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by

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Abstract

A stochastic frontier model is fitted for growth of the gross values added of the aggregate and the regional economies in the Philippines. The contributions of the different sectors to the aggregate all the sectors are also assessed. The estimated technical efficiency for the aggregate economy averages 82% and exhibits severe fluctuations within the period 1976-2007. The cycles of the technical efficiencies also coincide with the different political events within the period. The manufacturing sector and the National Capital Region are the most important drivers of the aggregate growth. It is necessary to intervene in the agriculture, fishery and forestry sector to push production towards frontier level. This will provide the foundations necessary to launch the industrialization that will accelerate growth in the Philippine economy.

Keywords: regional growth, technical efficiency, stochastic frontier model

JEL Classifications: C21, O40, O47

1. Introduction

Growth and efficiency has been and continuous to be an interesting theme in economic studies. Varying growth theories were developed trying to explain patterns of growth that different countries, regions or even countries within a region manifested. (Lucas, 2000) highlighted the diversity in growth patterns and speed among the countries and argued that disparity between the poor and rich countries can be explained by the slow process of industrialization among the poor countries (much faster among the rich countries). Modeling the structural transformation among different countries, (Gollin, et al, 2002) explained why industrialization happened at different dates and at different speed among the countries. They emphasized the necessity of growth in agricultural productivity as a central element for development. Technological innovations propel increase in agricultural productivity. As agriculture sector becomes more efficient, labor migration towards other sectors can contribute in efficiency and productivity increases in those sectors. This will subsequently drive growth in the aggregate economy.

Growth patterns among the different sectors and regions in the Philippines are highly diverse and exhibits so much fluctuations. Table 1 summarizes the growth in gross value added (GVA) among the different sectors for the period 1976-2007. Even with various agriculture programs in the period (e.g., Masagana 99, Green Revolution, passage of the Agriculture and Fisheries Modernization Act (AFMA)), agriculture is among the slowest-growing sector. The sectors growing fast are not necessarily the sectors pointed out in the literature to stimulate the

most optimal growth in the aggregate economy. The table also illustrates the vulnerability of various sectors to various shocks. All sectors cannot sustain growth within period. While mining and quarrying exhibited higher growth average, it also exhibits so much volatility within the period. Construction has always been in a boom-and-bust cycle and on the average, yield very low growth average.

Table 1: Growth in Sectoral GVA in the Philippines (1976-2007)

Sector	Average	Standard Deviation	Minimum	Maximum
Agriculture, Fishery, and Forestry	2.57	2.93	-6.38	10.02
Mining and Quarrying	5.17	12.84	-8.78	50.96
Manufacturing	2.94	4.05	-10.11	9.52
Construction	2.46	14.91	-48.17	33.27
Electricity, Gas, and Water	5.50	6.91	-11.42	22.26
Transportation	5.57	3.30	-1.72	11.37
Trade	4.56	3.11	-6.80	8.59
Finance	5.75	8.60	-19.42	15.92
Other Dwellings and Real Estate	2.46	2.88	-6.08	7.20
Private Services	5.20	3.92	-6.58	14.55
Government Services	3.12	2.52	-1.23	8.81
Philippines	3.51	3.54	-7.32	8.81

Source of Data: Regional Accounts, National Statistical Coordination Board (NSCB)

Growth across the regions is not as volatile as the growth among the different sectors. In Table 2, growth among the different regions is very close to the aggregate growth but fluctuations are much higher. Certain regions can possibly hit higher growths but there is also a danger for them to incur large economic contractions. Lower average growth is aggravated with high fluctuation. On the other hand, higher growth is complemented with lower fluctuation among certain regions.

Table 2: Growth in Regional GVA in the Philippines (1975-2007)

Region	Average	Standard Deviation	Minimum	Maximum
NCR	3.99	4.58	-10.31	9.22
CAR	4.60	4.30	-3.21	15.34
Region 1	2.90	7.38	-32.11	11.57
Region 2	2.47	7.70	-16.47	2.88
Region 3	3.23	4.02	-6.78	11.48
Region 4	3.56	3.67	-8.16	8.08
Region 5	3.16	3.76	-5.51	14.26
Region 6	3.29	3.89	-9.12	7.76
Region 7	3.90	3.88	-10.25	8.72
Region 8	2.86	2.97	-7.58	7.31
Region 9	2.88	3.94	-7.05	13.24
Region 10	2.40	5.49	-16.42	11.44

Region 11	2.48	3.68	-4.86	11.62
Region 12	2.21	4.66	-14.94	8.29
Philippines	3.51	3.54	-7.32	8.81

Source of Data: Regional Accounts, NSCB

Although the volatile behavior of growth among the different sectors and across the different regions illustrates the vulnerability and unsustainable directions of the economic programs implemented, it can be viewed to provide windows of opportunities for growth of the aggregate economy. It is possible that growth peaks at some point and hit the bottom on the other, because of the efficiency/inefficiency of utilization of various factors of production in the sectors and across the regions. There is an opportunity for the aggregate economy to grow provided that resources are efficiently utilized into production.

This paper seeks to assess and evaluate the dynamics leading to the fluctuations in growth among the sectors and across the different regions in the Philippines. We would like to measure technical efficiencies of the regions and sectors and characterize them over time and space. We propose that inefficiencies among the sectors and the regions can be tapped to help drive aggregate growth of the economy. Such information can be used in prioritizing resources to sectors/regions whose efficiency needs further intervention for optimal regional growth and subsequent convergence. This may also be used as alternative basis for prioritizing resources. With Internal Revenue Allotment (IRA) as a proximate measure of resource allocation in Table 3, we cannot observe the link between resources and economic growth. CAR and Region 2 have higher per capita IRA and good enough it also yield high growth in similar period. This is also true for Regions 3 and 5 with low IRA and low growth. In NCR and Region 7 however, very low IRA can be observed, yet it exhibits high growth. In Regions 9 and 10, higher IRA results to lower growth. There is an important link between allocation of resources and growth but only when resources are efficiently utilized as production inputs.

Table 3. Per Capita Internal Revenue Allotment By Regions

	Average Growth(%) (1997-2001)	**Per Capita IRA (In Pesos)**			**Growth Rate of Per Capita IRA (%)**	
Regions		**1997**	**1998**	**1999**	**1997-98**	**1998-99**
NCR	3.52	506.9	507.6	542.9	0.14	6.95
CAR	5.55	1466.4	1531.4	1557.4	4.43	1.70
Region 1	3.96	862.2	1092.8	891.2	26.75	-18.45
2	5.75	1105.7	1114.6	1240.6	0.80	11.30
3	1.32	661.1	660.9	742.8	-0.03	12.39
5	1.61	786.6	783.6	850.5	-0.38	8.54
6	2.32	836.3	866.8	984.6	3.65	13.59
7	3.30	809.3	808.6	871.2	-0.09	7.74
8	2.79	1026.9	1027.5	1098.2	0.06	6.88
9	1.96	1006.7	1002.5	1074.7	-0.42	7.20
10	1.55	1017.2	1014.1	1189.4	-0.30	17.29
11	3.42	911.6	899.4	947.4	-1.34	5.34

12	1.92	620.8	593.4	1166.7	-4.41	96.61
Philippines	2.75	242.2	240.2	912.1	-0.83	279.73

Sources of Data: Annual IRA Allocation, Department of Budget and Management (DBM)

The study ignores the dynamic realignment of provinces and municipalities across the regions in the period 1975-2007. Since MIMAROPA, CALABARZON, ARMM and CARAGA had been created much later, they were excluded from the analysis. Furthermore, CAR was created only in 1988, hence, fewer data points were used in the analysis.

2. Growth Theory

There are proposals on how to explain growth patterns exhibited by the different countries. Some explains it in terms of geographical endowments of the countries, some in terms of accumulation of wealth, technological innovations, international aid, etc. Neither a single theme nor a single framework can unify all these theories since there are always peculiar factors leading to the dynamics in which these countries grow.

Among the recent work on growth theory, (Lucas, 1998) considered three models for economic growth: emphasizing physical capital accumulation and technological change; human capital accumulation through schooling; and human capital accumulation through learning-by-doing. The growth miracles of Korea, Taiwan, Hongkong, Singapore and Japan fits well to the model where human capital accumulation is generated through learning-by-doing since growth here is associated with increases in export of goods not formerly produced in these countries. (Shirazi and Abdul Manap, 2005) further worked on export-led growth hypothesis and verified this among South Asian countries where long-run relationship among exports, imports, and real output were noted.

Using an endogenous growth model, (Aghion and Howitt, 1992) noted that vertical innovations generated by a competitive research sector providing an important source of growth. Growth is modeled as a production function with size of innovations and size of the skilled labor force as the inputs. Both the level and variance of growth are direct functions of the two main factors of production. The endogenous growth model was also used by (Barro and Sala-i-Martin, 1992) but they introduced public finance into the model.

Using the Solow-Swan growth model, (Farmer and Lahiri, 2006) identified two important growth dynamics. Growth is uncorrelated with ratio of national investment to GDP. This gives hope among the developing countries whose national output has to be prioritized to welfare services, foreign debt servicing and other expenses and least on investments for economic activities and infrastructure. They also observed the instantaneous convergence of GDP per capita across countries, more specifically, conditional convergence was noted where the presence of capital market imperfections can lead towards slow convergence.

There are many contributions as to the sector most important in driving growth. (Matsuyama, 1999) focused on factor accumulation and innovation and argues that both views may capture different phases of a single growth experience. The cyclical pattern of growth is necessary for sustainability. It was noted that it is empirically plausible for the economy to

perpetually move back and forth between two phases. Higher output growth, higher investment, no innovation, and a competitive market structure then followed by lower output growth, lower investment, high innovation, and a more monopolistic market structure. The economy is projected to grow faster in cycles than in the balanced growth path that can also be unstable.

(Bernard and Jones, 1996) studied convergence among 14 OECD countries from 1970-1987 using aggregate productivity. With the exception of the manufacturing sector, convergence was observed specially for services. They also found empirical evidence that the service sector is responsible for the bulk of cross-country convergence to the United States.

The importance of growth in agriculture sector as growth engine of the aggregate economy is reported in many work, e.g., (Gollin, et al, 2002) highlighted that agricultural growth is central to aggregate economic growth, (Ball, et al, 1997) pointed out that productivity growth is the path towards growth in agriculture. (Foster and Rosenzweig, 2002) used panel data to examine the consequences of economic growth propelled by agricultural technical change on economic mobility. They noted that the changing household composition causes income mobility and the evolution of income distribution over time. The process on how household dynamics can facilitate the impact of technical change on inequality and rural economic growth was identified.

With province-level panel data in China, (Lin, 1992) examined the effect of various factors on agricultural growth. The move away from collective management of farms was attributed as the source of about half of the output growth during the 1978-1984 period. (Lin, 1992) also explained that the slowdown in agricultural growth after 1984 is commenced after the end of the household farming reform, the rapid exodus of the labor force from the cropping sector, and the sharp decline in the growth rate of fertilizer usage. The higher-level factor of the decline was also attributed to the sharp reduction in state procurement prices that possibly lead to the factors identified.

3. Technical Efficiency

Following the theory on growth fuelled by technological innovations, technical efficiency should be examined. As technology is introduced, it is expected to facilitate efficiency in the production of goods and services in various sectors. This will in turn increase productivity, consequently leading towards growth of the sector and hence, of the aggregate economy.

There is a considerable gap between technological progress and economic growth. As (Laitner and Stolyarov, 2003) noted, inventions are exogenously determined and is a rare event, this consequently results to fluctuations in the rate of influence over time. Inventions would necessarily change the production function, but will also change the input requirements for labor skills and physical capital. Actual gains from innovation including production efficiency, can be realized once the applied knowledge is translated into investment (capital stock) along with the changing landscape of the production sector.

The mechanics and extent of technical efficiency oscillates over time and varies across sectors. Accounting for the lag time between the introduction of technology and growth, during the adjustment period, efficiency can be low and will peak only once the applied knowledge is clearly and correctly used. Efficiency will taper later once the resources are exhausted until such a time that a new technology is introduced again. Referring to the technical efficiency of the Japanese agriculture sector, (Grabowski and Pasurka, 1988), found four different subperiods. As new technology is disseminated to the sector, technical efficiency increases. There is however an adjustment period of farmers to new technology before efficiency enhancement is achieved. Later on, Japan was forced to import large amounts of food leading the fall of domestic production and since there are few alternative employment opportunities, inefficiency rise again.

Technical efficiency has been linked to various factors. Using farm level data in the Philippines, (Villano and Fleming, 2006) linked technical inefficiency and production risks and measured average technical efficiency at 79%. The high degree of variability is attributed to the instability of farming conditions in the rainfed lowland environment. (Mastromarco and Woitek, 2006) noted that public infrastructure leads efficiency resulting to increased productivity and finally growth. This argument is used in explaining the persistent differences in growth rate of North and South Italy. (Shiraishi and Yano, 2004) examined productivity of collective-owned enterprises in China and observed that efficiency is explained primarily by capital. Declining capital resulting from de-collectivization leads towards increased inefficiency triggering lower productivity. Ownership of German banks was used by (Altunbas, et al, 2001) to explain efficiency, reported that there is little evidence that privately-owned banks are more efficient that their mutual and public-sector counterparts.

4. Stochastic Frontier Models

The extensive literature on stochastic frontier analysis has been summarized comprehensively by (Kumbhakar and Lovell, 2000). A cross-sectional production frontier model is given by:

$$y_i = f(x_i;\beta)\exp(v_i)TE_i \text{ or } TE_i = \frac{y_i}{f(x_i;\beta)\exp(v_i)} \quad (1)$$

where y_i is the single output of producer i, x_i is the vector of inputs used in producing y_i, f is a parametric function, TE_i is the output-oriented technical efficiency of producer i, and v_i is a random error. There is perfect efficiency when TE=1, while inefficiency when TE<1. The shortfall in production environment characterized by $\exp(v_i)$ varies across

producers. Let $TE_i = \exp(-u_i)$, then the production stochastic frontier model becomes $y_i = f(x_i;\beta)\exp(v_i)\exp(-u_i)$, the last two factors are corresponding error components.

The model is estimated usually via the maximum likelihood (MLE) or its variants. The quantities v_i, u_i, and x_i, are assumed to be independent and v_i is usually assumed to be normally distributed while u_i is the positive half normal distribution to ensure that technical efficiency estimates are between zero and one. Other combination of the distribution of v and u include normal-exponential, normal-truncated normal, and normal-gamma. The nature and relationship between v and u can be enhanced further using mixed model specifications. (Green, 1990) however, observed that estimates of efficiency vary depending on the distributional assumption on v and u. A model specification that best characterize reality can help improve the robustness property of the estimates.

Since the model is postulated in such a way so that efficiency is an upper bound of productive capacity of producers, efficiency estimates are restricted to be biased downwards (inefficient than they really are). The bias is analyzed by (Gijbels et.al., 1999) in the data envelopment analysis (DEA) estimator which is the set under "lowest" concave monotone function covering all the sample points, for a single input and single output case.

The choice of the best way to analyze the effect of exogenous factors depends on adequacy of the underlying assumption associated with the model. Even a nonlinear regression was used in estimation. The resulting estimates of production efficiencies however, are expected to vary according to the postulated model.

5. Methodology

Principal components analysis is used to unveil latent factors that group together regions and sectors that exhibit similar growth patterns. The method is used as an alternative way to cluster regions and sectors over time.

A stochastic frontier model is postulated with aggregate regional or sector growth as the output, and the components as the factors of the exponential production function given as follows:

$$\ln(y_t + k) = \beta_0 + \sum \beta_i x_{it} + v_i - u_i \qquad (2)$$

The constant k is added to the aggregate growth y_t to address the negative growth for some regions and sectors. x_{it} is the i^{th} component of the aggregate to the left-hand side of the equation. u_i is the random error contributing towards efficiency/inefficiency assumed to come from the truncated part of the Normal distribution (positive part), $N_+(0, \sigma_u^2)$. v_i is the pure random error component distributed as $N(0, \sigma_v^2)$.

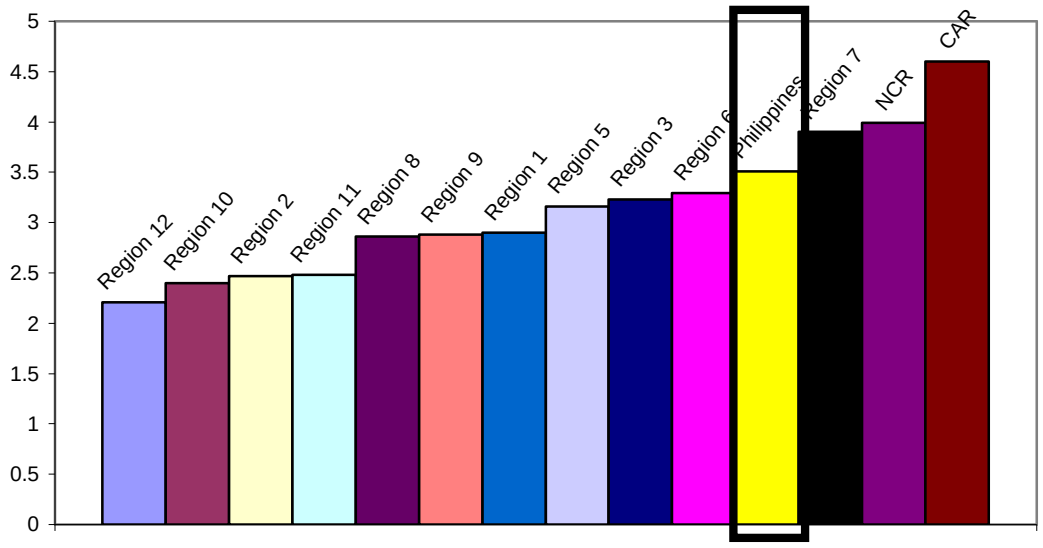
6. Results and Discussion

The analysis is done in two approaches: by region with regional growth as the output and the different sector's growth as the inputs; by sector with the national-level growth of the sector as the output and the regional growth of the sector as the inputs.

There is a highly diverse fluctuation in growth among the regions and across the sectors. To address the problems caused by negative growth in the estimation of the exponential model, varying constants were used. Among the sectors, the coefficient is at least 2% for the transportation and government services sectors to as high as 49% for the construction sector that posted the largest negative growth of over 48% within the 1976-2007 period. For the regions, the lowest factor was used for CAR (4%) and the largest for Region 1 (33%).

Figure 1 exhibits inequality among the regional economies in the Philippines. Of the 13 regions analyzed, only three regions yield an average growth that is higher than the aggregate growth for the Philippines, all the rest have much lower average growth. CAR is the newest region having been created only in 1987, reflected much higher growth than the two most urban regions, NCR and Region 7. Region 12 posted the lowest average growth rate but note that there are also many instances of provincial reassignment (taking out/inclusion) affecting overall growth of this region. Regions 2 and 1 posted relatively low growth and high volatility during the period 1975-2007. Within the reference period 1977-2007, contraction of as low as -32% to growth as high as 23% was exhibited across the regions. While Region 8 also had a low average growth rate, it is the most stable with growth ranging from -7 to +7 within the same period.

Figure 1 Average Growth Among the Regions (1975-2007)



Although the Finance Sector is quite volatile, it posted the highest average growth at 5.75%. The Construction Sector is also volatile and has the lowest average growth only at 2.46%. The sectors Other Dwellings and Real Estate, Government Services, and Agriculture, Fishery and Forestry are among the most stable sectors but posting lower positive growth in general, and did not hit really low negative growth at certain instances. The agriculture sector is not among the fast-growing sector, contrary to what has been identified in many growth models to be the important driver of aggregate growth. Efficiency in agriculture would mean higher productivity and possible migration of the skilled labor to other sectors. Agriculture is traditionally labor-intensive employing nearly half of the labor force in the Philippines.

Analysis by Region

The sectoral components of GVA growth at the national level produced four components accounting approximately 79% of total variation in growth rates by sector within the period 1975-2007. The most prominent grouping of sectors is the fast-moving group including manufacturing, trade, and finance. The group is primarily concerned with a vertically integrated commercial operations namely, investing (finance), production (manufacturing), and marketing/selling (trade). The second group is another set of the fast-moving sectors basically providing support to other sectors and includes the utilities (electricity, gas, and water) and government services. Agriculture, fishery and forestry sector separates into a group of its own, reflecting the unique growth behavior of the sector. The agriculture sector is one of the most stable-growing sectors although at relatively lower level. The fourth group is composed of mining and quarrying sector alone. The sector have very high average growth but with high volatility as well within the period.

The estimates of the parameters of a stochastic frontier model for aggregate growth of all sectors in the Philippines with the growth of the different sub-sectors as inputs are summarized in Table 4. Only three of the 11 sectors' growth contributes significantly to the fluctuations in the aggregate growth. Within the period 1976-2008, growth is propelled

primarily by the manufacturing sector. Construction also contributes significantly to aggregate growth but to a lesser rate. While the agriculture, fishery and forestry contributes significantly to aggregate growth, the magnitude is too low for what the growth theory points out as an important stimulus to economic growth. Trade may also contribute but the present data does not contain enough evidence to prove empirical significance. The potential contribution of trade may have already been accounted by the manufacturing sector which is the most dominant contributor to the aggregate growth.

Table 4 Estimates of the Stochastic Frontier Model for Aggregate Philippines Growth

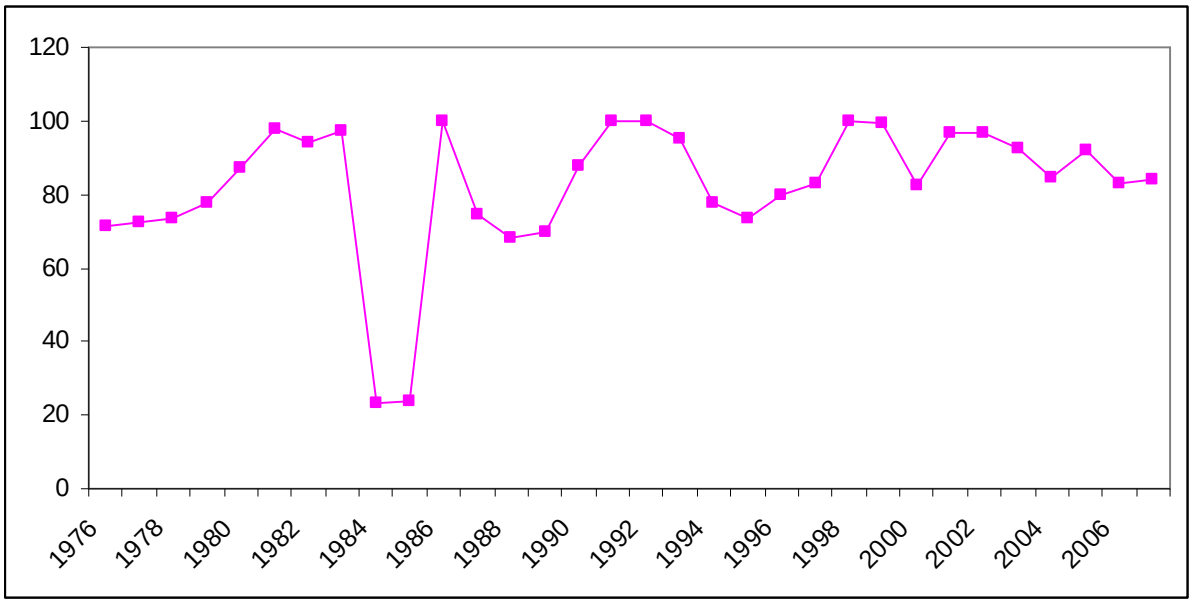
```
Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00   Prob>=chibar2 = 1.000

Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(4)    =  7.142e+09
Log likelihood =  5.3649322                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
lgr_con_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    mfg_phil |    .072102   .0186089     3.87   0.000     .0356293    .1085748
   cons_phil |   .0102609   .0019416     5.28   0.000     .0064555    .0140663
  trade_phil |   .0243338   .0138632     1.76   0.079    -.0028375    .0515051
    aff_phil |   .0076305    .003553     2.15   0.032     .0006667    .0145943
       _cons |   2.173959   .0509925    42.63   0.000     2.074016    2.273903
-------------+----------------------------------------------------------------
    /lnsig2v |  -36.13634    312.249    -0.12   0.908    -648.1331    575.8605
    /lnsig2u |  -1.786891        .25    -7.15   0.000    -2.276882     -1.2969
-------------+----------------------------------------------------------------
     sigma_v |   1.42e-08   2.22e-06                     1.8e-141    1.1e+125
     sigma_u |   .4092433   .0511554                      .320318    .5228556
      sigma2 |     .16748     .04187                     .0854163    .2495438
      lambda |   2.88e+07   .0511554                     2.88e+07    2.88e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 17.29  Prob>=chibar2 = 0.000
```

The average technical efficiency of the aggregate Philippine economy in the period 1976-2007 is 82%, or about 18% inefficiency. This means that efficiency-enhancing policies may still be adopted since near frontier efficiency was observed only a few times within the period. The patterns of technical efficiency estimates shows severe fluctuations over time (coefficient of variation is 23%), also coinciding with various political events in the country. In 1976, the estimated technical efficiency was about 71%, this increased gradually until 1981 when it peaked at 97%, barely 3% off the frontier level. Several programs like the impact of PD 27 (Land Reform) starting to take place, the Masagana 99 (agricultural production program), and even the boom of the garments sector can be fueling this movement towards the frontier production level of the aggregate economy. In 1983, Sen. Benigno Aquino Jr was assassinated causing political turmoil in the Marcos administration. The technical efficiency estimate in 1983 was still at 97%, but dropped to the lowest point for two consecutive years at 23%. In 1986 however, the people's revolt (People Power) leading to the toppling of Marcos administration followed by the installation of Pres. Corazon Aquino and the trust of various sectors was regained. In 1986, technical efficiency hit the highest level at 99%. In 1987, it went down to the more realistic level of 75%, gradually increasing again until several military attempts to seize power from the government slowed down the increasing technical efficiency. In 1991, when President Aquino's term is almost completed and during the presidential elections in 1992, technical efficiency soared high again to 99%. After-election adjustment also followed, but again peaked in 1998 on another election year. Claims of

corruption in Estrada administration pulled down the technical efficiency to 82% in 2000. The pattern of upturns and downturns continued to appear during the term of President Arroyo, see Figure 2 for details.

Figure 2 Estimated Technical Efficiency of the Aggregate Economy (1976-2007)



National Capital Region (NCR)

Among the economic sectors included in the study, only the agriculture, fishery and forestry sector is not present in NCR. Three latent factors may characterize these economic sectors, accounting for 72% of the total variation in the growth of all the sectors. The NCR growth is primarily characterized by a combination of the growth in all sectors except government services with negligible loading for the first component. The manufacturing, finance, and trade sector however, dominates the first component, implying that NCR economy is driven by these sectors. Being the capital region, it is indeed the financial and trading center of the country. And because of the availability of all modes and networks of transportation system (inter-island and international), it is also the most strategic location of different manufacturing companies. The second component is the combined contributions of the support sectors (electricity, gas and water and government services). Because residential and other type of real estate has been highly priced in NCR, it separates into the third component. The general pattern reflected in NCR is passed on to the aggregate Philippine economic growth, an evidence of how much influence the NCR economy has.

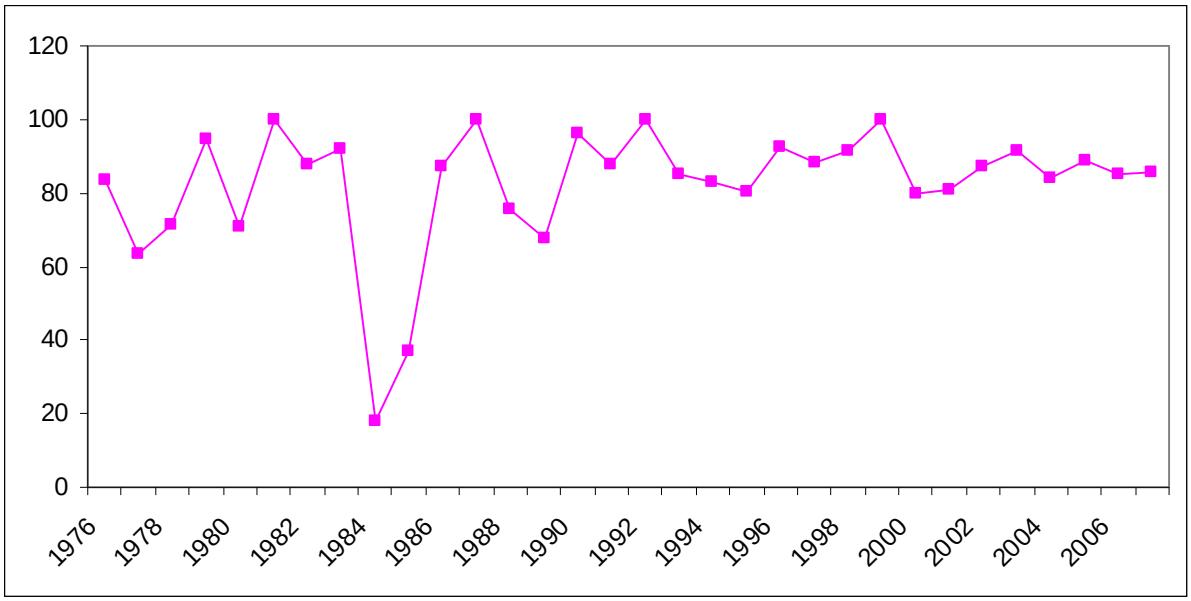
There is empirical evidence that growth in NCR is fueled primarily by the manufacturing sector, followed by the finance sector. While trade can also potentially contribute to NCR's aggregate economic growth, there is no empirical evidence on its significance. The construction sector and electricity, gas and water may also influence the stochastic frontier model but their statistical significance is not guaranteed within the present data.

Table 5 Estimates of the Stochastic Frontier Model for Aggregate NCR Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(5)    =  3.025e+09
Log likelihood =  6.4005096                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
 lgr_con_ncr |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     mfg_ncr |    .061837   .0046381    13.33   0.000     .0527466    .0709275
    cons_ncr |   .0014332   .0036138     0.40   0.692    -.0056498    .0085162
     egw_ncr |    .005466   .0055512     0.98   0.325    -.0054141    .0163461
   trade_ncr |   .0344278    .022276     1.55   0.122    -.0092324    .0780881
     fin_ncr |   .0031879   .0007035     4.53   0.000     .0018091    .0045667
       _cons |   2.428348   .0696922    34.84   0.000     2.291754    2.564942
-------------+----------------------------------------------------------------
    /lnsig2v |  -37.29225   1198.654    -0.03   0.975     -2386.61    2312.026
    /lnsig2u |  -1.851615        .25    -7.41   0.000    -2.341606   -1.361624
-------------+----------------------------------------------------------------
     sigma_v |   7.98e-09   4.78e-06                            0           .
     sigma_u |   .3962114   .0495264                     .3101179    .5062059
      sigma2 |   .1569835   .0392459                      .080063     .233904
      lambda |   4.96e+07   .0495264                     4.96e+07    4.96e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 14.00  Prob>=chibar2 = 0.000
```

The average estimate of technical efficiency for NCR is 82%, the same efficiency level as of the aggregate Philippine economy. Similar fluctuation as the Philippine data is reflected in the NCR technical efficiency estimates with coefficient of variation of 21%. This may be explained by the fact that bulk of the national output is generated in the NCR. Except for the 1984-1985 periods with very low estimates of technical efficiency, NCR is slightly robust to the cycles that the different political events affecting the patterns of the estimates of technical efficiency for the entire county has exhibited, see Figure 3 for details.

Figure 3 Estimated Technical Efficiency of NCR (1976-2007)



Cordillera Administrative Region (CAR)

CAR was created only in 1987, the youngest among the regions analyzed in this paper. The region is a contrast of highly urban center (Baguio City) and upland settlements in the Cordillera mountain ranges. As influenced by the geographic characteristics, the economic landscape is also complicated. Four latent factors accounting for 75% of the total variation in growth rates among the economic sectors were identified. The most important factor comprises the transportation, trade, finance, other residential dwellings and real estate, and private services. This is followed by a combination of the agriculture, fishery, and forestry sector along with electricity, gas and water sector. The third is a contrast between mining and construction sector. The last component is also a contrast between manufacturing and government services.

Most of the sectors contribute significantly to the aggregate regional economy, but trade and private services yield negative contributions. Other residential dwellings and real estate sector contributes the most in the growth of the aggregate output for the region. See Table 6 for the complete estimation results.

Table 6 Estimates of the Stochastic Frontier Model for Aggregate CAR Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =          20
                                                  Wald chi2(8)    =  3.106e+09
Log likelihood =  6.4643528                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
 lgr_con_car |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     aff_car |   .0268381   .0047198     5.69   0.000     .0175875    .0360888
  mining_car |    .024543   .0027487     8.93   0.000     .0191557    .0299303
     mfg_car |   .0287983   .0009078    31.72   0.000      .027019    .0305776
    cons_car |   .0111217   .0016687     6.67   0.000     .0078512    .0143922
   trade_car |  -.0152618   .0041769    -3.65   0.000    -.0234483   -.0070753
     fin_car |   .0338829   .0073722     4.60   0.000     .0194336    .0483322
    odre_car |   .1034451   .0144604     7.15   0.000     .0751032     .131787
     pvt_car |  -.0654625   .0148177    -4.42   0.000    -.0945047   -.0364203
       _cons |   1.757413   .0018638   942.94   0.000      1.75376    1.761066
-------------+----------------------------------------------------------------
    /lnsig2v |  -37.03909    720.095    -0.05   0.959    -1448.399    1374.321
    /lnsig2u |  -2.098018   .3162278    -6.63   0.000    -2.717813   -1.478223
-------------+----------------------------------------------------------------
     sigma_v |   9.06e-09   3.26e-06                           0    2.7e+298
     sigma_u |   .3502847   .0553849                     .2569416     .477538
      sigma2 |   .1226994    .038801                     .0466509    .1987478
      lambda |   3.87e+07   .0553849                     3.87e+07    3.87e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 17.36  Prob>=chibar2 = 0.000
```

The average technical efficiency estimate for the region is slightly higher at 85%, indicating that the region is off from the frontier production level only by 15%. Several instances of near-frontier production level were noted within the period 1988-2007 (See Figure 4). While most regions usually have high efficiency level at the start of a presidential administration, it was the reverse in 1992 for CAR. The importance of the finance sector also contributed to the downturn of the regional efficiency during the 1997 Asian financial crisis.

Figure 4 Estimated Technical Efficiency of CAR (1988-2007)

Region 1 (Ilocos)

There are three components that characterize the economy of Region 1 accounting for a total of 74% of the variations in the growth of all sectors. The sectors comprising the Region 1 economy contributes evenly as reflected in the averaging effect of the first component on all the sectors' growth except the construction sector. The second component is a contrast of many sectors like mining and quarrying, construction, electricity, gas and water, and finance. The third component is another contrast, this time of construction and government services.

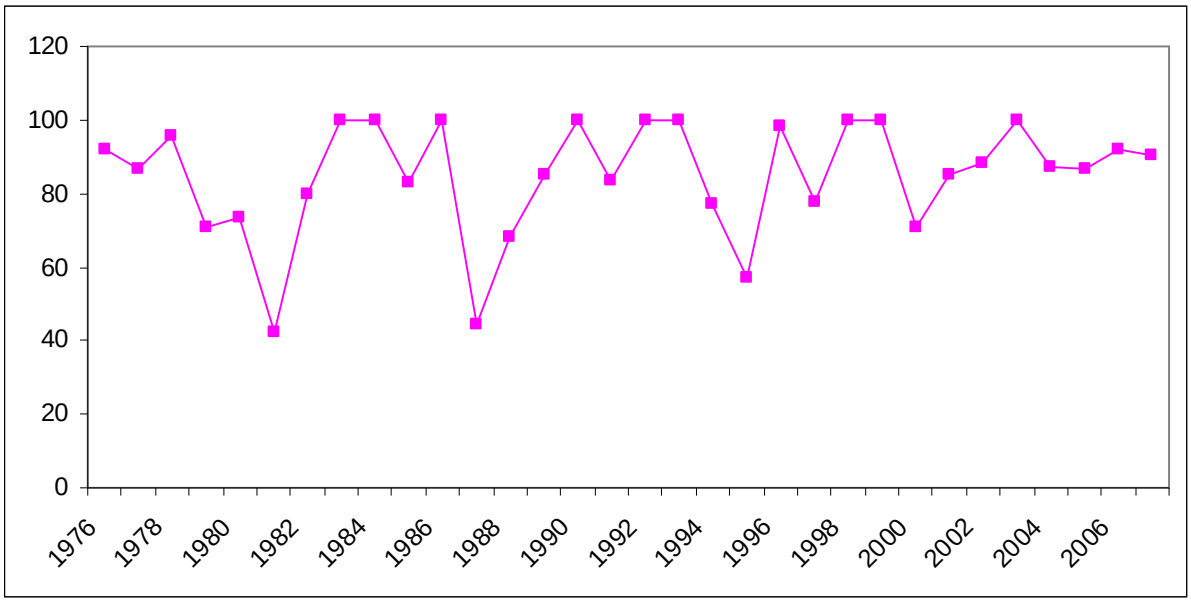
Many sectors contributed significantly in defining the growth of the region, but trade and finance have negative coefficients. Agriculture, fishery and forestry and private services yield the most important role in explaining the regional economic growth (see Table 7).

Table 7 Estimates of the Stochastic Frontier Model for Aggregate Region 1 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(9)    =  7.821e+09
Log likelihood =  16.925808                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
   lgr_con_1 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_1 |   .0351477    .002721    12.92   0.000     .0298147    .0404807
    mining_1 |    .001404    .000052    26.98   0.000      .001302     .001506
       mfg_1 |   .0043202   .0006852     6.31   0.000     .0029773    .0056631
      cons_1 |   .0024558   .0000868    28.28   0.000     .0022856     .002626
       egw_1 |    .005708   .0003166    18.03   0.000     .0050875    .0063286
     trans_1 |    .013328   .0017335     7.69   0.000     .0099304    .0167256
     trade_1 |   -.006777   .0007575    -8.95   0.000    -.0082617   -.0052923
       fin_1 |  -.0145836   .0018725    -7.79   0.000    -.0182536   -.0109136
       pvt_1 |   .0301352   .0027448    10.98   0.000     .0247555    .0355149
       _cons |   3.423887   .0098595   347.27   0.000     3.404562    3.443211
-------------+----------------------------------------------------------------
    /lnsig2v |  -36.41045   260.2716    -0.14   0.889    -546.5334    473.7125
    /lnsig2u |  -2.509446        .25   -10.04   0.000    -2.999437   -2.019455
-------------+----------------------------------------------------------------
     sigma_v |   1.24e-08   1.61e-06                     2.1e-119    7.3e+102
     sigma_u |   .2851548   .0356444                      .223193    .3643183
      sigma2 |   .0813133   .0203283                     .0414705    .1211561
      lambda |   2.30e+07   .0356444                     2.30e+07    2.30e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 18.43  Prob>=chibar2 = 0.000
```

The average technical efficiency for the period 1976-2007 is higher than that of the aggregate national economy at 85%. CAR also yields similar average but that is because it is spared from the downturns in the early 1980's since the region was created much later. In Figure 5, Region 1's economy is almost always near the frontier level within the period 1976-2007. The technical efficiency never falls below the 40% level (Philippines near 20%, NCR below 20%). While most regions and the national aggregate efficiency rise in 1987, this is the lowest along with that in 1981 for Region 1.

Figure 5 Estimated Technical Efficiency of Region 1 (1976-2007)



Region 2 (Cagayan Valley)

The economic sectors in Region 2 are summarized into four groups accounting for a total of 73% of the total variations of all sectors. Group 1 is an aggregate of all sectors with emphasis on trade, electricity, gas and water, private services, and other residential dwellings and real estate. The second group is composed of finance, manufacturing, and transportation sectors. The agriculture, fishery and forestry sector separates into the third component while mining and quarrying into the fourth component.

Table 8 summarizes the estimation results for a stochastic frontier model for aggregate growth of output in Region 2 with the different sector's growth as inputs. The aggregate growth is most sensitive to the agriculture, fishery and forestry and trade sectors. Private services is also prominent but to a lesser extent. Only three of the 11 sectors did not exhibit significant contribution to the aggregate growth but mining yield negative effect.

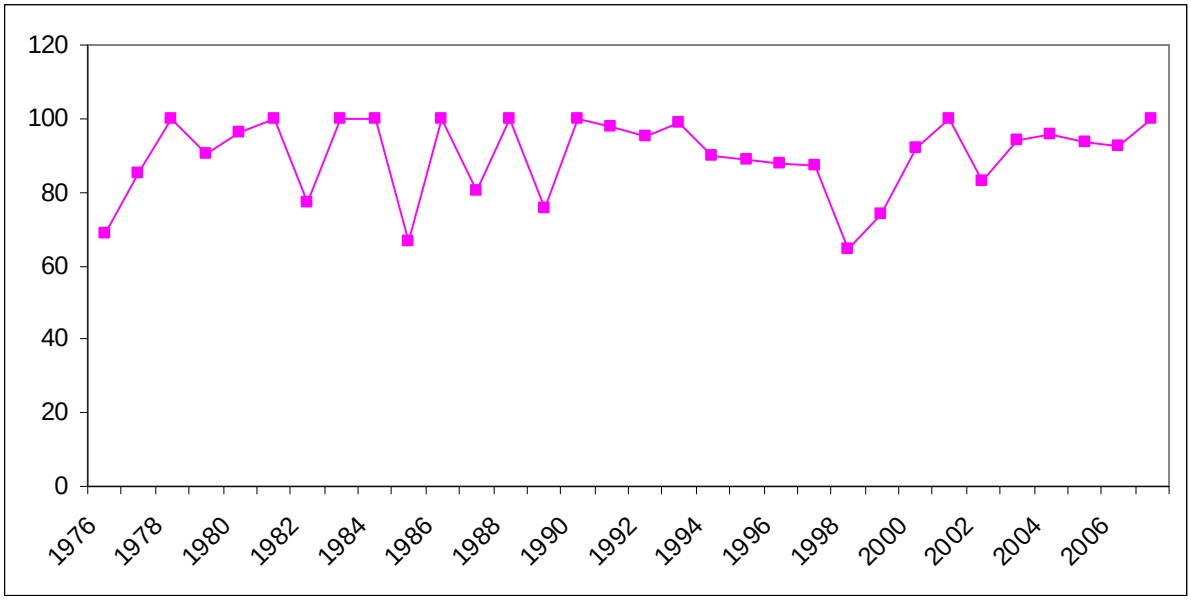
Table 8 Estimates of the Stochastic Frontier Model for Aggregate Region 2 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(8)    =  9.559e+10
Log likelihood =   33.07604                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lgr_con_2 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_2 |   .0234387   .0017352    13.51   0.000     .0200378    .0268397
    mining_2 |  -.0001088   .0000216    -5.04   0.000    -.0001511   -.0000665
       mfg_2 |   .0041218   .0006993     5.89   0.000     .0027512    .0054924
      cons_2 |   .0059314   .0001289    46.02   0.000     .0056788     .006184
       egw_2 |   .0090546    .000638    14.19   0.000     .0078041    .0103051
     trade_2 |   .0256336     .00317     8.09   0.000     .0194206    .0318466
       pvt_2 |   .0179182   .0000521   343.91   0.000     .0178161    .0180203
       gov_2 |   .0086602   .0009707     8.92   0.000     .0067576    .0105627
       _cons |   2.665986   .0036676   726.91   0.000     2.658798    2.673174
-------------+----------------------------------------------------------------
    /lnsig2v |  -39.26362   720.3965    -0.05   0.957    -1451.215    1372.688
    /lnsig2u |  -3.518835        .25   -14.08   0.000    -4.008826   -3.028844
-------------+----------------------------------------------------------------
     sigma_v |   2.98e-09   1.07e-06                           0    1.2e+298
     sigma_u |   .1721451   .0215181                     .1347394    .2199353
      sigma2 |   .0296339   .0074085                     .0151136    .0441543
      lambda |   5.78e+07   .0215181                     5.78e+07    5.78e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 19.67  Prob>=chibar2 = 0.000
```

Given the present resources in Region 2, it exhibited efficiency in the utilization of such, foremost, the average for the period 1976-2007 is very high at 89%, it has also a very small variation with a coefficient of variation of only 12%, finally, the lowest technical efficiency estimate is only 64%. Most of the time, the economy produced at a near-frontier level (see Figure 6). Efficiency in Region 2 is not affected by the fluctuations in political conditions that significantly affected the aggregate national economic growth.

Figure 6 Estimated Technical Efficiency of Region 2 (1976-2007)



Region 3 (Central Luzon)

The 11 economic sectors contributed differently to the aggregate growth in Region 3. Accounting for a total of 75% of the total variations in all sectors, five latent factors can be identified. The first factor is as aggregate contribution of the trade, finance, and other dwellings and real estate. The manufacturing sector separates into the second component. Agriculture, fishery and forestry and mining and quarrying sectors form aggregate of the third component. Electricity, gas and water and construction sectors separate into components 4 and 5 respectively.

Growth in Region 3 is primarily coming from the agriculture, fishery and forestry sector. The region is producing a highly diverse variety of crops, livestock and fisheries. The finance, trade, and manufacturing sectors complement the contribution of agriculture. Other residential dwellings and real estate however, contributes negatively to the aggregate growth. This can be a sign that the sector is fully exploited and the consequence is a negative return to scale, a growth in the sector will no longer be beneficial to the aggregate economy.

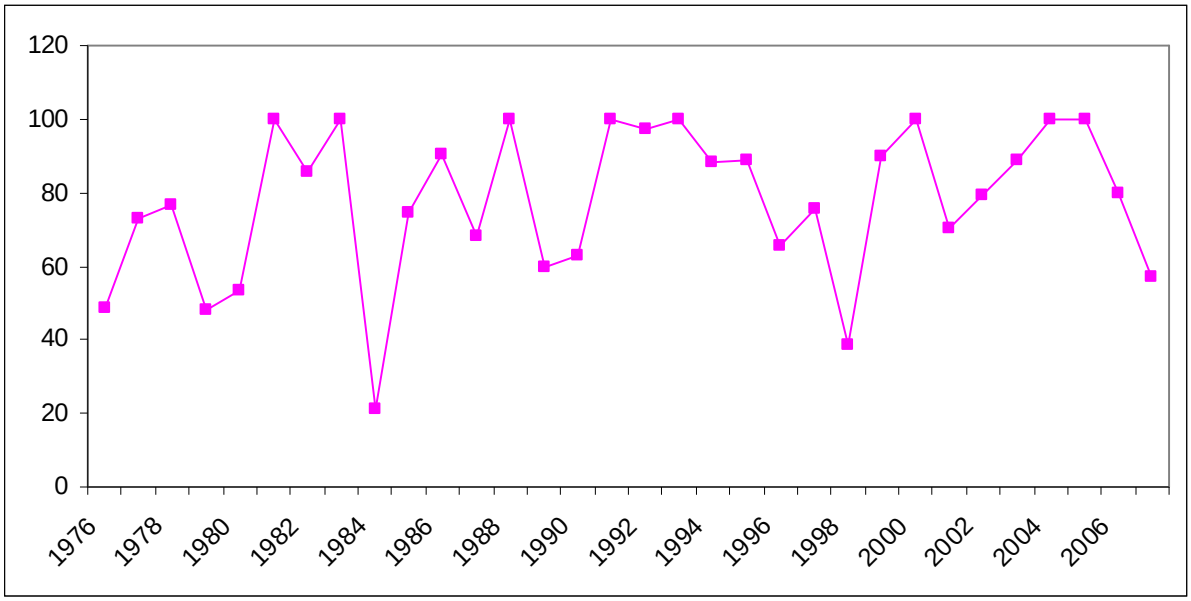
Table 9 Estimates of the Stochastic Frontier Model for Aggregate Region 3 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(8)    =  1.103e+11
Log likelihood =  1.6808281                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
   lgr_con_3 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_3 |   .0609794   .0088856     6.86   0.000     .0435639    .0783949
       mfg_3 |   .0250848   .0015366    16.32   0.000     .0220731    .0280965
      cons_3 |    .009081   .0008762    10.36   0.000     .0073638    .0107983
       egw_3 |   .0104095   .0005975    17.42   0.000     .0092384    .0115805
     trade_3 |   .0397013   .0044499     8.92   0.000     .0309797    .0484229
       fin_3 |   .0404671   .0095181     4.25   0.000      .021812    .0591222
      odre_3 |  -.0258476   .0052295    -4.94   0.000    -.0360971   -.0155981
       pvt_3 |    .022113   .0003362    65.77   0.000      .021454    .0227721
       _cons |   1.698349   .0253703    66.94   0.000     1.648624    1.748073
```

```
-------------+----------------------------------------------------------------
    /lnsig2v |  -40.86228   1734.253    -0.02   0.981    -3439.935     3358.21
    /lnsig2u |  -1.560023   .2540003    -6.14   0.000    -2.057855   -1.062192
-------------+----------------------------------------------------------------
     sigma_v |   1.34e-09   1.16e-06                           0           .
     sigma_u |   .4584007   .0582169                   .3573901    .5879602
      sigma2 |   .2101312   .0533734                   .1055213    .3147411
      lambda |   3.42e+08   .0582169                   3.42e+08    3.42e+08
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 20.57  Prob>=chibar2 = 0.000
```

Recall that (Villano and Fleming, 2006) estimated the technical efficiency of certain groups of farmers from this region to be 79%. The aggregate regional estimate of technical efficiency averages 77% within 1976-2007 periods, rather low compared to the estimates from other regions. The technical efficiency for the region also exhibits volatility, with coefficient of variation of 27%, and lowest efficiency coefficient at 21%. With the dominance of agriculture and fisheries, the technical efficiency for the aggregate regional economy is influenced not by political events but by some weather anomalies. The lowest technical efficiency coefficient happened in 1984, the year after the 1982/1983 drought period. In 1998 where the worst El Nino episode for the last century was recorded, it also yields the worst downturn in technical efficiency. Since 2006 up to 2007, there is again a trend of a declining technical efficiency coefficient.

Figure 7 Estimated Technical Efficiency of Region 3 (1976-2007)



Region 5 (Bicol)

The economic sectors in Region 5 form into four components accounting for 70% of the total variation of all sectors. Manufacturing, finance, and other residential dwellings and real estate form the first component. The second component is a contrast between mining and private services. Electricity, gas and water (largest source of geothermal energy) separate into the third component. Finally, agriculture, fisheries and forestry formed the fourth component.

The agriculture, fishery and forestry sector is the most important driver of the aggregate economy of Region 5, closely followed by private services. Manufacturing, trade, and finance also contribute into the growth of the regional economy. Transportation sector yield a negative effect into the regional growth possibly due to congestion within the sector. The region serves as a transit point of transportation routes towards the Central and Southern Philippines.

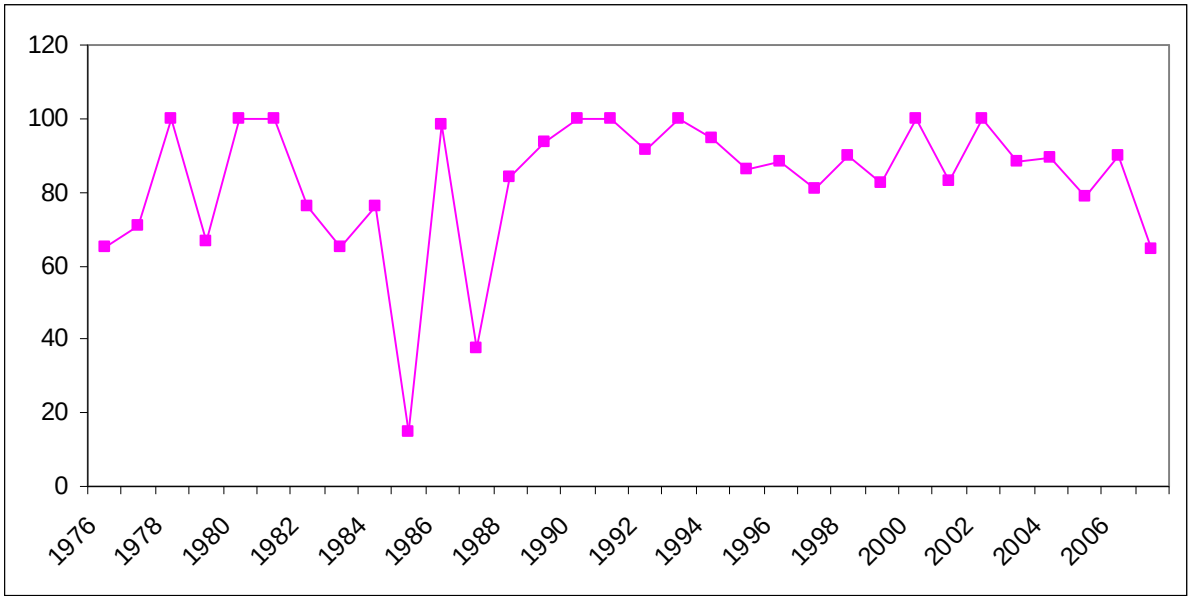
Table 10 Estimates of the Stochastic Frontier Model for Aggregate Region 5 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(8)    =  3.899e+09
Log likelihood =  3.9436591                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lgr_con_5 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_5 |   .0563063   .0029035    19.39   0.000     .0506155     .061997
       mfg_5 |   .0132058   .0048106     2.75   0.006     .0037772    .0226344
      cons_5 |    .006215   .0015505     4.01   0.000      .003176     .009254
       egw_5 |   .0036599   .0025235     1.45   0.147     -.001286    .0086058
     trans_5 |  -.0179968   .0071803    -2.51   0.012    -.0320699   -.0039237
     trade_5 |   .0162579   .0100234     1.62   0.105    -.0033876    .0359034
       fin_5 |   .0152405   .0024001     6.35   0.000     .0105365    .0199445
       pvt_5 |   .0379596   .0088948     4.27   0.000     .0205262     .055393
       _cons |   1.883233    .059371    31.72   0.000     1.766868    1.999598
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.70575   2010.814    -0.02   0.985    -3979.829    3902.418
    /lnsig2u |  -1.698061        .25    -6.79   0.000    -2.188052    -1.20807
-------------+----------------------------------------------------------------
     sigma_v |   3.94e-09   3.96e-06                           0           .
     sigma_u |   .4278294   .0534787                      .3348655    .5466015
      sigma2 |    .183038   .0457595                       .093351     .272725
      lambda |   1.09e+08   .0534787                      1.09e+08    1.09e+08
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 20.71  Prob>=chibar2 = 0.000
```

Except for the fluctuations from 1985 to1988, technical efficiency for the region is relatively robust. Averaging slightly higher for the period 1976-2007 at 83%, the coefficient of variation is about 23% because of the very low value in 1985 at 15%. Although there is an indication of efficiency going down in 2007, this is still within the level it is moving long with since 1988 (see Figure 8).

Figure 8 Estimated Technical Efficiency of Region 5 (1976-2007)



Region 6 (Western Visayas)

The Region 6 economic sectors can be summarized into three components for a total of 66%. Manufacturing, trade, finance, and other residential dwellings and real estate comprise the first component. Agriculture, fishery and forestry separate into the second component and electricity, gas and water into the third component.

There is no stochastic frontier model that fits the Region 6 data well, possibly attributed to the fact that all variations in growth of GVA in the region can be explained completely by the growth in the four sectors in Table 11. Manufacturing (food processing) has become an important livelihood (micro to medium scale enterprises) in the region. Agriculture and fisheries continued to be an important economic activity for many households, producing important commodities like rice, sugarcane, mangoes, and various fishery products.

Table 11 Estimates of the Stochastic Frontier Model for Aggregate Region 6 Growth

```
 Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                   Wald chi2(4)    =     297.55
Log likelihood =  7.2803203                        Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lgr_con_6 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_6 |   .0439535   .0071869     6.12   0.000     .0298673    .0580396
    mining_6 |   .0025718   .0011906     2.16   0.031     .0002384    .0049053
       mfg_6 |   .0557191   .0071033     7.84   0.000      .041797    .0696413
       fin_6 |   .0354453   .0050942     6.96   0.000      .025461    .0454297
       _cons |   2.069512    .368299     5.62   0.000     1.347659    2.791364
-------------+----------------------------------------------------------------
    /lnsig2v |  -3.293016    .252013   -13.07   0.000    -3.786953    -2.79908
    /lnsig2u |  -11.29268   259.5165    -0.04   0.965    -519.9357    497.3503
-------------+----------------------------------------------------------------
     sigma_v |   .1927217   .0242842                      .1505475    .2467104
     sigma_u |   .0035304      .4581                     1.3e-113    1.0e+108
      sigma2 |   .0371541   .0095129                      .0185091    .0557991
      lambda |   .0183187   .4617688                     -.8867315    .9233689
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00   Prob>=chibar2 = 1.000
```

Region 7 (Central Visayas)

The growth of sectors comprising Region 7 can be summarized into four components, accounting at least 71% of the total variation in growth of all the sectors. The most important component is a combination of the manufacturing, construction, transportation, finance, and other residential dwellings sectors. Government services along with the utility sector (electricity, gas, and water) settle for the second component, while agriculture, fishery, and forestry sector and trade sector, comprise the third and fourth sectors, respectively.

Region 7 as an economic system exhibits relative efficiency, posting an average estimated technical efficiency of 86%. The manufacturing sector appeared to be the most important driver of regional growth in the period. Transportation, finance, agriculture, fishery, and forestry, and trade sectors also contribute significantly into the regional economic growth (see Table 12 for details).

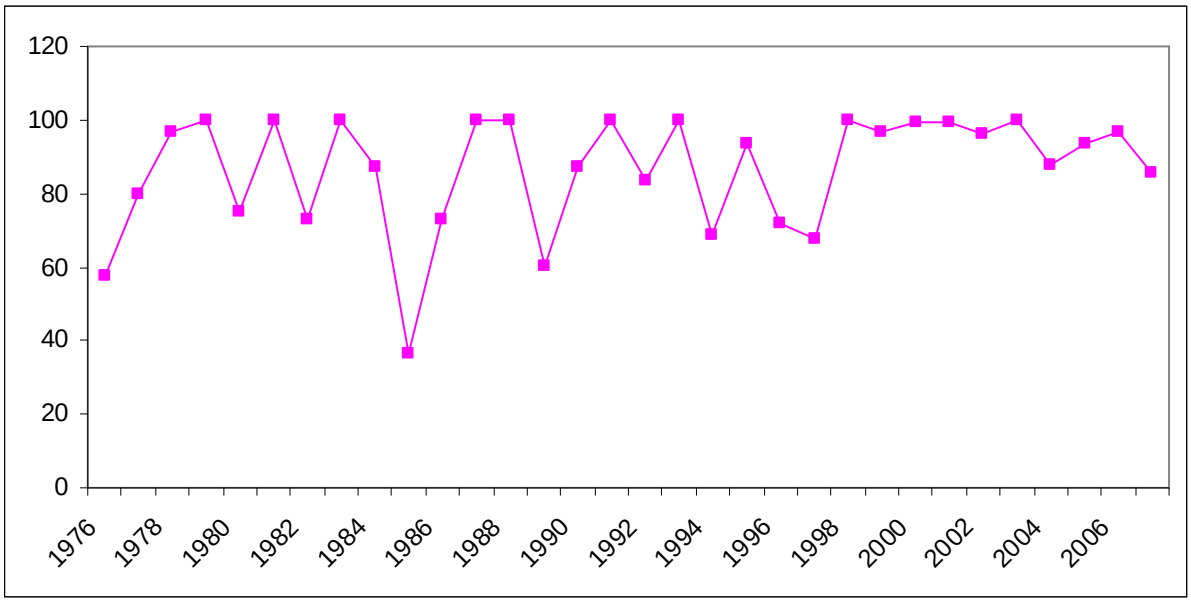
Table 12 Estimates of the Stochastic Frontier Model for Aggregate Region 7 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(8)    =  2.046e+10
Log likelihood =  17.910278                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lgr_con_7 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_7 |   .0144873   .0064106     2.26   0.024     .0019227    .0270519
       mfg_7 |   .0317364   .0022041    14.40   0.000     .0274165    .0360563
      cons_7 |   .0088551   .0000664   133.37   0.000      .008725    .0089853
       egw_7 |   .0111065   .0029733     3.74   0.000      .005279     .016934
     trans_7 |   .0165905   .0047443     3.50   0.000     .0072918    .0258893
     trade_7 |   .0115729   .0013333     8.68   0.000     .0089596    .0141862
       fin_7 |   .0156894   .0030213     5.19   0.000     .0097677    .0216111
      odre_7 |  -.0172333   .0054759    -3.15   0.002    -.0279659   -.0065008
       _cons |   2.339901   .0054318   430.78   0.000     2.329255    2.350548
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.13435   501.6924    -0.08   0.939    -1021.433    945.1646
    /lnsig2u |  -2.570976   .2499999   -10.28   0.000    -3.060966   -2.080985
-------------+----------------------------------------------------------------
     sigma_v |   5.24e-09   1.31e-06                     1.6e-222    1.7e+205
     sigma_u |   .2765157   .0345645                     .2164311    .3532807
      sigma2 |   .0764609   .0191152                     .0389958    .1139261
      lambda |   5.28e+07   .0345645                     5.28e+07    5.28e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 23.65  Prob>=chibar2 = 0.000
```

The estimated technical efficiency for Region 7 is plotted in Figure 9. Efficiency for the region exhibits some degree of robustness except in 1985 when almost all the regions (national economy also follow similar trend) posted extremely low estimates of technical efficiency. In Region 7 however, there are more instances when the technical efficiency estimates approaches near frontier level. In the recent past, technical efficiency has been very high (although there is an indication of a downturn especially in 2007).

Figure 9 Estimated Technical Efficiency of Region 7 (1976-2007)



Region 8 (Eastern Visayas)

The growth among the different sectors in Region 8 is summarized into four components that accounts for 76% of their total variation. The first component is a combination of the growth among the transportation, trade, finance, and other residential dwellings sectors. The second component is a contrast between manufacturing and electricity, gas and water sectors with the mining sector. Agriculture, fishery and forestry contrasts with construction in the third component. The government services along with electricity, gas and water comprises the fourth and final component.

The production function for Region 8 does not delineate significantly the inefficiency error from pure errors (see Table 13 for details). This may be explained in similar fashion as Region 6, the production function is completely explained by the movement of outputs from the different sectors.

Table 13 Estimates of the Stochastic Frontier Model for Aggregate Region 8 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(7)    =     562.21
Log likelihood =  17.325402                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
   lgr_con_8 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_8 |   .0228698   .0074773     3.06   0.002     .0082147     .037525
    mining_8 |  -.0027909   .0002779   -10.04   0.000    -.0033355   -.0022462
       mfg_8 |   .0179089   .0023931     7.48   0.000     .0132184    .0225993
      cons_8 |   .0075645   .0015829     4.78   0.000      .004462    .0106669
     trade_8 |   .0283855   .0080085     3.54   0.000     .0126891    .0440818
      odre_8 |   .0316751   .0147647     2.15   0.032     .0027369    .0606133
       gov_8 |   .0191241   .0055003     3.48   0.001     .0083437    .0299045
       _cons |   1.953946   .2920961     6.69   0.000     1.381449    2.526444
-------------+----------------------------------------------------------------
    /lnsig2v |  -3.920978   .2550838   -15.37   0.000    -4.420933   -3.421023
    /lnsig2u |   -11.1257   187.2259    -0.06   0.953    -378.0817    355.8303
-------------+----------------------------------------------------------------
     sigma_v |   .1407895   .0179566                      .1096495    .1807733
     sigma_u |   .0038378   .3592707                      7.95e-83    1.85e+77
      sigma2 |   .0198364   .0052599                      .0095272    .0301457
      lambda |   .0272594   .3632409                     -.6846798    .7391985
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00   Prob>=chibar2 = 1.000
```

Region 9 (Zamboanga Peninsula)

There is a highly varied growth patterns among the different sectors of the regional economy in Region 9. This can be summarized into four components accounting 68% of the total variation among the growth of all the sectors. The first component is a composite of manufacturing, transportation, trade, and finance sectors. Mining and private services comprises the second, agriculture, fishery and forestry for the third, and electricity, gas and water sector for the fourth component.

The stochastic frontier model with regional growth as the indicator of output and the growth among the different sectors as inputs is estimated with coefficients summarized in Table 14.

The agriculture, fishery and forestry remains to be the most important driver of the regional growth in Region 9. Manufacturing, transportation, finance, and other residential dwellings also yield empirical evidence of its contribution into the growth of the regional economy.

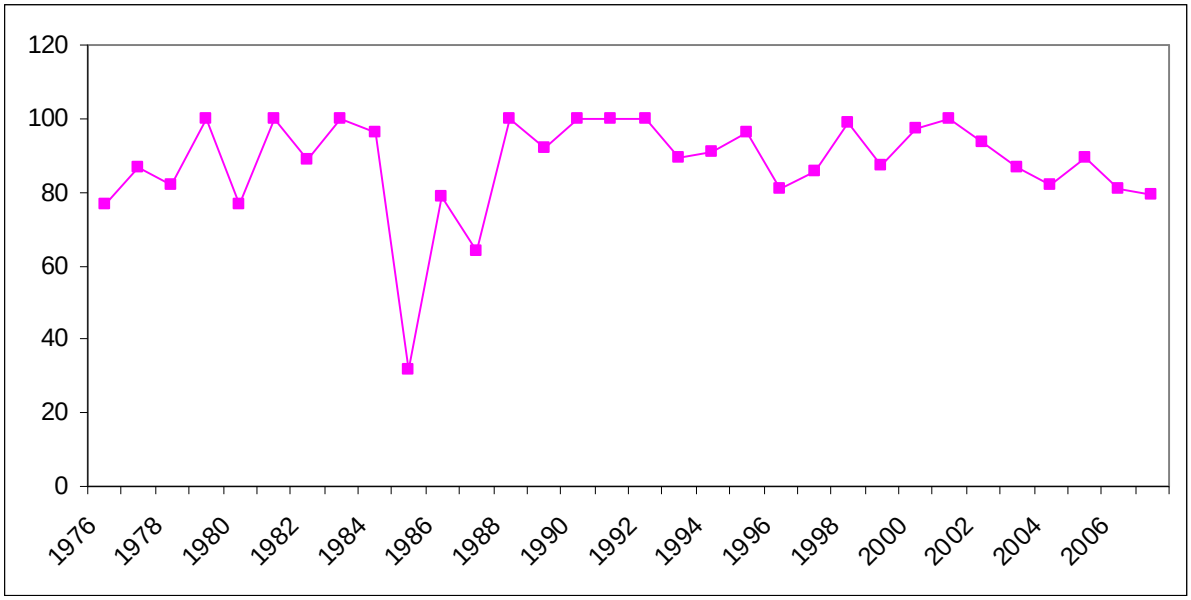
Table 14 Estimates of the Stochastic Frontier Model for Aggregate Region 9 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(8)    =  1.538e+10
Log likelihood =  19.256112                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lgr_con_9 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       aff_9 |    .037021   .0022546    16.42   0.000      .032602      .04144
    mining_9 |   .0008363   .0000243    34.46   0.000     .0007887    .0008838
       mfg_9 |   .0145473   .0009936    14.64   0.000        .0126    .0164947
      cons_9 |   .0066212   .0001715    38.62   0.000     .0062852    .0069573
       egw_9 |    .002203    .000734     3.00   0.003     .0007644    .0036416
     trans_9 |   .0179694   .0006775    26.53   0.000     .0166416    .0192972
       fin_9 |   .0154257   .0043244     3.57   0.000       .00695    .0239014
      odre_9 |   .0222769   .0015993    13.93   0.000     .0191424    .0254115
       _cons |   2.094424   .0107256   195.27   0.000     2.073402    2.115445
-------------+----------------------------------------------------------------
    /lnsig2v |  -37.99513   510.3343    -0.07   0.941    -1038.232    962.2418
    /lnsig2u |  -2.693913   .2540003   -10.61   0.000    -3.191744   -2.196081
-------------+----------------------------------------------------------------
     sigma_v |   5.62e-09   1.43e-06                     3.6e-226    8.9e+208
     sigma_u |   .2600305   .0330239                     .2027317     .333524
      sigma2 |   .0676159   .0171744                     .0339546    .1012772
      lambda |   4.63e+07   .0330239                     4.63e+07    4.63e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 20.46  Prob>=chibar2 = 0.000
```

The estimated technical efficiency during the 1976-2007 periods is plotted in Figure 10. Except for the volatility that the political events in the 1980's had caused, the efficiency in growth of the regional economy is fairly robust. In the recent history, technical efficiency consistently stayed above the 80% level, although there is a trend of a gradual decline until 2007. The average during the period is high at 88% compared to other regions for the same period.

Figure 10 Estimated Technical Efficiency of Region 9 (1976-2007)



Region 10 (Northern Mindanao)

Region 10 is one of the most varied regional economies with many sectors contributing to the overall growth performance of the region. Four components can explain a total of 78% of the total variation of the growth in all the economic sectors. Agriculture, fishery and forestry, transportation, trade, finance, other residential dwellings, and private services appeared to be the most important sectors combined into the first component. Mining and construction contrasts with manufacturing into the second component. Electricity, gas and water combines with government services into the third component. Manufacturing and government services combine again into the fourth component.

There is an indication that growth in Region 10 is driven primarily by agriculture, fishery and forestry, private services and transportation. The stochastic frontier model however, failed to decompose the inefficiency error from the pure error, possibly because the production function suffices to explain completely the variation in growth of the output of the regional economy, see Table 15 for details.

Table 15 Estimates of the Stochastic Frontier Model for Aggregate Region 10 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(6)    =     701.82
Log likelihood =   17.27421                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
  lgr_con_10 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      aff_10 |   .0372978   .0044461     8.39   0.000     .0285836    .0460121
      mfg_10 |  -.0061341   .0035474    -1.73   0.084    -.0130868    .0008186
    trans_10 |   .0212585   .0101152     2.10   0.036     .0014331     .041084
    trade_10 |   .0122813   .0045537     2.70   0.007     .0033563    .0212063
      pvt_10 |   .0308827   .0054147     5.70   0.000       .02027    .0414953
      gov_10 |   .0128881   .0044085     2.92   0.003     .0042476    .0215286
       _cons |   2.551154   .2415326    10.56   0.000     2.077758    3.024549
-------------+----------------------------------------------------------------
    /lnsig2v |  -3.952497   .2561325   -15.43   0.000    -4.454507   -3.450486
    /lnsig2u |  -11.68291   206.0055    -0.06   0.955    -415.4462    392.0804
-------------+----------------------------------------------------------------
     sigma_v |   .1385882   .0177485                      .1078242    .1781297
     sigma_u |   .0029046   .2991831                      6.12e-91    1.38e+85
      sigma2 |   .0192151   .0050041                      .0094073     .029023
      lambda |   .0209586   .3019601                     -.5708723    .6127895
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00   Prob>=chibar2 = 1.000
```

Region 11 (Davao)

Region 11 economy contributes well into the national economy, but it exhibited a very erratic growth patterns across the sectors during the period 1976-2007. Three components can explain a total of 63% of the growth of the regional economy. Trade and finance are very important for the region and combines into the first component. Agriculture, fishery and forestry combines with government services into the second component. Finally, mining and private services contrast as the third component. The region produces many of high-value crops and host to many mining firms producing various metals.

The stochastic frontier model estimated for Region 11 is summarized in Table 16. Manufacturing sector provides the most important stimulus in the growth of the regional economy. Agriculture, fishery, and forestry and finance sectors also contributed significantly into the regional growth.

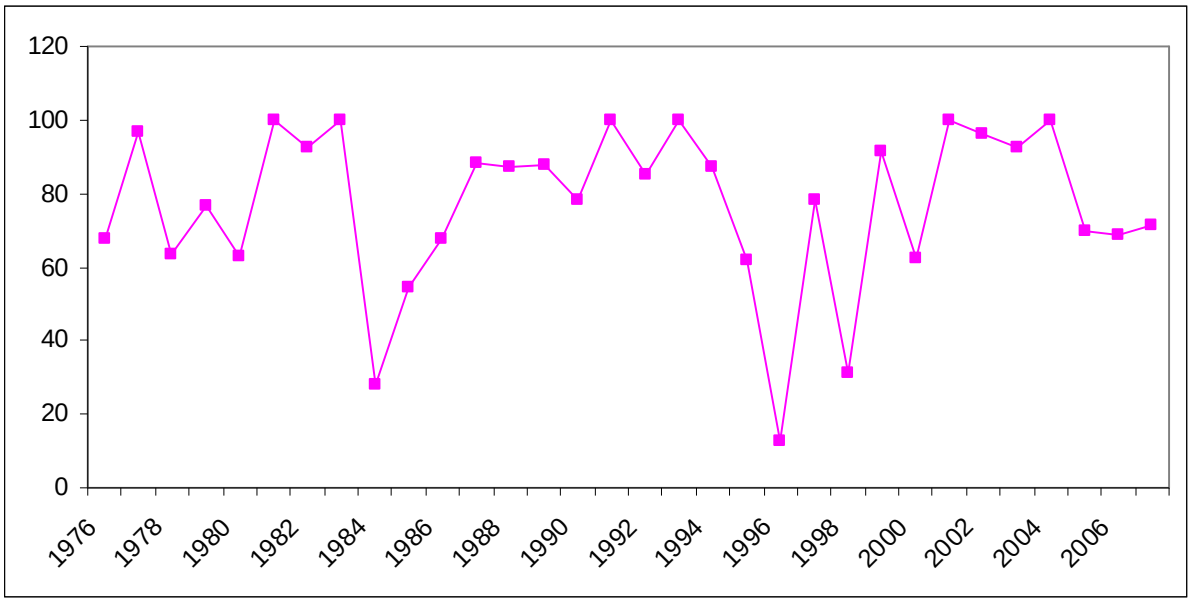
Table 16 Estimates of the Stochastic Frontier Model for Aggregate Region 11 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(6)    =  1.363e+10
Log likelihood =  -4.146663                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
  lgr_con_11 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      aff_11 |   .0370008   .0049531     7.47   0.000      .027293    .0467087
      mfg_11 |   .0875172   .0128559     6.81   0.000     .0623202    .1127143
     cons_11 |    .008968   .0007139    12.56   0.000     .0075688    .0103672
    trans_11 |  -.0372614   .0075537    -4.93   0.000    -.0520663   -.0224565
      fin_11 |   .0300612   .0035754     8.41   0.000     .0230536    .0370688
      pvt_11 |   .0142167    .003583     3.97   0.000     .0071943    .0212392
       _cons |   1.757846   .0049826   352.79   0.000      1.74808    1.767612
-------------+----------------------------------------------------------------
    /lnsig2v |   -37.8571   794.6659    -0.05   0.962    -1595.374    1519.659
    /lnsig2u |  -1.184056   .2540003    -4.66   0.000    -1.681887   -.6862247
-------------+----------------------------------------------------------------
     sigma_v |   6.02e-09   2.39e-06                             0           .
     sigma_u |   .5532042    .070257                     .4313033    .7095585
      sigma2 |   .3060349   .0777329                     .1536811    .4583887
      lambda |   9.19e+07    .070257                     9.19e+07    9.19e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 23.47  Prob>=chibar2 = 0.000
```

The estimated technical efficiency coefficients are summarized in Figure 11. The average technical efficiency of 76% for the region means that there is so much more efficiency that needs to be achieved to induce a sustainable growth of for the region. The socio-political events that happened in the 1980's and those of the 1990's caused the volatility in technical efficiency estimates for the region. There is also an indication that the different political events that happened in the country also induced the same fluctuations in technical efficiency that is reflected in the national economy. There are a few instances where the region reached near-frontier level during the periods 1976-2007.

Figure 11 Estimated Technical Efficiency of Region 11 (1976-2007)



Region 12 (SOCSKSARGEN)

Four components can summarize the variation of growth among the economic sectors in Region 12, accounting for 75% of the total variation. Agriculture, fishery and forestry along with transportation, trade, finance, private services, and government services comprise the most important component of the regional economy. The second component is a composite of the manufacturing and other residential dwellings sectors. The construction sector separates into the third component, while mining and construction combines into the fourth component. Agriculture and private services can be the two most important driver of growth in the region, the stochastic frontier model however, failed to delineate the inefficiency error from the pure error, see Table 17 for details.

Table 17 Estimates of the Stochastic Frontier Model for Aggregate Region 12 Growth

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(6)    =     387.26
Log likelihood = -4.1300707                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
  lgr_con_12 |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      aff_12 |   .0690553   .0097954     7.05   0.000     .0498567     .088254
      mfg_12 |  -.0444515   .0131379    -3.38   0.001    -.0702014   -.0187016
      egw_12 |   .0091528   .0046912     1.95   0.051    -.0000419    .0183474
      fin_12 |   .0226792   .0087189     2.60   0.009     .0055905    .0397679
      pvt_12 |    .064862   .0100193     6.47   0.000     .0452245    .0844995
      gov_12 |   .0156394    .008892     1.76   0.079    -.0017886    .0330674
       _cons |   2.317458   .8622424     2.69   0.007     .6274944    4.007422
-------------+----------------------------------------------------------------
    /lnsig2v |  -2.571661   .2643864    -9.73   0.000    -3.089848   -2.053473
    /lnsig2u |  -9.882699   301.6178    -0.03   0.974    -601.0426    581.2772
-------------+----------------------------------------------------------------
     sigma_v |    .276421    .036541                      .213328     .358174
     sigma_u |    .007145   1.077522                     3.1e-131    1.7e+126
      sigma2 |   .0764596   .0217494                     .0338316    .1190876
      lambda |   .0258481     1.0882                    -2.106985    2.158682
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 0.00   Prob>=chibar2 = 1.000
```

Analysis by Sector

In the subsequent analysis, growth of the national economy is postulated as a function of the regional growths through a stochastic frontier model. This will allow the analysis of efficiency across the different sectors of the national economy and the possible role that the different regions may contribute. Overall analysis of the aggregate growth and analysis on the breakdown for some sectors are presented.

Considering the aggregate of all economic sectors, 88% of the total variation in growth across all the regions may be summarized into five components. Among the regions, the National Capital Region, Region 4 (CALABARZON and MIMAROPA), Central Visayas and the Bicol Regions aggregates into the most important component. Except for Bicol Region, these regions contribute significantly into the magnitude of the aggregate macroeconomy. CAR, Ilocos Region, Northern Mindanao and Davao Region aggregates into the second component. The third component is a combination of most of the regions in Mindanao. Central Luzon and Cagayan Valley separates into the fourth and fifth components, respectively.

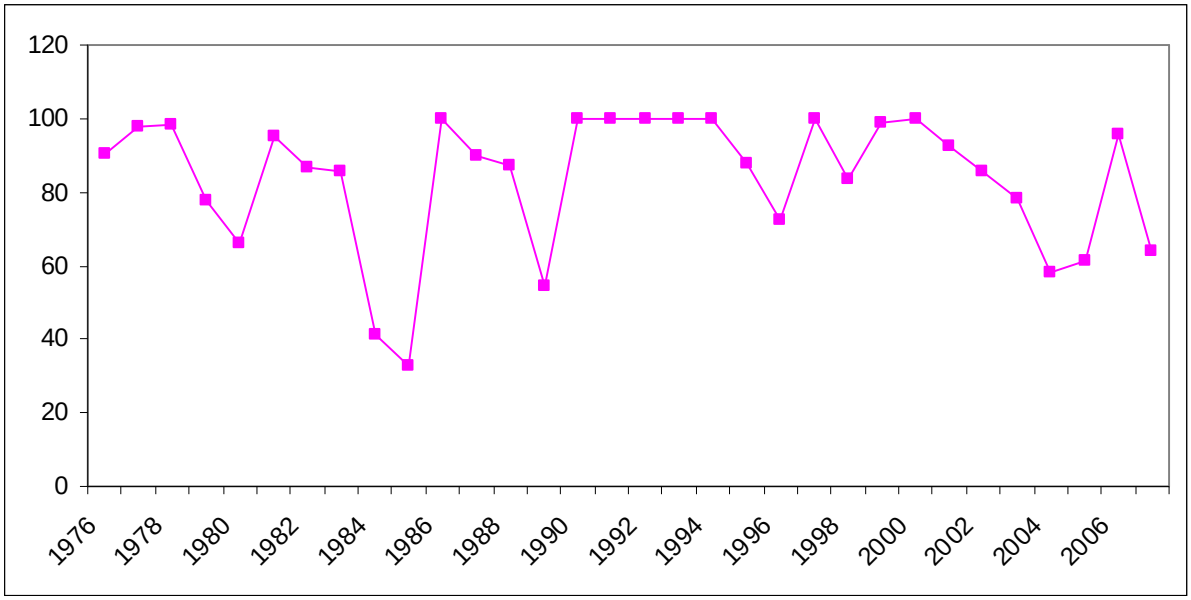
A stochastic frontier model with growth of the macroeconomy as the response and the growth of the different regions as inputs is estimated, parameter estimates are summarized in Table 18. Expectedly, the National Capital Region is the most important determinant of the variation in growth of the national economy. Western Visayas, Central Visayas, Bicol Region and the Zamboanga Peninsula complete the top 5 contributing regions.

Table 18 Estimates of the Stochastic Frontier Model for Aggregate Growth-All Sectors

```
Stoc. frontier normal/half-normal model           Number of obs   =         31
                                                  Wald chi2(8)    =  1.680e+10
Log likelihood =  10.589277                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
lgr_con_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  gr_con_ncr |   .0794609   .0131412     6.05   0.000     .0537046    .1052172
    gr_con_3 |  -.0270068   .0069208    -3.90   0.000    -.0405712   -.0134424
    gr_con_5 |   .0167397   .0034664     4.83   0.000     .0099457    .0235338
    gr_con_6 |   .0708258   .0140572     5.04   0.000     .0432742    .0983774
    gr_con_7 |   .0142343   .0069549     2.05   0.041     .0006029    .0278656
    gr_con_8 |   -.021279   .0069779    -3.05   0.002    -.0349555   -.0076024
    gr_con_9 |   .0185032   .0000392   472.37   0.000     .0184264      .01858
   gr_con_12 |  -.0230256    .004164    -5.53   0.000    -.0311868   -.0148643
       _cons |   1.996147   .0159738   124.96   0.000     1.964838    2.027455
-------------+----------------------------------------------------------------
    /lnsig2v |  -37.51487   478.0119    -0.08   0.937    -974.4009    899.3712
    /lnsig2u |  -2.134762   .2540003    -8.40   0.000    -2.632593   -1.636931
-------------+----------------------------------------------------------------
     sigma_v |   7.14e-09   1.71e-06                     2.6e-212    2.0e+195
     sigma_u |    .343908   .0436764                     .2681264    .4411081
      sigma2 |   .1182727   .0300413                     .0593929    .1771526
      lambda |   4.82e+07   .0436764                     4.82e+07    4.82e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 15.23  Prob>=chibar2 = 0.000
```

Similar with the model with the economic sector's growth as determinants, the estimated average technical efficiency for the period 1976-2007 is relatively high at 84%. There is however, a highly fluctuating behavior of the efficiency of the aggregate national economy within the estimation period (see Figure 13). Several episodes of very low efficiency levels can be observed, the lowest happened during the transition period from the time of Pres. Marcos to Pres. Aquino in the 1980's. The most recent pattern further depicts a declining efficiency level of the macroeconomy as explained by the growth in the economies of the different regions.

Figure 13 Estimated Technical Efficiency of All Sectors (1976-2007)



Agriculture, Fishery and Forestry Sector

Rice and corn are the major agricultural commodities produced in practically the whole country. Some areas are not necessarily ideal for growing these cereals but since they constitute the staple of majority of the population, it is widely grown throughout the country even for areas not ideal for these crops. Growth in agriculture exhibited large variability among the different regions across the country. Some 77% of the total variation in growth of agriculture, fishery and forestry sector (AFF) across the regions can be summarized into four components. The first component is a composite of the growth from the major producing regions (Cagayan Valley, Central Luzon, Bicol Region, Western Visayas, Eastern Visayas, Davao Region and SOCSKSARGEN). These regions produced a variety of crops: Cagayan Valley-corn and forestry products; Central Luzon-rice and fishery; Bicol Region-industrial crops; Western Visayas-rice and fishery; Eastern Visayas-corn and fishery; Davao Region-corn, industrial crops, and fishery; and SOCSKSARGEN-corn and fishery. CAR and Northern Mindanao combines into the second component, both producing temperate vegetables. In addition, Northern Mindanao also produces corn. The third component is a combination of growth of AFF in Ilocos Region, Central Visayas, and Zamboanga Peninsula, all producing industrial crops, corn, and fishery. The fourth component contains the residual variation of Ilocos Region from the third component.

A stochastic frontier model is also fitted with growth in AFF for the national economy as the output and growth in AFF in the regions as inputs, results are summarized in Table 19. Growth in Western Visayas (Region 6) is the most important determinant of growth in AFF. The region is a producer of some important crops like rice, fisheries, sugarcane, and mango. The four other regions completing the top five regions contributing in AFF growth are: Central Luzon (Rice); Bicol Region (industrial crops); Zamboanga Peninsula (corn and fishery); and Davao Region (corn, fruits, fishery).

Table 19 Estimates of the Stochastic Frontier Model for Aggregate Growth-Agriculture, Fisheries and Forestry Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         19
                                                  Wald chi2(9)    =  2.496e+09
Log likelihood =  8.8814114                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   laff_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     aff_car |   .0169118   .0005287    31.99   0.000     .0158755     .017948
       aff_1 |   .0278455   .0005535    50.31   0.000     .0267607    .0289303
       aff_3 |   .0348871   .0068368     5.10   0.000     .0214872     .048287
       aff_5 |   .0337799    .004966     6.80   0.000     .0240466    .0435131
       aff_6 |   .0430602   .0060479     7.12   0.000     .0312064    .0549139
       aff_9 |   .0361433   .0035447    10.20   0.000     .0291958    .0430909
      aff_10 |   .0116916   .0020865     5.60   0.000     .0076022     .015781
      aff_11 |   .0336376   .0012261    27.43   0.000     .0312344    .0360407
      aff_12 |  -.0086899   .0025119    -3.46   0.001    -.0136131   -.0037667
       _cons |   1.723402   .0513554    33.56   0.000     1.622747    1.824057
-------------+----------------------------------------------------------------
    /lnsig2v |  -37.51369   712.3841    -0.05   0.958    -1433.761    1358.733
    /lnsig2u |  -2.386468   .3244428    -7.36   0.000    -3.022364   -1.750572
-------------+----------------------------------------------------------------
     sigma_v |   7.15e-09   2.55e-06                           0    1.1e+295
     sigma_u |    .303239   .0491919                      .220649    .4167428
      sigma2 |   .0919539   .0298338                     .0334807     .150427
      lambda |   4.24e+07   .0491919                     4.24e+07    4.24e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 13.00  Prob>=chibar2 = 0.000
```

The AFF is one of the more efficient sectors but efficiency is not consistently maintained over the period 1988-2007. The average estimated technical efficiency is 85% but the coefficient of variation is high at 21%. In the late 80's until the 90's, AFF has been approaching near frontier-level production. In 1998, when the worst El Nino episode of the century hit, technical efficiency dropped to the lowest point. Even with the passing of the Agriculture and Fisheries Modernization Act (AFMA) in 1997, efficiency of the AFF remains unstable until the most recent year (2007), see Figure 14 for details.

Figure 14 Estimated Technical Efficiency of Agriculture, Fishery and Forestry Sector (1988-2007)

Manufacturing Sector

While manufacturing is a dominant economic activity in the National Capital Region (NCR), there has been substantial growth in the sector in other regions as well. Variations in growth of the manufacturing sector across the different regions can be summarized into four components accounting for 80% of the total variation. The first component is a combination of growth from among all regions, but NCR, Ilocos Region, Bicol Region, Zamboanga Peninsula, and SOCSKSARGEN prominently contributes to this component. While NCR manufactures a variety of goods, the other regions focused on processing of agricultural and fishery products. The second component aggregates the growth in Cagayan Valley, Central Visayas, and Northern Mindanao regions. Davao Region separates into the third component, while Western Visayas in the fourth component.

Expectedly, the fluctuation of the growth of NCR contributes the most to the variation in growth of the manufacturing sector at the national aggregate. The other top regional contributors in growth of the manufacturing sector are: Central Visayas, Central Luzon, Western Visayas, and Zamboanga Peninsula.

Table 20 Estimates of the Stochastic Frontier Model for Aggregate Growth-Manufacturing Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         20
                                                  Wald chi2(10)   =  4.895e+10
Log likelihood =  57.383068                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lmfg_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     mfg_ncr |   .0275671   .0029054     9.49   0.000     .0218726    .0332617
     mfg_car |   .0009598   .0007475     1.28   0.199    -.0005053     .002425
       mfg_3 |    .010356   .0017602     5.88   0.000     .0069061    .0138058
       mfg_5 |   .0049815   .0022811     2.18   0.029     .0005107    .0094523
       mfg_6 |   .0063309   .0006032    10.50   0.000     .0051487    .0075131
       mfg_7 |   .0132946   .0016951     7.84   0.000     .0099723     .016617
       mfg_8 |   .0028985   .0011529     2.51   0.012     .0006388    .0051582
       mfg_9 |   .0129635   .0017209     7.53   0.000     .0095905    .0163364
      mfg_11 |  -.0047373   .0008389    -5.65   0.000    -.0063816   -.0030931
      mfg_12 |  -.0044036   .0019841    -2.22   0.026    -.0082925   -.0005148
       _cons |   2.432623   .0095216   255.48   0.000     2.413961    2.451285
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.75185   249.6209    -0.16   0.877    -527.9999    450.4961
    /lnsig2u |   -7.18989   .3162278   -22.74   0.000    -7.809685   -6.570095
-------------+----------------------------------------------------------------
     sigma_v |   3.85e-09   4.80e-07                      2.2e-115    6.67e+97
     sigma_u |   .0274622   .0043422                      .0201441    .0374388
      sigma2 |   .0007542   .0002385                      .0002867    .0012216
      lambda |    7138269   .0043422                       7138269     7138269
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 2.75   Prob>=chibar2 = 0.049
```

Comprising mostly of formally organized establishments as producing units, the manufacturing sector is the most efficient among the economic sectors, the estimated technical efficiency averages 98% within the period 1988-2007. While the sector produces almost always near frontier level, efficiency drop slightly during the period of rice crisis in 1996, the Asian Financial Crisis in 1997 and the El Nino in 1998. Inefficiency is manifesting again in the recent period, possibly worst that the episode in the 1990's, see Figure 15.

Figure 15 Estimated Technical Efficiency of Manufacturing Sector (1988-2007)

Construction Sector

There is indeed a spread in construction outside the NCR. Growth in the construction sector has been dominated by those outside the NCR. A total of 76% in total variation of the growth in the construction sector may be explained by three components. The most important component is an aggregate mostly of the growth in all regions but dominated by Western Visayas, Central Visayas, Zamboanga Peninsula, and Davao Regions where rapid growth in the sector was registered during the reference period. Central Luzon and SOCSKSARGEN aggregates into the second component, while NCR separates into the third component.

The estimates of the stochastic frontier model for the construction sector are summarized in Table 21. The five most important regional drivers of growth in the sector are: SOCSKSARGEN, Ilocos, NCR, CAR, and Bicol Regions. New roads constructed outside the NCR motivated the growth in construction in these regions.

Table 21 Estimates of the Stochastic Frontier Model for Aggregate Growth-Construction Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         20
                                                  Wald chi2(7)    =  3.908e+10
Log likelihood =  39.143514                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
  lcons_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    cons_ncr |   .0054233   .0001619    33.50   0.000      .005106    .0057405
    cons_car |   .0034081    .000636     5.36   0.000     .0021615    .0046548
      cons_1 |   .0070774   .0005131    13.79   0.000     .0060718    .0080831
      cons_2 |  -.0058593    .000397   -14.76   0.000    -.0066375   -.0050812
      cons_5 |   .0020973   .0006039     3.47   0.001     .0009138    .0032809
     cons_10 |  -.0021716    .000134   -16.20   0.000    -.0024343   -.0019089
     cons_12 |   .0074223   .0003272    22.69   0.000     .0067811    .0080636
       _cons |   3.916605   .0014792  2647.72   0.000     3.913705    3.919504
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.15115   399.4655    -0.10   0.924    -821.0891    744.7868
    /lnsig2u |  -5.365934   .3162278   -16.97   0.000    -5.985729   -4.746139
-------------+----------------------------------------------------------------
     sigma_v |   5.19e-09   1.04e-06                     5.0e-179    5.4e+161
     sigma_u |     .06836   .0108087                     .0501436    .0931942
      sigma2 |   .0046731   .0014778                     .0017767    .0075695
      lambda |   1.32e+07   .0108087                     1.32e+07    1.32e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 11.26  Prob>=chibar2 = 0.000
```

The sector is relatively efficient, with an estimated technical efficiency averaging 95% for the period. Efficiency of the sector generally hovers within the frontier level, declining slightly only a few times. Recently however, there is a declining pattern in technical efficiency of the construction sector, see Figure 16 for details.

Figure 16 Estimated Technical Efficiency of Construction Sector (1988-2007)

Electricity, Gas, and Water Sector

Five components summarize growth across the regions in the electricity, gas and water (EGW) sector, accounting for 80% of the total variation. The first component is also an average of regional growth but with higher loadings for the Ilocos, Central Luzon, Western Visayas, Central Visayas, and Davao Regions. NCR and Zamboanga Peninsula aggregates into the second component, while SOCSKSARGEN separates into the third component. Northern Mindanao and Davao Region are in the fourth component, while Bicol and Eastern Visayas are in the fifth component.

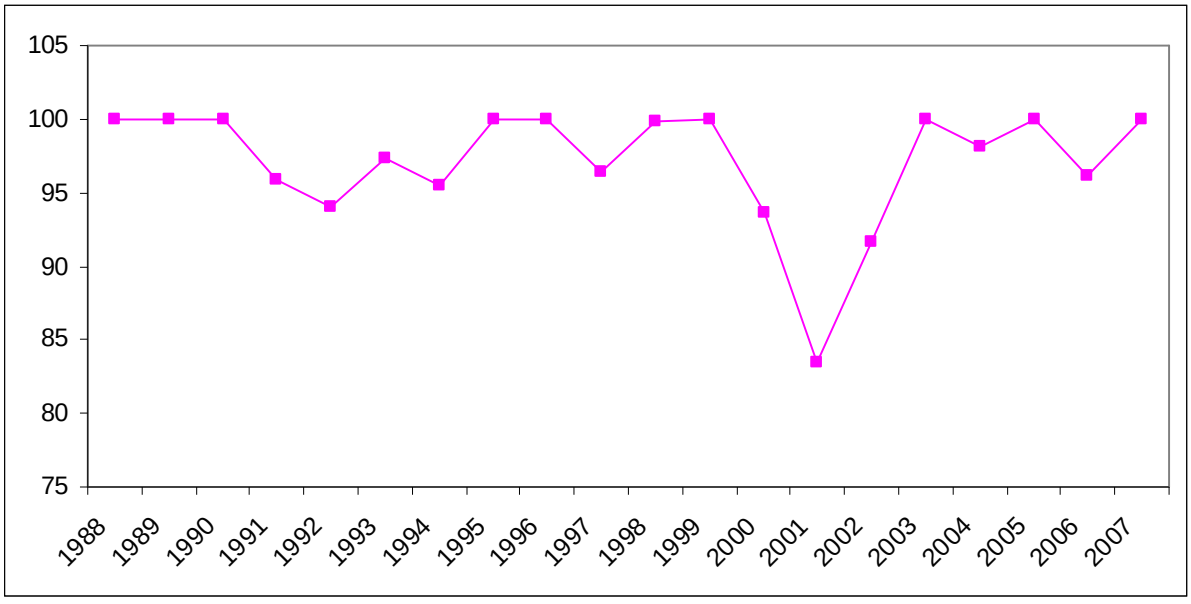
The estimates of the parameters of a stochastic frontier model in Table 22 indicates that growth in the EGW sector is fueled primarily by growth from the Ilocos Region, Central Visayas, and Central Luzon. The average technical efficiency is very high for the period 1988-2007 at 97%. Efficiency dropped in 2001 but quickly regained and maintained up to the present, see Figure 17 for details.

Table 22 Estimates of the Stochastic Frontier Model for Aggregate Growth-Electricity, Gas and Water Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         19
                                                  Wald chi2(11)   =  3.949e+10
Log likelihood =  42.850031                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   legw_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     egw_ncr |   .0090009   .0019071     4.72   0.000     .0052631    .0127387
     egw_car |  -.0257456   .0026133    -9.85   0.000    -.0308677   -.0206236
       egw_1 |   .0334701    .003646     9.18   0.000     .0263241    .0406161
       egw_2 |   .0082064   .0020834     3.94   0.000      .004123    .0122897
       egw_3 |   .0171789   .0019283     8.91   0.000     .0133996    .0209583
       egw_5 |  -.0069114     .00166    -4.16   0.000    -.0101649   -.0036579
       egw_6 |   .0047616   .0012487     3.81   0.000     .0023143     .007209
       egw_7 |   .0211693   .0009738    21.74   0.000     .0192607    .0230779
       egw_8 |  -.0279705   .0019875   -14.07   0.000     -.031866    -.024075
      egw_10 |   .0086202   .0016469     5.23   0.000     .0053923    .0118481
      egw_11 |  -.0188308   .0023683    -7.95   0.000    -.0234726   -.0141889
       _cons |   2.671344   .0111415   239.76   0.000     2.649507    2.693181
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.07353   384.2365    -0.10   0.921    -791.1633    715.0162
    /lnsig2u |  -5.962112   .3244429   -18.38   0.000    -6.598009   -5.326216
-------------+----------------------------------------------------------------
     sigma_v |   5.40e-09   1.04e-06                     1.6e-172    1.8e+155
     sigma_u |   .0507392    .008231                     .0369199    .0697312
      sigma2 |   .0025745   .0008353                     .0009374    .0042116
      lambda |    9395187    .008231                      9395187     9395187
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 18.97  Prob>=chibar2 = 0.000
```

Figure 17 Estimated Technical Efficiency of Electricity, Gas and Water Sector (1988-2007)



Transportation Sector

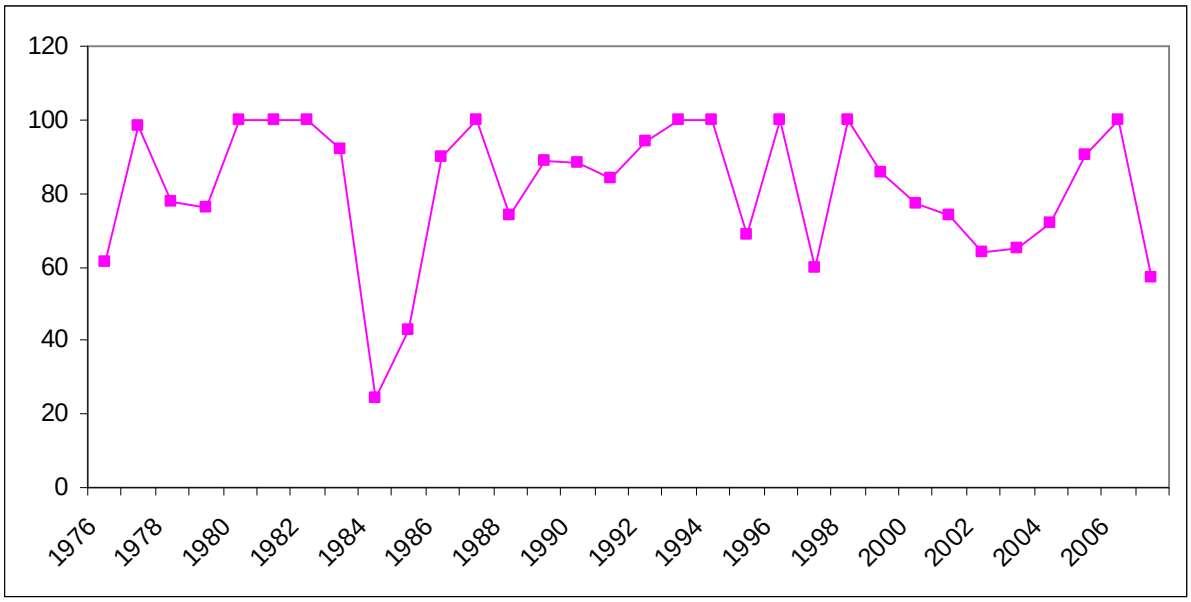
Patterns in growth of the transportation sector are quite homogeneous across the sectors. Only two components will be needed to summarize the growth of the sector across the regions accounting for 80% of their total variations. The first component simply aggregates growth in all the regions while the second component separates those in CAR, Ilocos, and Cagayan Valley. The regions in the second component are among the areas requiring long hours of inland road transportation.

The stochastic frontier model whose estimates are summarized in Table 23 indicates that NCR, Central Visayas, and Zamboanga Peninsula are the most important contributors of growth in the transportation sector. The sector is quite inefficient with an average of 81% technical efficiency coefficient for the period 1976-2007. In Figure 18, the efficiency level of the sector is highly volatile dropping to the lowest point in 1984/1985. The recent trend also shows a declining efficiency level for the sector.

Table 23 Estimates of the Stochastic Frontier Model for Aggregate Growth-Transportation Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(10)   =  1.439e+09
Log likelihood =  7.5827168                       Prob > chi2     =     0.0000
------------------------------------------------------------------------------
 ltrans_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   trans_ncr |   .0769251   .0010086    76.27   0.000     .0749484    .0789019
     trans_1 |   .0157473   .0051712     3.05   0.002     .0056119    .0258827
     trans_2 |    .023273    .009196     2.53   0.011     .0052493    .0412968
     trans_3 |   .0156578   .0027075     5.78   0.000     .0103513    .0209644
     trans_7 |    .059727   .0150382     3.97   0.000     .0302526    .0892014
     trans_8 |   .0263149   .0074428     3.54   0.000     .0117272    .0409026
     trans_9 |   .0498941   .0219249     2.28   0.023     .0069222     .092866
    trans_10 |   .0263247    .008437     3.12   0.002     .0097884     .042861
    trans_11 |  -.0340919   .0186434    -1.83   0.067    -.0706322    .0024485
    trans_12 |  -.0668748   .0233306    -2.87   0.004    -.1126019   -.0211477
       _cons |   1.079504   .0177462    60.83   0.000     1.044722    1.114286
-------------+----------------------------------------------------------------
    /lnsig2v |  -36.81204   980.9765    -0.04   0.970    -1959.491    1885.867
    /lnsig2u |  -1.925503        .25    -7.70   0.000    -2.415494   -1.435511
-------------+----------------------------------------------------------------
     sigma_v |   1.01e-08   4.98e-06                            0           .
     sigma_u |   .3818409   .0477301                      .2988699    .4878459
      sigma2 |   .1458025   .0364506                      .0743606    .2172444
      lambda |   3.76e+07   .0477301                      3.76e+07    3.76e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 19.37  Prob>=chibar2 = 0.000
```

Figure 18 Estimated Technical Efficiency of Transportation Sector (1976-2007)



Trade Sector

Trade sector involves a lot of the informally organized entities. Three components can summarize variation in growth across the regions accounting for 77% of their total variation. The first component is an aggregate of growth in all the regions. The second component combines the growth in Zamboanga Peninsula and in SOCSKSARGEN. The third component however, is a contrast between Cagayan Valley and SOCSKSARGEN.

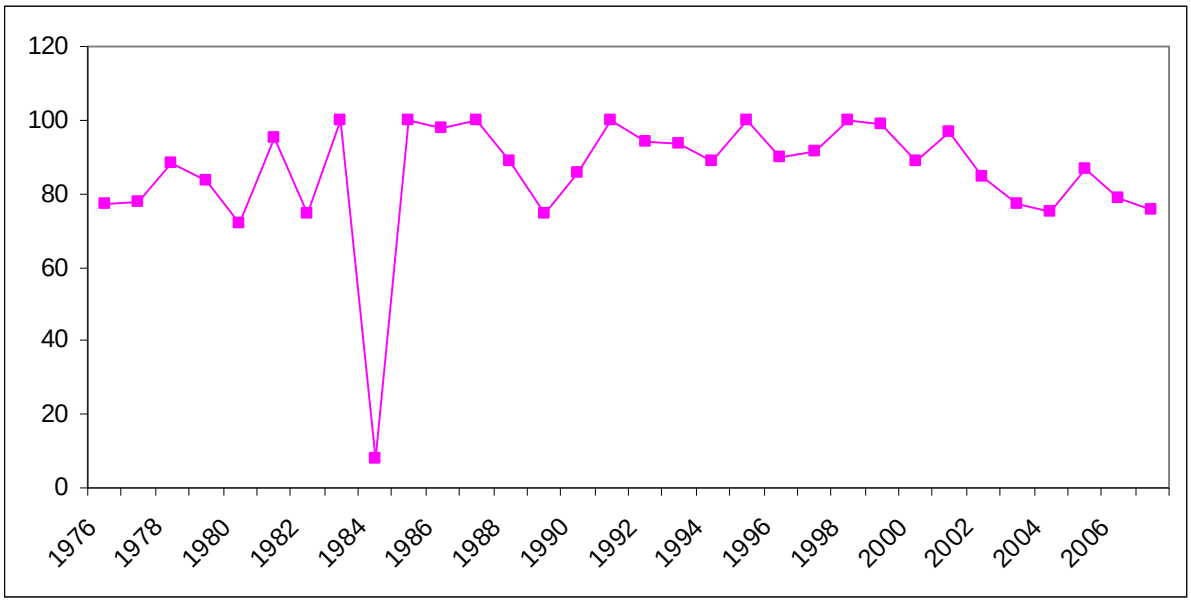
In Table 24, there is empirical evidence on the importance of the contribution of NCR, Central Luzon, and Western Visayas on the growth of the trade sector. The average technical efficiency coefficient for the period 1976-2007 is 86%, relatively higher compared to other sectors. Except in 1985 where the sector became extremely inefficient, technical efficiency hovers around the 80% level. There is however a declining trend exhibited in the recent period, see Figure 19 for details.

Table 24 Estimates of the Stochastic Frontier Model for Aggregate Growth-Trade Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(6)    =  3.065e+10
Log likelihood =  .25045474                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
 ltrade_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   trade_ncr |   .0285599   .0003886    73.49   0.000     .0277982    .0293216
     trade_1 |   .0071931   .0073266     0.98   0.326    -.0071668     .021553
     trade_3 |   .0246689   .0303166     0.81   0.416    -.0347507    .0840884
     trade_6 |   .0224489    .004303     5.22   0.000     .0140151    .0308827
     trade_9 |   .0156588   .0017577     8.91   0.000     .0122139    .0191038
    trade_11 |   .0294628   .0217953     1.35   0.176    -.0132553    .0721809
       _cons |   2.008037   .0365726    54.91   0.000     1.936355    2.079718
-------------+----------------------------------------------------------------
    /lnsig2v |  -40.07386   1375.171    -0.03   0.977     -2735.36    2655.213
    /lnsig2u |  -1.467236         .25    -5.87   0.000    -1.957227   -.9772451
-------------+----------------------------------------------------------------
     sigma_v |   1.99e-09   1.37e-06                              0           .
     sigma_u |   .4801686   .0600211                      .3758318    .6134708
      sigma2 |   .2305618   .0576405                      .1175886    .3435351
      lambda |   2.42e+08   .0600211                      2.42e+08    2.42e+08
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 27.20  Prob>=chibar2 = 0.000
```

Figure 19 Estimated Technical Efficiency of Trade Sector (1976-2007)



Finance Sector

The growth in finance sector is very homogeneous across the regions, with only one component needed to explain 76% of the total regional growth variations. The resulting component averages with similar weights for regional growths on the sector.

NCR, Ilocos, and Northern Mindanao are among the most important drivers of growth of the sector (see Table 25). The average technical efficiency is relatively low at 81% for the period

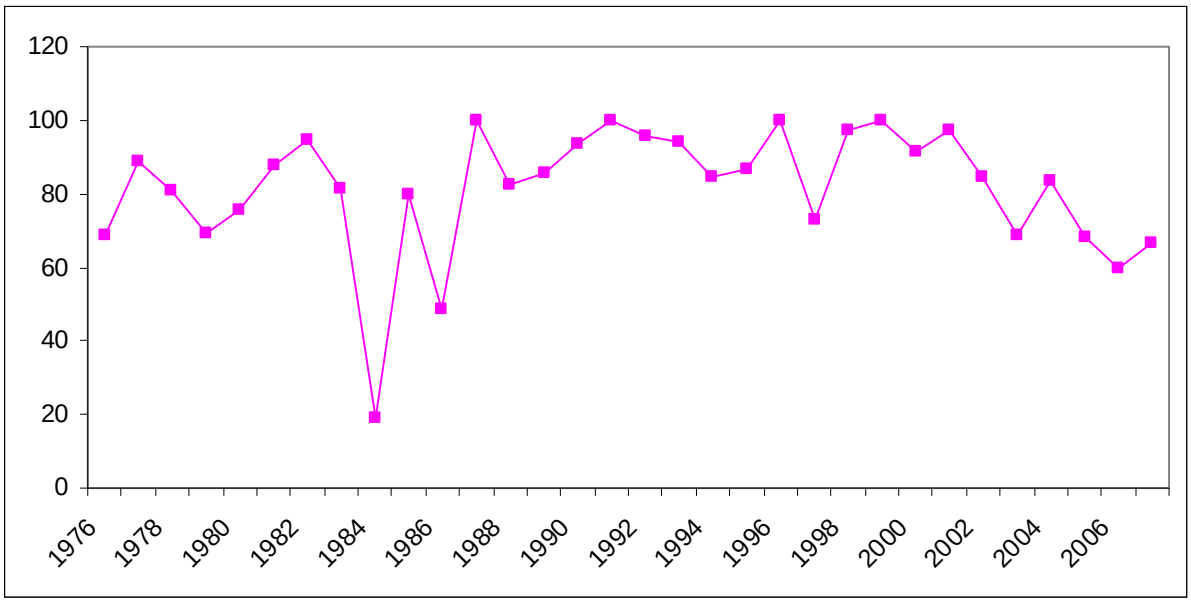
1976-2007. Inefficiencies can be observed similarly in 1985 lasting until the early part of the administration of Pres. Aquino. The 1997 Asian Financial Crisis also pulled down the efficiency level. The recent trend however, exhibits declining efficiency level for the sector, see Figure 20 for details.

Table 25 Estimates of the Stochastic Frontier Model for Aggregate Growth-Finance Sector

```
Stoc. frontier normal/half-normal model           Number of obs   =         32
                                                  Wald chi2(4)    =  3.871e+10
Log likelihood =  6.9593001                       Prob > chi2     =     0.0000

------------------------------------------------------------------------------
   lfin_phil |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     fin_ncr |   .0329179   .0015431    21.33   0.000     .0298934    .0359424
       fin_1 |    .038299   .0072334     5.29   0.000     .0241218    .0524761
       fin_2 |  -.0298955   .0093394    -3.20   0.001    -.0482005   -.0115906
      fin_10 |   .0377684   .0079199     4.77   0.000     .0222456    .0532912
       _cons |   2.995509   .0029397  1018.99   0.000     2.989747    3.001271
-------------+----------------------------------------------------------------
    /lnsig2v |  -38.09511   628.1115    -0.06   0.952    -1269.171    1192.981
    /lnsig2u |  -1.886539        .25    -7.55   0.000     -2.37653   -1.396548
-------------+----------------------------------------------------------------
     sigma_v |   5.34e-09   1.68e-06                      2.5e-276    1.1e+259
     sigma_u |   .3893528   .0486691                      .3047495    .4974432
      sigma2 |   .1515956   .0378989                      .0773151     .225876
      lambda |   7.29e+07   .0486691                      7.29e+07    7.29e+07
------------------------------------------------------------------------------
Likelihood-ratio test of sigma_u=0: chibar2(01) = 24.73  Prob>=chibar2 = 0.000
```

Figure 20 Estimated Technical Efficiency of Finance Sector (1976-2007)



7. Conclusions and Recommendations

There is a highly diverse fluctuation in growth of outputs across the regions and among the sectors. Efficiency of the aggregate economy and for some sectors and in some regions sometimes reaches near frontier level, but this is not maintained consistently within the period 1976-2007. This indicates that sustainable growth of the Philippine economy may be stimulated by efficiency-enhancing policies for some sectors and in some regions.

The agriculture sector is not among the fast-growing sectors, contrary to what has been identified in many growth models to be the important driver of aggregate growth. Efficiency in agriculture could mean higher productivity and possible migration of the skilled laborers to other sectors to increase productivity in that sector as well. The stochastic frontier model for aggregate growth of all sectors in the Philippines with the growth of the different sub-sectors as inputs further revealed that growth is propelled primarily by the manufacturing sector. Construction also contributes significantly to aggregate growth but to a lesser rate. While the agriculture, fishery and forestry contributes significantly to aggregate growth, the magnitude is too low for what the growth theory points out as an important stimulus to economic growth.

The National Capital Region is the most important determinant of the variation in growth of the national economy. Western Visayas, Central Visayas, Bicol Region and the Zamboanga Peninsula are also among the top five contributing regions for the growth of the aggregate economy.

Growth in Western Visayas is the most important determinant of growth in agriculture, fishery, and forestry (AFF). The AFF is one of the more efficient sectors but efficiency is not consistently maintained over time. In 1998, when the worst El Nino episode of the century hit, technical efficiency dropped to the lowest point. Even with the passing of the Agriculture and Fisheries Modernization Act (AFMA) in 1997, efficiency of the AFF remains unstable until the most recent year.

There is indeed a significant spatial-temporal variation in growth of regional and sectoral economies in the Philippines. The volatility of growth in the regions/sectors is caused by efficiency fluctuations over time and space. Policy support, governance, allocation of resources aligned to their needs, are some of the directions that can be pursued to sustain efficiency of economic production that will subsequently accelerate growth of the economy.

The efficiency-enhancing interventions should focus on the agriculture, fishery and forestry sector. As the sector becomes efficient, productivity may also increase, initiating skilled labor migration towards other sectors. This will also stimulate efficiency and productivity in other sectors and subsequently drive growth of the macroeconomy. Other sectors that need to be considered are: transportation, trade, finance and private services. Among the regions, efficiency-enhancing interventions can be directed towards Regions 3, 10, 11, and 12.

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