investigate the growth transition of each region.To model economic transition, the transition dynamics of log per capita GRDP of the regions were examined over the time period of the data. In order to generate a graphical overview of the convergence behavior and transition growth of Philippine regional economies, we plot log per capita GRDP against time as shown in Figure 3.

Figure 3 – Philippine Regional Economic Growth: 1988-2008



Theregions are subdivided into three groups according to initial per capita GRDP (1988 data) where the first two subgroups consist of five regions while the third group, considered as the richest group, has four regions. The plot shows cross sectional averages of log per capitaGRDP of the 14 regions over 1988to 2008. It displays the three groupings and depicts the time path of subgroup averages for each group.Note that the arrangement of the panels produces an escalator effect from which we could classify the groups as poorest to richest. Though subdivided, the points from one group to another seem to be connected in form. The slopes of the paths suggest speed of growth of the regions within a group. The first group exhibits steeper slope, which indicatesfaster growth rate as the regions become richer.Also, notice how the shape becomes flatter as we go from the poorest to the richest group. This behavior suggests that as regions transition from a lower level to a higher level group, growth becomes slower on the average.If the lowest group continuesto grow faster and the highest group's growth declines or slows down at some point, then eventually the differences in per capita output across regions would narrow, which in turn might lead to convergence of the regions over time.The above results are just provided to establish the possibility of convergence and growth transitions among Philippine regions. We now provide quantitative evaluations of the transitionand convergence.

III. ECONOMIC TRANSITION AND CONVERGENCE

As provided in Phillips and Sul (2006), we measure economic growth of regions using log per capita GRDP. Denote per capita GRDP by y_{it}, i=1, 2… 14 and t=1, 2… 21. That is, per capita GRDP of region i at year t.We, therefore, measure the transition of $\log y_{it}$. But, it is not just a matter of tracing out the transition path of a particular region over time. The main interest lies on how a particular region evolves through time relative to the other regions in the panel. A better approach, therefore, is to map out the relative transition of a region. We employ a trending mechanism that models economic transition using the *relative transition coefficient*

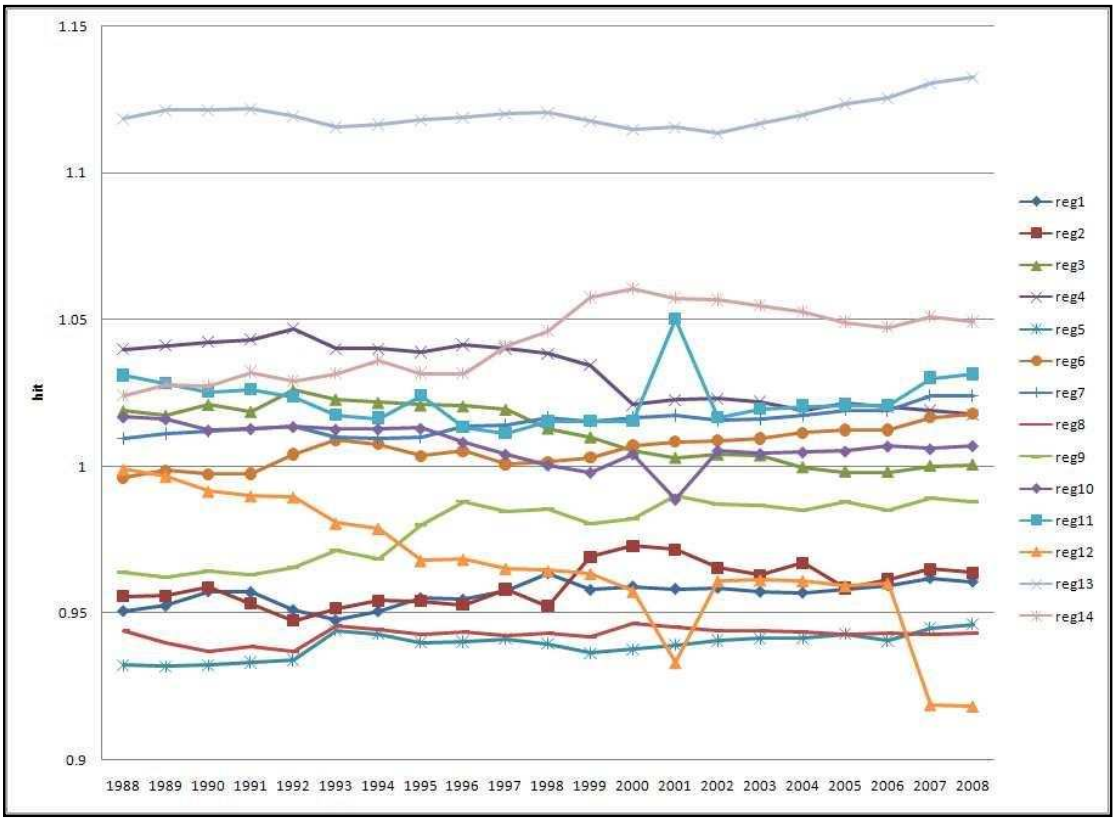
$$h_{it} = \frac{\log y_{it}}{N^{-1}\sum_{i=1}^{N} \log y_{it}} \quad (1)$$

as defined by Phillips and Sul (2006). The variable h_{it} measures the transition of region i relative to the panel average.It, in fact, traces out the 'transition curve' of region i. It also measures a region's relative departure from the common steady state growth path. Thus, convergence or divergence of a region can be reflected through the behavior of h_{it} .If ultimate growth convergence holds, then

$$h_{it} \to 1, \text{for all } i, \text{ as } t \to \infty \quad (2)$$

This implies that, under convergence, the cross sectional variance of h_{it} approaches zero as $t \to \infty$. That is, in the long run, the variation of the relative transitions decreases.So if we plot each individual relative transition paths and obtain the above limiting form of the relative transition coefficients, this might suggest potential convergence of provinces.Phillips and Sul (2007) argued that decreasing behavior of the cross sectional variance of h_{it} does not imply overall convergence. This may just be a result of either presence of convergence within subgroups of provinces or overall divergence.Figure 4 below provides the plot of the relative transition coefficients of the 14 regions.The transition path of NCR emphasizes the region's prosperityacross time relative to the average economic performance of the panel.

Figure 4 – RelativeTransition Paths for the 14 Philippine regions



The relative transition pathshows how a region'seconomic performance evolves through time relative to the average performance of all regions in the panel.Though the plot in Figure 4 does not support any evidence of convergence, i.e. the paths do not cluster around a common limit over time, it is not sufficient to base the conjecture of presence of convergence or divergence mainly from the plot. We therefore perform the formal test proposed by Phillips and Sul (2006) known as the Log t Convergence Test.

The main objective is to test the null hypothesis of full panel convergence – that is, overall convergence of the 14 regions. If the null hypothesis is rejected, we conclude that the regions are divergent but this does not imply that there is already lack of convergence. There may be presence of local convergence within subgroups of regions – those regions with similar convergence characteristics. We therefore explore the possibility of forming convergence clubs wherein the most affluent of the regions should belong to the first club, the next richest to the second club, and so on. The poorest should therefore be classified in latter clubs. It is also possible that the poorest among the regions are divergent and do not belong in any of the clubs. This condition is an indication that such regions possess no characteristics that appear to be similar than the rest, on the average, and that they may be lagging behind in terms of income growth.

The test on the null hypothesis of convergence does not rely on any assumptions concerning stationarity or nonstationarity of the process involved.[9]Thelog t test is a simple one-sided t-test. It is based on a time series linear regression of the cross sectional variance ratio, H_1 / H_t on $\log t$ where

$$H_t = \frac{1}{N}\sum_{i=1}^{N}(h_{it}-1)^2, \qquad h_{it} = \frac{\log y_{it}}{N^{-1}\sum_{i=1}^{N}\log y_{it}} \quad (3)$$

After the cross section variance ratio given in (3) are computed, we run the following regression

$$\log\left(\frac{H_1}{H_t}\right) - 2\log(\log(t)) = \beta_o + \beta_1 \log t + \varepsilon_t \text{ for } t = [rT],[rT]+1,...,T \quad (4)$$

where $[rT]$ is the integer part of rT and r = 0.3, as recommended by Phillips and Sul (2006). We will be testing the null hypothesis

$$H_o : \beta_1 \geq 0 \quad (5)$$

This basically requires that the estimated coefficient, $\hat{\beta}_1$ in (4) be positive for the hypothesis in (5) to hold. Otherwise, it should be rejected in favor of the alternative hypothesis of divergence,

$$H_A : \beta_1 < 0$$

Since the test is just based on a one-sided t-test, then at the 5% level, we reject the null hypothesis of convergence in (5) if $t_{\hat{\beta}1} < -1.65$ .Rejection of the null hypothesis, however, simply means that there is no evidence for full panel convergence. But, this may imply support for local convergence and so we continue examining if theregions could be subdivided into a number of potential convergence clubs. This is done through a recursive application of the log t regression testand using the clustering and algorithmic procedures proposed by Phillips and Sul (2006).The basic assumption is that there is a known "core subgroup" G_K, containing at least K members that possess convergence behavior. Provided below is a brief summary on how to determine the core primary group and the potential regions that might converge with the core over time, which will result to forming the convergence clubs.

Step 1: Sort the 14 regions in decreasing order of final period per capita GRDP – 2008per capita output.

Phillips and Sul (2007) noted that evidence of multiple club-convergences in the long run is usually most apparent in the final time series observations.

[9]Refer to Phillips and Sul (2007) for technical aspects of the Log t test

Step 2: Form a core primary group of k^* regions.

We choose the region with the highest final per capita GRDP, based on the ordering in Step 1, as the base region. We then recursively run the equation in (4) for $2 \le k < N$ regions included. Calculate the convergence test statistic t_k for each subgroup. The addition of regions is terminated once $t_k < -1.65$, which signifies that the last addedregionhas divergent behavior relative to previously addedregions.We then choose the subgroup with maximum t_k for all k subject to the condition that we are only considering subgroups for which $t_k > -1.65$. This is to ensure that the null hypothesis of convergence is supported for all k. The chosen subgroup is then considered as the core primary group of size k^*.

Step 3: Sieve data for new club members.

Once the core group is determined, we may now examine the behavior of other regions relative to the core primary group. We may investigate if it's possible for other regions to converge with the core in the long run. We add one region at a time to the core group with k^* members; run the log t test in each inclusion of a region; and, compute the test statistic t_{k^*+1}. We include a region to the core if t_{k^*+1} for the region is positive. This implies that $\hat{\beta}_1 > 0$ in the fitted regression. If there is no regression for which the test statistic is positive, then there is no region satisfying convergence with the core and hence, the core itself will serve as the convergence club.

Step 4: Recursion and stopping rule.

Once a convergence club is set, we continue with investigating whether the remaining regions can still be further subdivided into other clubs.First, test if these remaining regions satisfy null hypothesis of convergence or not. If the hypothesis is not rejected then the remaining regions form a convergence club. And so, we have two convergence clubs. Otherwise, we repeat Steps 1 to 3. If, however, in Step 2, there is no k for which $t_k > -1.65$, we conclude that the extra regions are already divergent, i.e., for k = 2, $t_k < -1.65$ we consider the remaining regions as having divergent behavior.

The test does not stop, however, on merely formulating and determining convergence clusters. The formed clubs simply suggest potential regionsthat tend to have similar or steady-state characteristics over the sample period. A further examination on the transitioning between groups is pursued. Following the works of Phillips and Sul (2006), the paper investigates the possibility of sequential club convergence wherein part of one club moves towards another club, i.e. convergence between neighboring regions of different club clusters. Possible interpretations for this kind of transition behavior are offered by Phillips and Sul (2006). One is the possibility that certain clubs may be slowly converging towards one another. Another is the tendency of some regions within a certain club to exhibit transitioning towards a higher or lower club through time, leading to chances of joining a new club in the future. The log t regression is also utilized in this aspect.We follow the steps provided by Phillips and Sul (2006). Working from the identified convergence clubs, we test the possibility that a fraction of two consecutive clubs converge. The clubs under consideration are then both divided into two parts. The members in the lower half (based on final per capita GRDP) of the upper club are combined with the members in the upper half (based on final per

capita GRDP) of the lower club. The log t test is then performed using the pooled regions. If the null hypothesis of convergence is supported then we could say that the fraction of regions in the lower club has a tendency to converge with that in the upper club or vice versa. This might be anindicationthat low income regions are catching up with high income ones resulting to narrowing per capita output differences among neighboring (in terms of final per capita GRDP) regions.

The next section presents the results of the Log t Convergence Test, based on per capita GRDP,for the 14 Philippine regions.

IV. RESULTS

The basic idea is to test the null hypothesis of full panel convergence of the 14 regions. The estimated equation of the log t regression for all of the regions is,

$$\log\left(\frac{H_1}{H_t}\right) - 2\log(\log(t)) = 0.567 \; - \; 0.948\log t$$

(5.14) (-22.03)

The numbers in parentheses are the t-statistics of the estimated coefficients. The result clearly rejects the null hypothesis of convergence at the 5% level.The next step is to investigate the possibility of club convergence. The complete results of the recursive runs of the test are omitted here to save space, but can be requested from the authors.We only discuss here how the clustering works for the initial determination of a core group and for the first convergence club.

From the steps provided in the previous section, we organizethe regions according to 2008 per capita GRDP, the region with the highest per capita output being the first in the list. We then assign the region with the highest final per capita GRDPas the base region. It is NCR in this case. We then add the second region, CAR, to NCR and run log t regression for k = 2 regions. The t-statistic for this is -2.56, which signifies that NCR and CAR are relatively divergent with respect to per capita output. NCR is thus considered, not just being the base region in this initial process, but also as the core region and also the only region forming the first convergence club! This result simply implies that NCR's relative income performance isfar way abovethat of the other regions'; with the second region in the list, CAR, not being able to converge with NCR in terms of per capita output.

Following is a summary of the classification of regions into convergence clubs.

Summary of Convergence Clubs of Philippine regions over 1988 to 2008

CLUB 1
NATIONAL CAPITAL REGION
ADMINISTRATIVE

CLUB 2
CORDILLERA

CLUB 3
SOUTHERN MINDANAO
CENTRAL VISAYAS
WESTERN VISAYAS

SOUTHERN TAGALOG

CLUB 4
NORTHERN MINDANAO
CENTRAL LUZON
WESTERN MINDANAO

CAGAYAN VALLEY
ILOCOS REGION

CLUB 5
BICOL REGION
EASTERN VISAYAS
CENTRAL MINDANAO

Figures 5 to 8 present the relative transition curves of the regions per club, wherein Figure 8 shows the relative transition paths of NCR and CAR vis-à-vis the other three convergence clusters.

Figure 5 – Relative Transition Paths of Regions in Club 3

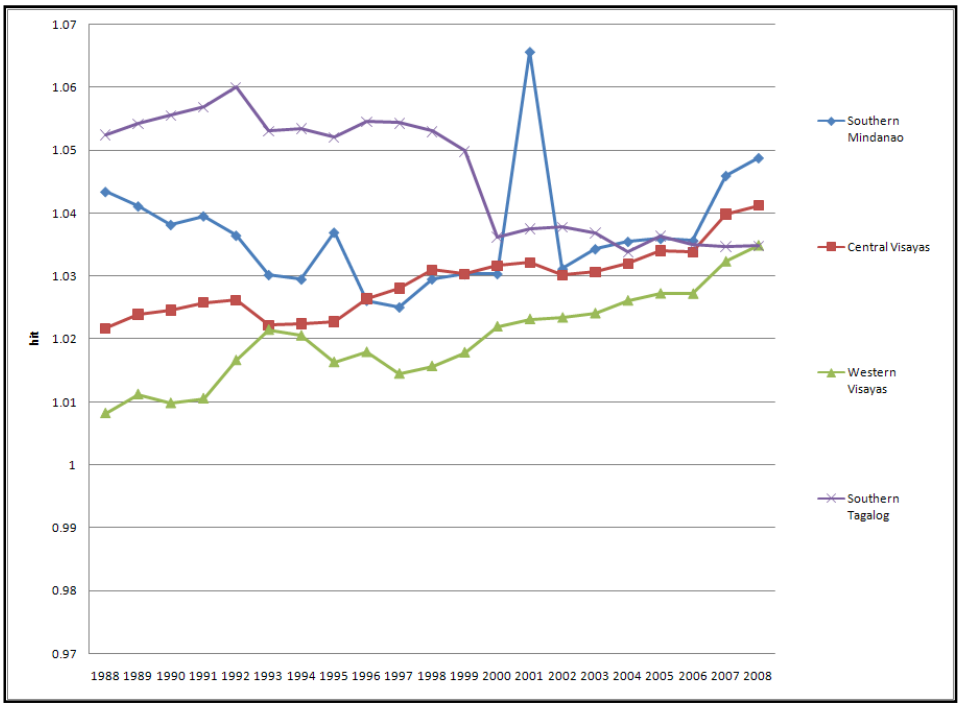


Figure 6 – Relative Transition Paths of Regions in Club 4

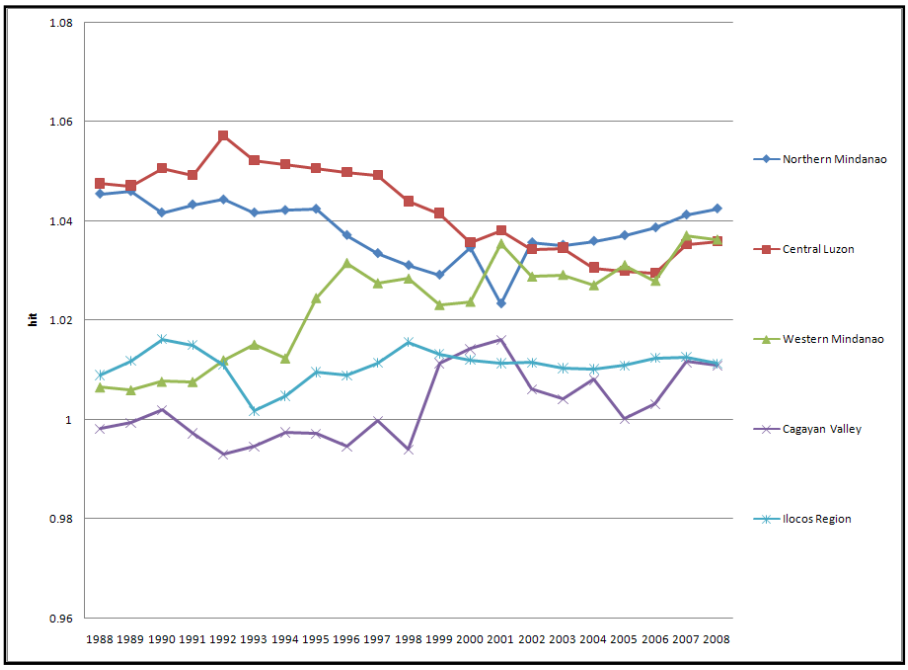


Figure 7 – Relative Transition Paths of Regions in Club 5

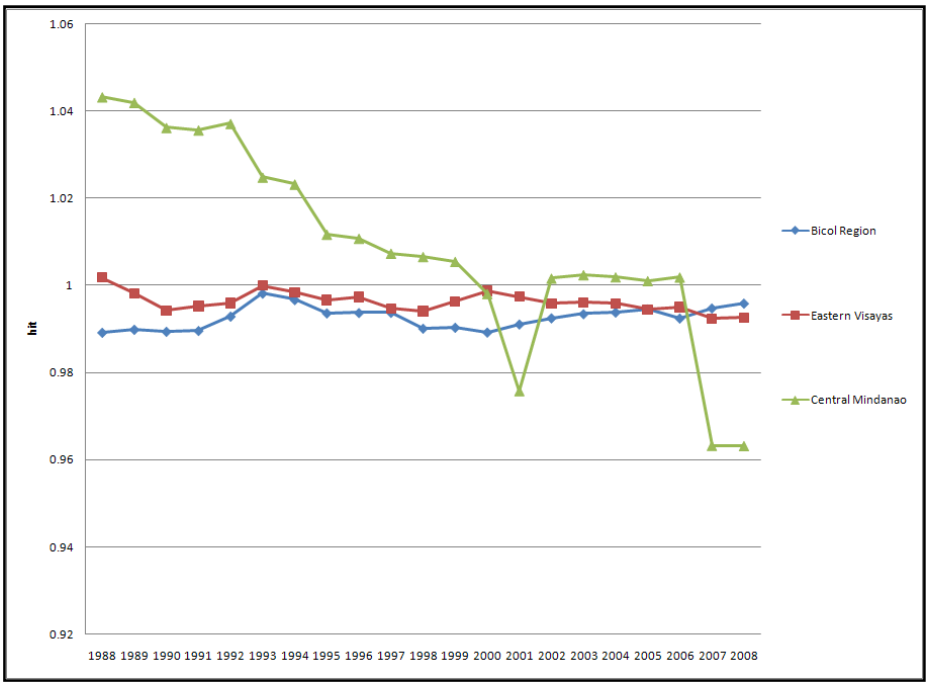
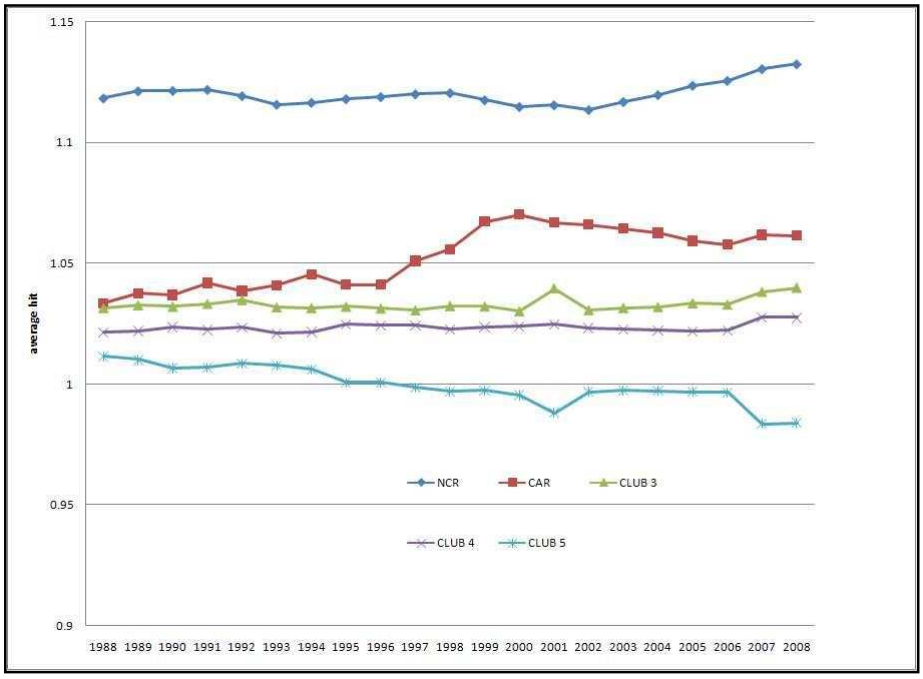


Figure 8 – Relative Transition Paths of the 5 Clubs



From Figure 8, it is clear that the clubs have no tendency of achieving ultimate convergence as the paths do not approach a common limit over time.But, we can test if it is possible for regional transitioning over time between certain clubs.

The summary of the log t test for the determination of convergence clubs and convergence between clubs is provided in Table 2.

Table 2 – Convergence Clubs and Convergence between Clubs: 1988 to 2008

	t-stat		**t-stat**
Club 1 (1)*	base/core	Club 1+2 (1+1)	-2.5605
Club 2 (1)	base/core	Club 2+3 (1+2)	-3.8805
Club 3 (4)	3.0424	Club 3+4 (2+3)	4.1252**
Club 4 (5)	0.8073	Club 4+5 (3+2)	-7.4436
Club 5 (3)	0.1696		

*Numbers in parentheses are the number of regions in the club

**Null hypothesis of convergence not rejected

In investigating transitioning and convergence between clubs, we only consider two consecutive clubs at a time. The t values for each possible group are provided in the rightmost part of Table 2.The null hypothesis of convergence is not rejected for between Clubs 3 and 4. This formally indicates that regions from Club 4(lower club)may have a tendency to transition to Club 3(higher club) in the future. This result possibly suggests that the relative performance of those low-income regionsin terms of per capita output might achieve a “better” position over time provided, of course, that certain factors and inputs are introduced to attain that performance.

V. CONCLUSION AND RECOMMENDATION

The paper looks at the economic performance of the regions in the Philippines and estimates how this economic performance, using per capita GRDP, relates to the average performance of all regions. The paper utilized per capita output growth relative to the average per capita output of the panel. The use of the relative transition parameters and the mapping out of the relative transition paths give better quantifications of aregion’sgrowth and evolution through time. Since the relative transition parameter measures per capita output growth of a region relative to the average per capita output, it provides an empirical support for economic transitioning and convergence.The paper looks into the possibility that the poorest regionsprogress over time and could catch up with those experiencing sustained economic growth,thereby leading to narrowing per capita output differences and, in turn, sustained income growth for all regions.The core results of the study lie in the formulation and determination of convergence clusters. The idea is to classify regions with more or less similar characteristics into a single subgroup. The identification of subgroups would then be of great benefit for the development of possible economic policies that would boost the growth of each individual region.

The paper identified, via thelog t test, five convergence clubs, with only NCR as core member of the first club and CAR as core member of the second club.These results clearly suggest significant discrepancies in relative output performances of Philippine regions.

Aside from the determination of convergence clusters, the log t regression test provided strong empirical support for economic transitioning and convergence between identified clubs. Convergence between clubs indicates that lower income regions tend to transition towards higher income regions,thus signifying the possibility of decreasing income differentials across regions in the future. The support for economic transitioning observed between clubs 3 and 4 signifies decreasing long run income differentials across regions in the said clubs. This, in a way, calls for the formulationof more effective economic policies to boost each region's growthto come up with solid and better outcome.

The results presented here are basically initial results that we propose be employed as groundwork for further investigation and research. Econometric formulation and identification of factors affecting per capita output growth are not yet dealt with in this paper. The identification of relevant factors influencing transition and growth, such as human capital, education, and IT-related industries could be identified and established empirically by extending the log t regression test to incorporate such factors. The extensions and methodologies for these are also provided in the paper of Phillips and Sul (2006). This would be a fundamental motivation for advance research and studies.

3 Subgroups in Figure 3 (Initial per capita GRDP Ordering)

The regions are ordered based on 1988 per capita GRDP. Bicol Region was the poorest and NCR was the richest in 1988.

Subgroup 1: Bicol, Eastern Visayas, Ilocos Region, Cagayan Valley, Western Mindanao

Subgroup 2: Western Visayas, Central Mindanao, Central Visayas, Northern Mindanao, Central Luzon

Subgroup 3: Cordillera Administrative, Southern Mindanao, Southern Tagalog, National Capital Region

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