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# Boom-bust cycles and crisis periods in the Philippines: a regime-switching analysis

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**Abstract**

This study examines Philippine macroeconomic fluctuations using Markov regime-switching techniques. Using all available GDP data, an annual and a quarterly model are constructed to explain Philippine boom-bust cycles as switches into any of three states — a moderate growth state, a low growth state and a crisis state. The number and labeling of states are based on historical events. The annual model shows adequate tracking ability. The quarterly model reveals a finer classification of the bust phase into low growth states and crisis states for the 1990-decade — a result that does not appear in the annual model. The crisis dates determined by the quarterly model closely correspond to the four crisis episodes that occurred between 1981 and 1999.

*JEL classification:* E32, O11
*Keywords:* Boom-bust cycles, macroeconomic fluctuations, Markov regime-switching

## 1. Introduction

It is a widely held view that Philippine economic development is characterized by boom-bust cycles. These cycles show uneven sequences of high and low growth periods and are best represented by the actual path of GDP growth. This boom-bust phenomenon observed by researchers on the Philippine economy has been the subject of studies that try to understand and explain growth interruptions in relation to Philippine economic development. (See for example, Fabella [1995], De Dios [1998], and Rodlauer [2000]).

The main objective of this article is to analyze and track Philippine economic growth and development by identifying the boom-bust cycles noticed by these authors. This is done using Markov regime-switching methods originally proposed by Hamilton [1989] to study business cycles of developed economies (DEs). In his study, Hamilton uses a two-state Markov regime-switching model to date business

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cycle turning points of the US economy. The probabilities of occurrence of peaks and troughs his model generated closely correspond to the peak and trough dates established by the NBER. The method has also been applied successfully in examining business cycles of other developed economies (see Goodwin [1993]). The technique is, however, general enough to be used in examining less developed economy (LDE) growth cycles, especially those that show drastic structural change.

This study requires a model that generates results consistent with events that transpired in the various stages of growth and development of the Philippines. It is therefore necessary to give a historical background of Philippine economic performance. This is done in the second section. The historical accounts provide leads as to the state of the Philippine economy at the various stages of her development. In this section, it is seen that boom periods may be associated with *moderate growth states*. The bust phase on the other hand may be identified with either *low growth states* or *crisis states* or a mixture of both. Hence, the paper posits that Philippine economic fluctuations are best described by switches into any of these three states and can be modeled using Markov regime-switching techniques.

The third section briefly describes the Markov regime-switching methods used in dating business cycle turning points. The fourth section presents the results of parameter estimation and the inferences made about the state of the economy at a particular time using quarterly and annual real GDP data. The final section summarizes and concludes.

## 2. Philippine economic performance from 1950 to 1999

### *2.1 1950-1959*

The Philippine economy began to pick up in the late 1940s as a result of the reconstruction following the Second World War. With the basic infrastructure in place, the economy entered the 1950-decade growing in an environment shaped by an import substituting industrialization strategy. However, the expected structural transformation — maturity of industries using domestic inputs to produce goods that were previously imported — under this industrialization strategy did not happen. A key element of an import substituting industrialization strategy is the erection of temporary tariff barriers to protect the industries in their infancy. It was therefore cheaper for firms at this time to use imported inputs to produce import substitutes. It is well known that these protective barriers were not lifted and that serious efforts to dismantle this structure were not undertaken until only recently.

Import-substituting firms encouraged by the strategy remained dependent on imported inputs, and because the peso was overvalued owing to exchange controls imposed since 1949, trade deficits became the rule. Reasonable growth rates were recorded. However, towards the end of the decade, the pressure to devalue the peso increased, inflation rose, and growth slowed down.

### *2.2 1960-1969*

After a decade of growth, the economy bottomed out in 1960; in 1962, the peso succumbed to exchange market pressure, the exchange rate moved from 2.02 to 3.85 pesos per dollar and IMF help was sought [Montes 1987]. Researchers on the Philippine economy observed this initial pattern — several periods of moderate growth followed by a slowdown — replicating itself in the succeeding decades.

During this decade, policy makers also experimented with multiple exchange rate systems. While the 1962 devaluation eased the pressure on the BOP for a while, import growth consistently outstripped export growth in the remaining years of this decade. This is because the export promotion strategy adopted when the import-substituting strategy was abandoned was difficult to reconcile with a fixed exchange rate regime in the light of real appreciation. The sluggishness of the foreign trade sector throughout the decade (despite the investment incentives to export firms) contributed to a BOP crisis in 1970 (see Jurado [1976]).

### *2.3 1970-1979*

To cushion the impact of the 1970 BOP problem, the Philippines entered another IMF-sponsored structural adjustment program that aimed to correct the structural defects of the economy. The move towards a centralized government with the imposition of martial law in 1972 made it easier for the government to spend for capital outlays using foreign money. During this period, foreign borrowing was the main mode of financing public investment. Because of this, the 1970-decade was marked as the period of "debt-driven growth." Given that the Philippines is a relatively small and highly open economy, the volatile international environment led to wild swings in domestic business activity. The highest growth for the decade of 8.5 percent in 1973 due to the so-called export boom was followed by a low 3.5 percent in 1974 after the first oil shock. With available foreign resources being directed towards low productivity investment, little structural adjustment took place. In this decade, one sees a half-hearted implementation of an outward looking strategy reflected in the vigorous defense of the exchange rate.

### *2.4 1980-1989*

The progressive deterioration of the Philippine economy from the 1970s up to the early 1980s has many roots including the inefficient allocation of debt-financed investment of the late 1970s. Rising incremental capital-output ratios and deteriorating external terms of trade reflected these inefficiencies. The previous decade's 'hybrid' industrialization strategy (export promotion under a fixed exchange rate regime) made the economy vulnerable to external shocks. A widening crisis in the financial sector, which began with the collapse of the commercial papers market in 1980, and a worsening external debt profile, in which short-term debt amounted to 25 percent of total external debt, were clear indications of further deterioration. Deficits on the fiscal side and the current account began to rise and the savings-investment gap widened. These set the stage for the worst BOP crisis that hit the Philippines in the third quarter of 1983, two years after the second oil shock. In October 1983, a moratorium on external debt payments was declared, which effectively meant that no new inflows from abroad would be forthcoming. The total collapse of the Philippine economy was manifested by negative annual growth rates of –7.6 percent for both 1984 and 1985. The economy recovered towards the end of the 1980-decade with IMF assistance. This was reflected in an average growth rate of 5.6 percent from 1987 to 1989 under a new government. The gravity of the crisis also forced the new government to seriously implement structural reforms in trade, finance and regulation.

### *2.5 1990-1999*

In the 1987-89 recovery, consumption demand was the primary source of growth followed by significant increases in public investment financed by domestic borrowing. During this period, increases in investment rates and the government's pump-priming program that generated huge fiscal deficits raised capacity. However, these deficits led to a poor macroeconomic environment. To steer the economy away from the fiscal crisis, the government adopted a tight monetary policy, cut spending and raised indirect taxes that, together with uncertainties in the international environment due to the gulf war, led to a slowdown beginning in 1990. In 1991, the breakdown of power plants forced firms to cut production and led to negative growth. The effects of the power crisis lasted until the first half of 1993.

A new government vigorously pursued trade liberalization in 1992 and liberalization of the foreign exchange market in 1993. Foreign capital began to come in at this time, and reached its highest level at approximately 7 percent of GDP in 1996. The economy's average growth rate for the years 1994 to 1997 was 4.9 percent. The Asian financial crisis that hit the Philippines in August 1997, in addition to the El Niño weather phenomenon, halted the growth episode and GDP growth stood at –0.54 percent in 1998.

### *2.6 Discussion*

Table 1 lists the important events that occurred in each decade from 1950 to 1999. As a further guide, panel D of Figure 1 shows the graph of GDP growth for the whole period under study. This diagram gives a visual perspective of Philippine boom-bust cycles. From the historical account above, one will notice a pattern of moderate growth for several years, followed by deterioration. After a slowdown, inflow of foreign resources lifts the foreign exchange constraint and the economy is back on track to the normal growth path. One can see this pattern in the early growth years of the 1950s that were financed by war reparations. This was followed by the bust period in 1960 when exchange market pressure came about because of a binding foreign exchange constraint. Another cycle in the 1960s began when recovery was made possible with IMF assistance. Growth continued until the BOP crisis in 1970 and the first oil shock in the mid-Seventies hit the economy.

**Table 1. Significant Events from 1950 to 1999**

| *Decade* | *Highlights* |
|---|---|
| 1950 – 1959 | Reconstruction financed by war reparations; Import substituting industrialization strategy |
| 1960 – 1969 | 1962 devaluation; Abandonment of import-substituting industrialization strategy; Initial IMF help; Multiple exchange rate regimes |
| 1970 – 1979 | 1970 BOP problem; First oil shock; Debt driven growth with IMF assistance; martial law. |
| 1980 – 1989 | Second oil shock; 1983 BOP crisis; Political instability; Debt moratorium; Capital flight; End of martial law; Recovery with IMF assistance |
| 1990 – 1999 | Recession in 1990 due to the fiscal crisis; Power crisis of 1992; Asian currency crisis of 1997. |

It should be pointed out that most of the growth during the years from 1950 to 1980 was due to more resources being made available rather than on more productive use of existing resources. Thus, for boom periods, which can be associated with moderate growth states, the economy can be described as being awash with dollars, allowing it to raise import levels. Bust periods on the other hand can be characterized by foreign exchange shortages that curtail imports of raw materials and capital goods. (see also, de Dios [1998])

Growth interruption is a severe consequence of capital flight and a sudden stop of inflow of foreign resources. An example of this is the bust period from 1983 to 1986. During this period, political instability led to massive capital flight and further raised doubts about the ability of the economy to recover quickly. After this crisis, the flow of foreign money was not as easy as before. The crisis introduced a new dimension to the bust phase, which at this point, may now be characterized by either low growth periods (as in the 1960 bust) or crisis periods or both.

The boom-bust cycles experienced by the Philippines point to the important issue of sustainability of growth (see Fabella [1995]). An examination of the GDP growth path in Panel D of Figure 1 shows a more volatile movement and a seemingly shorter cycle length after the 1983 crisis as compared to periods prior to it. One can see that after the recovery, the growth interruptions in the 1990s were caused by crisis events – the fiscal crisis, the power crisis and the Asian financial crisis. This change in the growth pattern, cycle length and depth of the bust phase may arguably be attributed to structural reforms made after the 1983 crisis. These reforms, though extensive, were believed to be insufficient to address other structural problems like the low domestic savings rate and weak tax collection efforts, which proved to be the barriers to sustained growth (see De Dios [1998]). This may be the reason why the boom-bust cycle continues, though at a shorter cycle length. This is not to say that the reforms put in place were fruitless. The benefits of reforms came to light when observers noticed that the economy did not suffer as much from the Asian crisis as compared to its neighbors. A partial recovery was seen in 1999.

## 3. The Markov regime-switching method

In this study, boom-bust cycles in a LDE may be thought of as the analog of business cycles that describe business peaks and troughs of a DE. In both cases, one is interested in analyzing the series of high and low levels of output around some trend. Output gaps associated with these deviations from trend may be due to either real or monetary shocks and are of primary concern to policy makers in both LDEs and DEs. While boom-bust cycles and business cycles both describe economic fluctuations, a further distinction between them apart from the LDE and DE differentiation, can be made. The output trend in business cycle analysis of developed economies is associated with the time path of the full employment level of output. LDEs experiencing boom-bust cycles, however, are believed to operate at less than the full employment level of output. Thus, it might not be proper to associate the output trend in boom-bust cycles with the full employment output level.[1] Setting this difference aside, this article adopts Markov regime-switching methods used in analyzing DE business cycles to·track the history of booms and busts in the Philippines.

The technique is well suited to examine systems subject to drastic changes in regimes, which can be interpreted as discrete shifts in the parameters governing the motion of one of the system's main variables. Looking at panel D of Figure 1 once more, the Philippine economy appears suitable as subject of analysis using this method.

[1] One can think of other differences in terms of the types of shocks specific to LDEs and the policy responses to these shocks that also influence the growth path. However to keep the scope manageable, this paper limits itself to an analysis of an LDE's growth cycle and avoids comparisons with DEs.

The model used here follows Hamilton [1989, 1994] where the economy's growth rate is assumed to obey an autoregressive process of order $k$:

$$y_t - \mu(s_t) = \phi_1[y_{t-1} - \mu(s_{t-1})] + \ldots + \phi_k[y_{t-k} - \mu(s_{t-k})] + \varepsilon_t \quad (1)$$

where $y_t$ is output growth; the $\phi_k s$ are the $k$ autoregression parameters and $\varepsilon_t$ is a white noise process. $\mu(s_t)$ is the mean of output growth when the economy is at state $s_t$. In this study, the state of the economy is assumed to be the outcome of an unobserved first-order 3-state Markov process, where states 1, 2 and 3 correspond respectively to moderate growth, low growth and crisis periods that were discussed in the previous section.[2] Its evolution can be described by transition probabilities, $\Pr(s_t = j \mid s_{t-1} = i) = p_{ij}$, which can be organized in matrix form:

$$\mathbf{P} = \begin{bmatrix} p_{11} & p_{21} & p_{31} \\ p_{12} & p_{22} & p_{32} \\ p_{13} & p_{23} & p_{33} \end{bmatrix} \quad (2)$$

where $\sum_{j=1}^{3} p_{ij} = 1$. Each element shows the probability that state $i$ is followed by state $j$. For example, $p_{23}$ is the probability that a low growth state is followed by a crisis state.

The process $s_t$, is assumed to depend on past values of $y_t$ and $s_t$ only through $s_{t-1}$. Note, however, that since only $y$ is observed but not the state of the economy, a way must be devised to form optimal inference about the current state based on the observed values of $y$. Given the number of states, Hamilton [1989] shows how to estimate the parameters of the model and the transition probabilities above. He provides a recursive method for drawing probabilistic inference about the current state of the economy given the history of $y$. This method for drawing inference about the sequence of states, $\{s_t\}$, is an iterative process and is described by a nonlinear filter discussed in the next sub-section.

### *3.1 Hamilton's basic filter*

Assume for the moment that the parameters of the model with three states are known. To economize on notation, let $x_{t-1} = (y_{t-1}, y_{t-2}, \ldots, y_0)$ denote the history of $y$ up to time $t - 1$. Also, let $\Pr(Z = z)$ be represented by $p(z)$. Given the joint

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[2] A random variable, q, which satisfies the Markov property, is called a Markov process. It possesses the Markov property if the probability distribution for q t + 1 depends only on qt and not additionally on what happened before time t. Random walks and AR(1) processes have this property. The simplest example is a discrete time 2-state random walk: qt + 1 = qt + $h_{t+}$ 1 where $h_{t+}$ 1 is a random variable with probability distribution of:

$$\Pr(\eta_{t-1} = 1) = \Pr(\eta_{t-1} = -1) = \tfrac{1}{2} \quad t = 1, 2, \ldots$$

In this case, if $q_t = 5$, then $q_{t+1}$ can equal 4 or 6 with probability $\tfrac{1}{2}$.

conditional probability $p(s_{t-1},...,s_{t-k} \mid \dot{x}_{t-1})$, the objective is to arrive at $p(s_t,...,s_{t-k+1} \mid x_t)$ after updating the sequence $x_{t-1}$ to $x_t$, by adding $y_t$. Note that $(s_t,...,s_{t-k+1})$ is the sequence of $k$ most recent values of $s$.

The updating procedure is a series of steps given by equations (3) to (7). In this sequence, the left-hand-side of each equation is used as inputs to the succeeding equation. The algorithm begins by invoking the Markov property and assuming that $s_t$ is independent of $x_{t-1}$:

$$p(s_t, ..., s_{t-k} \mid x_{t-1} = p(s_t \mid s_{t-1}) \cdot p(s_{t-1}, ..., s_{t-k} \mid x_{t-1}) \quad (3)$$

where $p(s_t \mid s_{t-1}) = p(s_t \mid s_{t-1},...,s_{t-k}, x_{t-1})$. The next step shown by equation (4) computes for the joint density of $y_t$ and $(s_t,...,s_{t-k})$:

$$p(y_t, s_t, ..., s_{t-k} \mid x_{t-1}) = \quad (4)$$

$$p(y_t \mid s_t, ..., s_{t-k}, x_{t-1}) \cdot p(s_t, ..., s_{t-k} \mid x_{t-1}).$$

The second term on the right hand side above comes from step 1 shown in equation (3) while the first term is defined by:

$$p\left(y_t \mid s_t, ..., s_{t-k}, x_{t-1}\right) =$$

$$\frac{1}{\sqrt{2\pi}\sigma}\exp\left\{\frac{-[(y_t - \mu(s_t)) - \phi_1(y_{t-1} - \mu(s_{t-1})) - ... - \phi_k(y_{t-k} - \mu(s_{t-k}))]^2}{2\sigma^2}\right\}.$$

Next, note that the expression obtainable from (4),

$$p(y_t \mid x_{t-1}) = \textstyle\sum_{s_t=1}^{3} \cdots \sum_{s_{t-k}=1}^{3} p(y_t, s_t, ..., s_{t-k} \mid x_{t-1}), \quad (5)$$

can be combined with the result also given by equation (4) to arrive at:

$$p(s_t, ..., s_{t-k} \mid x_t) = \frac{p(y_t, s_t, ..., s_{t-k} \mid x_{t-1})}{p(y_t \mid x_{t-1})}. \quad (6)$$

The final output of the basic filter is then:

$$p(s_t, ..., s_{t-k+1} \mid x_t) = \textstyle\sum_{s_{t-k}=1}^{3} p(s_t, ..., s_{t-k} \mid x_t). \quad (7)$$

Further details on the algorithm can be seen in Hamilton [1988, 1989, 1994]. Markov regime-switching techniques have also been used in examining interest rates [Hamilton 1988], the peso problem [Kaminsky 1990] and exchange rate movements [Hamilton and Engle 1990].

There have also been some studies that analyze business cycles assuming more than two regimes. Sichel [1994] finds evidence linking inventory investment to a three-phase business cycle. A recent article by Cooper [1998] recognizes multiple regimes in the U.S. economy using regression tree analysis. These studies, however, do not use Markov regime-switching techniques.

### 3.2 *Filtered and smoothed probabilities*

As shown above, the filter operates by starting with the input, $p(s_{t-1},...,s_{t-k} \mid x_{t-1})$, in (3) to obtain the result in (7),

$$p(s_t, ..., s_{t-k+1} \mid x_t) \tag{8}$$

after an additional observation of *y*. This is the joint conditional probability of occurrence of the *k* most recent values of *s* given the complete history of *y* up to time *t*.

These probabilities can be summed up to obtain what is known as the 'filtered probability':

$$p(s_t \mid x_t) = \Sigma_{s_{t-1}=1}^{3} \cdots \Sigma_{s_{t-k+1}=1}^{3} p(s_t,...,s_{t-k+1} \mid x_t). \tag{9}$$

This is the probability that the economy is in either state 1, 2 or 3 given the information available at time *t*. For each period *t*, the 3 possible values sum to unity. Alternatively, it is also possible to compute for the probability of being in a state, $s_t$, using the full sample up to time *T*:

$$p(s_t \mid x_T) = \Sigma_{s_{t-1}=1}^{3} \cdots \Sigma_{s_{t-k+1}=1}^{3} p(s_t,...,s_{t-k+1} \mid x_T) \tag{10}$$

This is termed 'smoothed probability,' which is deemed more accurate since more information is used. Smoothed probabilities are reported in the empirical section.

A by-product of the algorithm is the likelihood function of $y_t$ that can be used to estimate the parameters of the model. From (5), one obtains the conditional log likelihood that can be maximized with respect to the unknown parameters in equations (1) and (2):

$$\log p\left(y_T, y_{T-1}, ..., y_k \middle| y_{k-1}, ..., y_0\right) = \Sigma_{t=k}^{T} \log p\left(y_t \middle| x_{t-1}\right). \tag{11}$$

All computations were done using the GAUSS software.[3]

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[3] The Markov switching GAUSS program used in this study can be obtained from James Hamilton's website: http://weber.ucsd.edu/~jhamilto/software.htm.

## 4. Empirical results

The choice of three states to model Philippine economic fluctuations should be clear from the preceding sections. These three states account for the moderate growth, low growth and crisis periods. In the early stages of the empirical exercise, no restrictions were placed on the transition probabilities except $0 \le p_{ij} \le 1$ and $\sum_{j=1}^{3} p_{ij} = 1$. However, difficulties were encountered as some unrestricted maximum likelihood estimates obtained boundary values, violating regularity conditions. To avoid this problem, some transition probabilities that were known to be zero were treated as constants and constrained to that value. For example, it is observed that a crisis state is not immediately followed by a moderate growth state and vice-versa. This is because a recovery is a gradual process and the arrival of a crisis is usually preceded by a slowdown in economic activity. Thus, it seems reasonable to set $p_{13} = \Pr(s_t = 1 \mid s_{t-1} = 3) = 0$ and/or $p_{13} = \Pr(s_t = 3 \mid s_{t-1} = 1) = 0$ in both annual and quarterly models. With these restrictions, it is easier to obtain a numerical solution to this highly non-linear problem.

All available GDP series were used in the study. Quarterly and annual GDP data at 1985 prices were obtained from the National Statistical Coordinating Board of the Philippines. The annual data is from 1948 to 1999. The NSCB started the quarterly series only in 1981 and the most current observation is for the fourth quarter of 1999. GDP growth rates, computed as 100 times the first difference of logs are shown on panel D of Figures 1 and 2. The annual model is useful in examining the full history as outlined in the second section. The available quarterly series is useful in providing a more refined classification of the state of the economy, which is not possible with annual data.

The first half of Table 2 shows the estimation results using annual data from 1951 to 1999 while the second half pertains to results using quarterly data from 1982:2 to 1999:4. The estimated transition matrix is shown in Table 3 for both models. The annual model is discussed first.

The annual model is estimated with two autoregressive lags ($k = 2$ in equation 1 above). The means and the variance of the innovation are estimated quite accurately as can be seen from the low standard errors. This is not the case for most of the transition probabilities where standard errors are relatively high. The smoothed probabilities plotted in panels A, B and C of Figure 1 are the probabilities that the economy is in a moderate growth state, low growth state or crisis state, respectively, using information from the full sample. As can be seen, they seem to track the movements of the economy fairly reasonably.

It can be seen in panel C of Figure 1 that the years 1984 and 1985 are classified as crisis states. It is also shown in the graphs that the four years of the BOP crisis from 1983 to 1986 are identified as a bust episode that is a mixture of low growth states (1983 and 1986) and crisis states (1984 and 1985). This bust episode is easily seen in Panel A which shows the probability that the economy is in a moderate

**Table 2. Annual and Quarterly Estimation Results**

| *Annual Model* Parameter | Estimate | Std. Error | *Quarterly Model* Parameter | Estimate | Std. Error |
|---|---|---|---|---|---|
| $\mu_1$ | 5.157 | 0.541 | $\mu_1$ | 1.299 | 0.105 |
| $\mu_2$ | 2.119 | 0.795 | $\mu_2$ | 0.568 | 0.341 |
| $\mu_3$ | −7.762 | 1.179 | $\mu_3$ | −2.505 | 0.205 |
| $\phi_1$ | 0.295 | 0.299 | $\phi_1$ | −0.901 | 0.157 |
| $\phi_2$ | 0.240 | 0.192 | $\phi_2$ | −0.896 | 0.159 |
| – | – | – | $\phi_3$ | −0.891 | 0.160 |
| – | – | – | $\phi_4$ | 0.095 | 0.157 |
| $\sigma^2$ | 2.029 | 0.621 | $\sigma^2$ | 2.136 | 0.430 |
| $p12$ | 0.176 | 0.130 | $p12$ | 0.124 | 0.088 |
| $p13$ | 0.000 | 0.088 | $p21$ | 0.199 | 0.146 |
| $p22$ | 0.320 | 0.266 | $p23$ | 0.152 | 0.084 |
| $p23$ | 0.129 | 0.133 | $p33$ | 0.601 | 0.160 |
| $p32$ | 0.492 | 0.349 | | | |

**Table 3. Transition Probability Matrices**

| *Annual Model* | | | *Quarterly Model* | | |
|---|---|---|---|---|---|
| 0.824 | 0.552 | 0.000 | 0.876 | 0.199 | 0.000 |
| 0.176 | 0.320 | 0.492 | 0.124 | 0.649 | 0.399 |
| 0.000 | 0.129 | 0.508 | 0.000 | 0.152 | 0.601 |

growth state. From that panel, one can also see the bust period of 1960 as a low growth state that coincides with the abandonment of the import-substituting policy. The year 1974 (when the first oil shock took effect) is also identified as a low growth state.

Note that the transition probabilities in Table 3 are time invariant and have a known geometric distribution. One can, therefore, compute for the expected duration of each state as $1/1 - p_{ii}$ (see Hamilton [1989]). Moderate growth periods with mean growth of 5.16 percent span 5.7 years. Low growth periods averaging 2.12 percent annually are expected to last for 1.5 years. Crisis states with an estimated average growth of –7.76 percent last for 2.0 years. This implies a complete cycle spanning approximately 9.7 years.

The quarterly version of the model is estimated with four autoregressive lags ($k = 4$ in equation 1 above) using all available, not seasonally adjusted data from the second quarter of 1982 to the fourth quarter of 1999. The second half of Table 2 shows the maximum likelihood estimates of quarterly model parameters while the second half of Table 3 gives the transition probabilities. The quarterly model provides relatively more accurate estimates of both parameters and transition probabilities as can be seen from the standard errors. State 1 is the moderate growth state with an average quarterly growth of 1.30 percent; state 2 is the low growth state that averages 0.57 percent; state 3 is the crisis state with an average growth rate of –2.50 percent.

For the quarterly model, Panel A of Figure 2 plots the smoothed probability that the economy is in a moderate growth state. The diagram shows boom-bust cycles that seem to occur with surprising regularity. The quarterly model also provides a finer classification of states. From panels A, B and C of Figure 2, the bust episodes of the 1990s are shown as combinations of low growth states and crisis states – information that is not apparent in the yearly model. Also, an exact match of boom and bust dates for the two models is not expected and slight discrepancies are observed. Bust period dates identified by both annual and quarterly models are shown in Table 4. These dates closely follow the chronology of events discussed in section 2.

The expected duration of the states for the quarterly model can also be computed using the formula given above. The length of the cycle in this case is 3.35 years (13.4 quarters) which is considerably shorter than the cycle length of the yearly model that includes the period 1950 to 1980.

The quarterly and annual model results demonstrate that a three-state process posited in this study is an adequate representation of the dynamics of the Philippine economy. Both models were able to infer from the data the boom and bust episodes that were discussed in section 2. The models were able to distinguish crisis states from low growth states in the bust phase, verifying the notion that bust periods in the Philippines are combinations of these states. The crisis dates determined by the quarterly model closely correspond to the periods which were deemed crisis periods by authors of studies mentioned above. These are the 1983 BOP crisis, the fiscal crisis, the power crisis and the Asian financial crisis.

**Table 4. Bust Period Dates Determined by the Models**

| *Annual Model** | *Quarterly Model* | |
|---|---|---|
| | *Low growth state* | *Crisis state* |
| 1960 | – | – |
| 1974 | – | – |
| 1983 to 1986 | 1983:1 – 1983:3 | 1983:4 – 1985:2 |
| | 1985:3 | |
| 1991 to 1992 | 1990:2 – 1990:3 | 1990:4 |
| | 1991:1 – 1992:1 | 1992:2 |
| | 1992:3 – 1993:3 | |
| 1998 | 1997:3 – 1997:4 | 1998:1 |
| | 1998:2 – 1999:1 | |

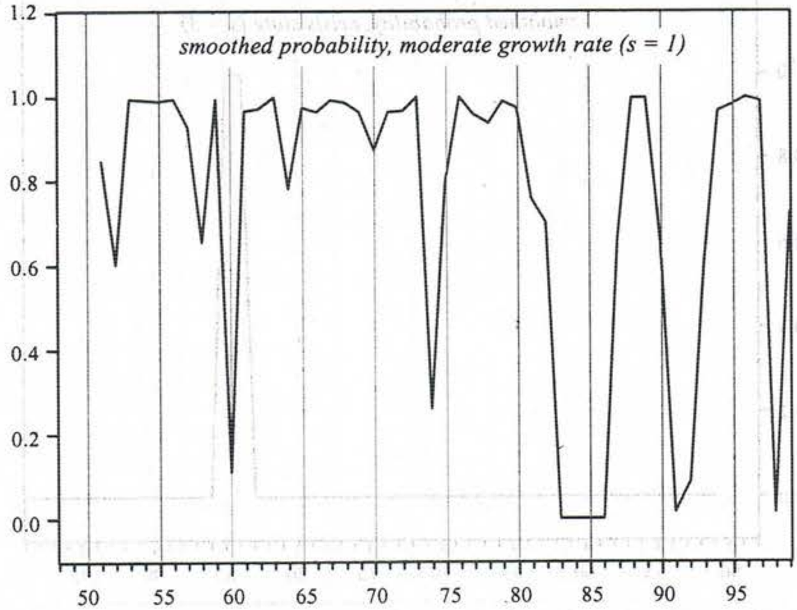
* 1984 and 1985 are crisis states; all the others are classified as low growth states

## 5. Summary and concluding remarks

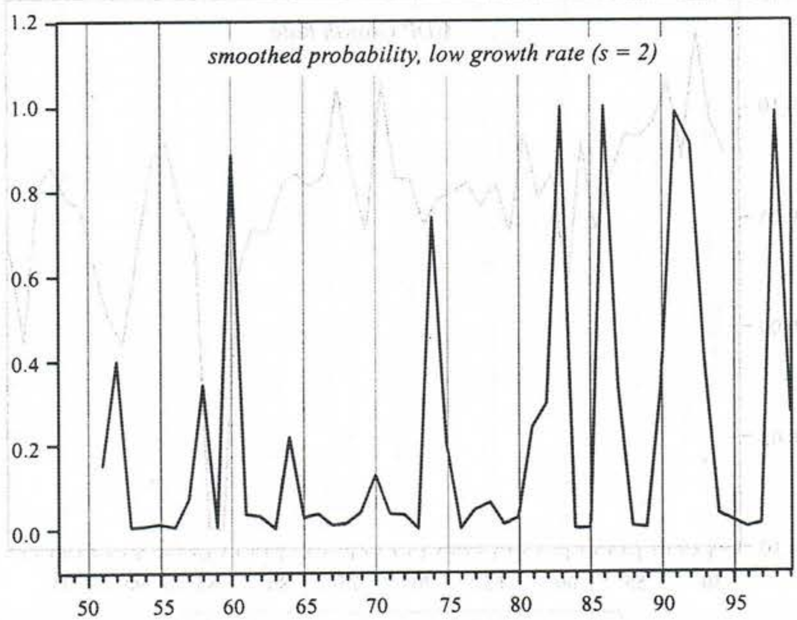
This study examines Philippine macroeconomic fluctuations using Markov regime-switching techniques. Using all available GDP data, an annual and a quarterly model are constructed to explain Philippine boom-bust cycles as switches into any of three states — a moderate growth state, a low growth state and a crisis state. The number and labeling of states are based on historical events. The annual model shows adequate tracking ability. The quarterly model reveals a finer classification of the bust phase into low growth states and crisis states for the 1990-decade — a result that does not appear in the annual model. The crisis dates determined by the quarterly model closely correspond to the four crisis episodes that occurred between 1981 and 1999.

Much effort was devoted to justify a 3-state process. However, it should be noted that in the econometric exercises for this paper, attempts were also made to fit a 2-state model for both annual and quarterly series. The results were uninteresting as periods were dichotomized into crisis and non-crisis states. In the annual 2-state model, the years 1984 and 1985 were responsible for the crisis states while the rest were classified as non-crisis periods. An attempt to model the Philippine economy's growth cycles as a 4-state process, using annual and quarterly data, was unsuccessful as difficulties were encountered in obtaining maximum likelihood estimates. The results of this paper strongly support the case for a three-state economy for the Philippines. The paper also demonstrates the ability of the Markov regime-switching technique to track a highly non-linear growth path due to large swings in economic activity and may be used to analyze other LDEs that experience occasional but drastic structural changes.

**Figure 1. Annual Model, 1949 – 1999**

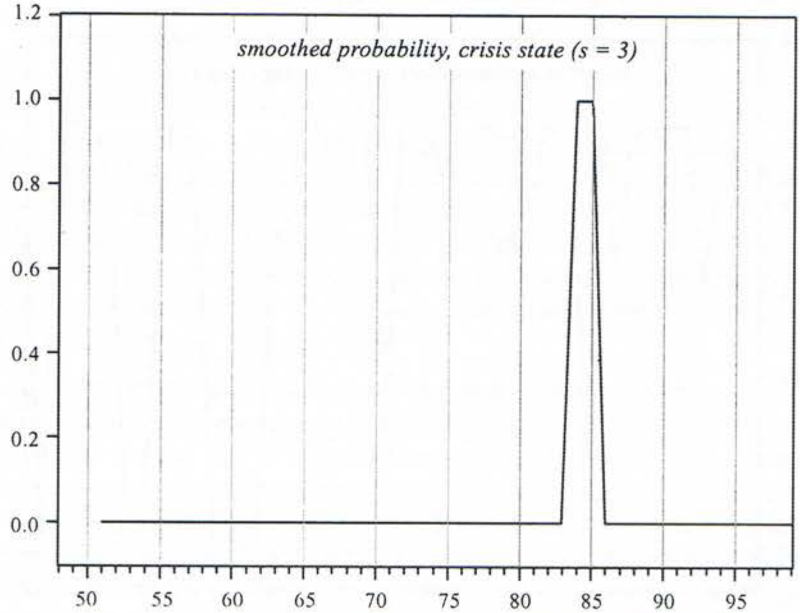



PANEL A: regime 1, probability that the economy is in a moderate growth state

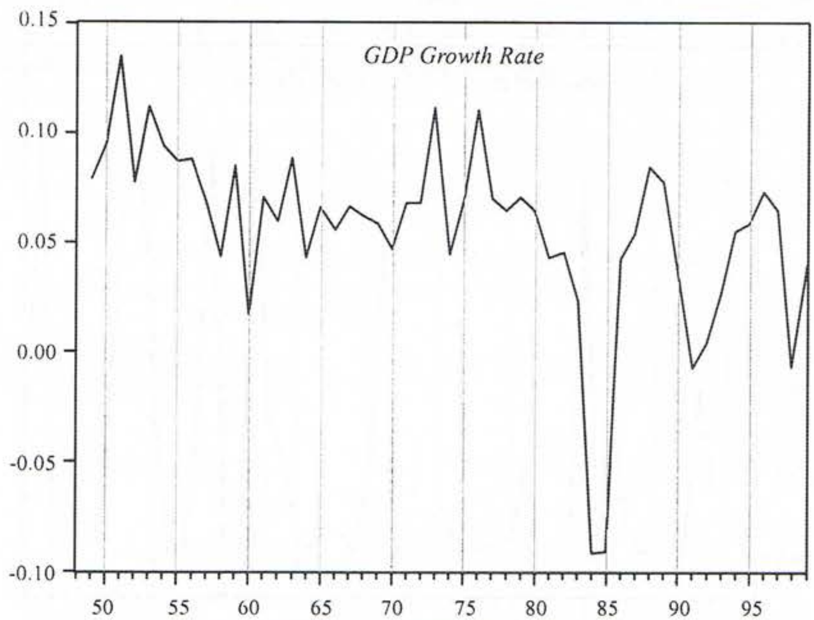



PANEL B: regime 2, probability that the economy is in a low growth state

**Figure 1. Annual Model, 1949 – 1999 (continued)**

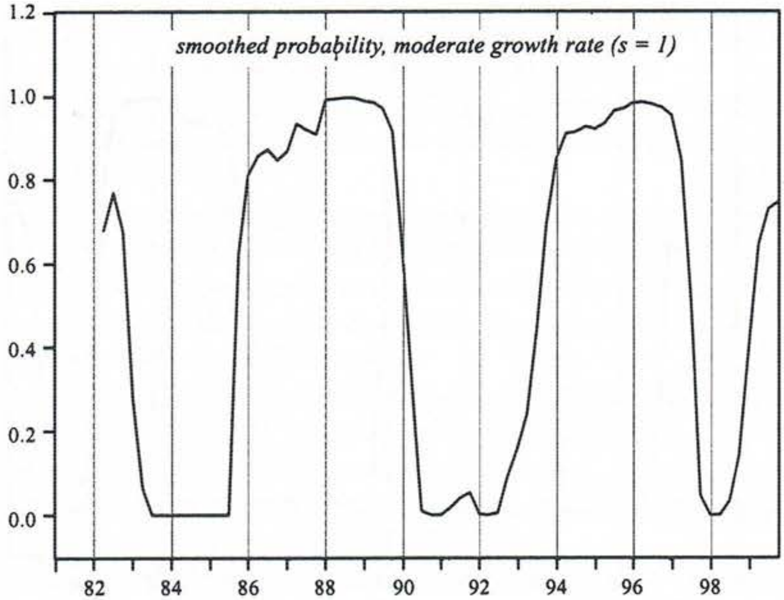



PANEL C: regime 3, probability that the economy is in a crisis state

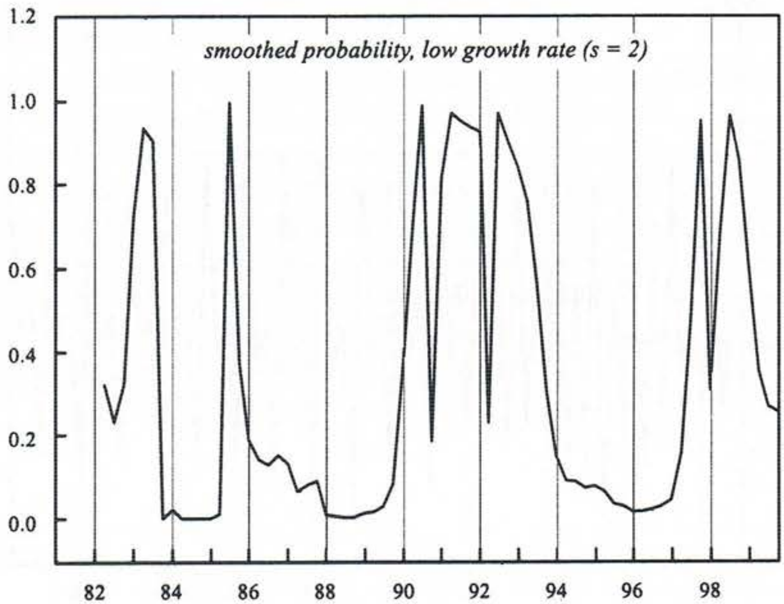



PANEL D: GDP growth rate, 1949-1999

**Figure 2. Quarterly Model, 1981:2 – 1999:4**

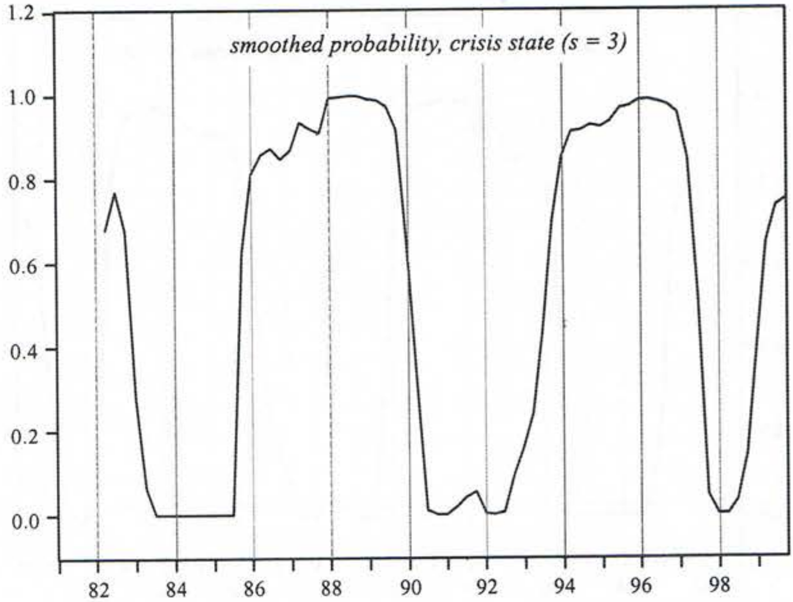



PANEL A: regime 1, probability that the economy is in a moderate growth state

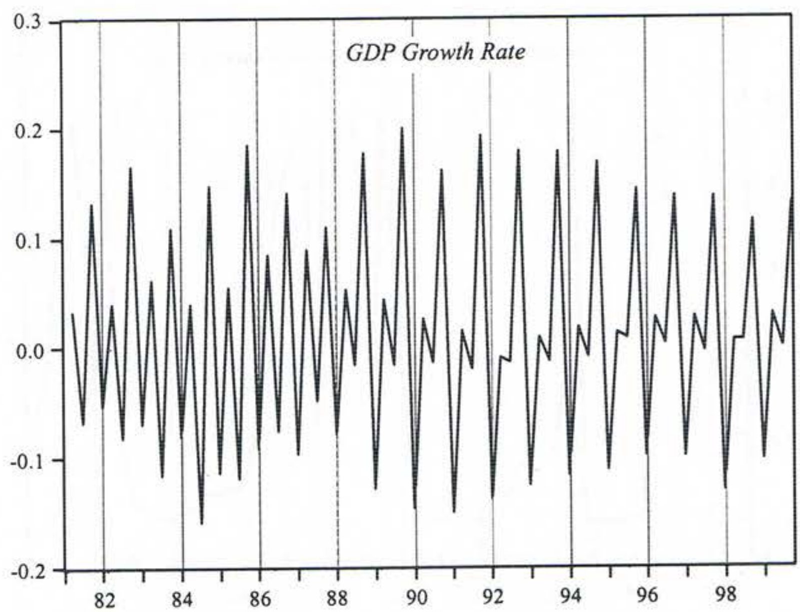



PANEL B: regime 2, probability that the economy is in a low growth state

**Figure 2. Quarterly Model, 1981:2 – 1999:4 (continued)**




PANEL C: regime 3, probability that the economy is in a crisis state




PANEL D: real GDP Growth, 1981:2 – 1999:4

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