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# A TOP-DOWN ECONOMETRIC MODEL FOR A PHILIPPINE REGION

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This paper demonstrates the feasibility of constructing a supply-determined top-down econometric model for a Philippine region. The specification, estimation, historical simulation, and ex-post forecast of the model for Region 7 (Central Visayas) are presented. The simulations show that the model tracks the sample period and ex-post values fairly well. The model could serve as a prototype for the other regions. The regional models could form a system of satellite models that could be linked to a national model which can then be used to determine regional forecasts consistent with a national forecast.

## 1. Introduction

Users of econometric forecasts and policy simulations who are concerned with regional issues and problems have been interested in generating regional estimates of production, employment, and other economic aggregates. Estimates of these aggregates on the national level are usually produced by national econometric models, and policymakers want to know their regional implications. The natural response to this demand is to construct regional econometric models that are consistent with the national model. A growing number of these models have been built and they generally fall into three types: (1) top-down models, (2) bottom-up models, and (3) top-down bottom-up models.

A top-down regional econometric model is one that can be linked to a national model in which the direction of causality is from the national model (top) to the regional model (down). The national model generates values of economic variables which are fed as exogenous inputs to the regional model.

The top-down model was the earliest variety of regional econometric model whose purpose was to link regional and national economic growth (Bell, 1967; Klein, 1969). It is based on the idea that the region is a small open economy operating in and being driven by the national economic environment. It has the advantage

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of being easy to build and attach in a consistent way to an existing national model. The main disadvantage is the lack of feedback from the regional model to the national model. Despite this limitation, top-down models have been useful in forecasting and policy analysis (Milne, *et al.* 1980; Crow, 1973). Moreover, they are good starting points for building other types of regional econometric models.

In a bottom-up model, the values of the regional variables are completely determined by the regional models while the values of the national variables are determined from the sums or averages of the regional variables. The main disadvantage of bottom-up models is that they ignore the fact that some variables, such as interest rate, are primarily determined at the national level. This led to the development of the hybrid model which combines the features of the top-down and the bottom-up models. (For a discussion of the various types of regional models, their problems and applications, see Adams and Glickman (1980) and Issaev *et al.* (1982)).

This paper specifies a supply-determined top-down econometric model for a Philippine region and presents the estimation, dynamic historical simulation, and ex-post forecast of the model for Region 7 (Central Visayas).[1] The specification follows the spirit of Klein's (1969) model and also draws from several other works on regional econometric modelling (e.g., Adams *et al.* 1975; Crow 1973; Milne *et al.* 1980.) Klein's suggestion for determining regional output by means of a production function is appropriate for developing economies where bottlenecks can occur due to limited investments. The simulations show that the model tracks the historical and ex-post values reasonably well. This model could serve as a prototype for the other regions of the Philippines. The regional models could form a system of satellite models that could be linked to a national model and could be used to determine (a) the regional forecasts corresponding to a national forecast and (b) the regional impacts of a given set of national policies. We illustrate these by presenting the result of a forecast and a policy simulation for Region 7.

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[1]An earlier demand-determined regional econometric model was constructed by Dr. Cayetano W. Paderanga and the author and estimated for Region 10 (Northern Mindanao) (Danao and Paderanga, 1988). Some of the specifications in the new model were drawn from that earlier model.

## 2. General Description of the Model

The model uses the national and regional accounts of the National Statistics and Coordination Board and is designed to be a part of a system of regional models which will be linked to a national model that also uses the same accounts. The regional model will be linked to the national model via output, employment, prices, government consumption, private investment, and public investment. These links are shown in Figure 1 which also shows the relationships among the major regional variables. The model determines gross regional product, regional personal consumption, regional private construction, regional employment, regional prices and wage rate, regional taxes, local government revenues and expenditures.

Regional output (real gross regional product) is determined by a production function while regional employment is determined by a demand-for-labor function of the output. Regional investment consists of public and private investments, the public component being exogenous and the private component being determined by national trends, interest rate, and expectations on the future of the regional economy. Regional prices are determined by national prices and regional wage rate while regional wage rate is determined by national wage rate, regional price and the legislated minimum wage rate. Regional output, representing economic activity, determines regional tax collection which affects disposable income which, in turn, affects personal consumption. A local government submodel consisting of local government revenues and expenditures was grafted to the model.

## 3. Specification

### *3.1. Stochastic Equations*

Output

Output in region $j$ ($QR_j$) is determined by a Cobb-Douglas production function

$$QR_j = (KR_j)^{\alpha}(E_j)^{\beta}(e)^{\tau T + \delta D}$$

where $KR_j$ is capital stock, $E_j$ is employment, $T$ represents technological progress, and $D$ is a dummy for political and economic crisis. Taking logarithms, we get

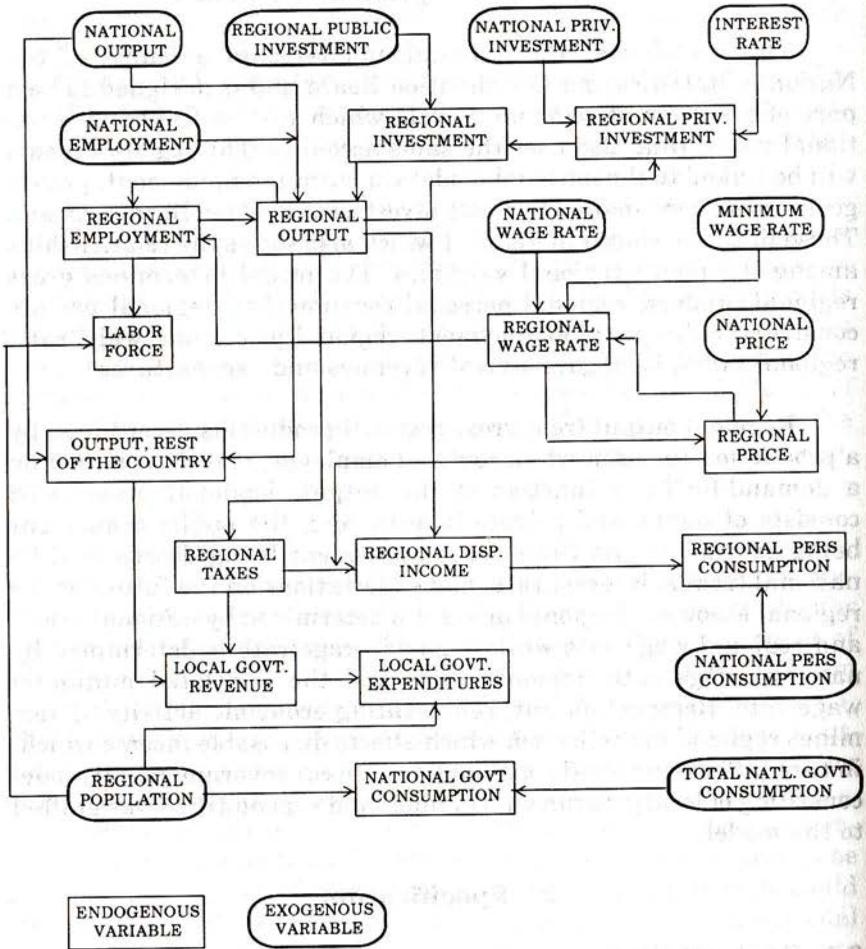


**Figure 1 – Schematic Diagram of the Model**

$$\log(QR_j) = \alpha \log(KR_j) + \beta \log(E_j) + \tau T + \delta D$$

As a measure of technological progress we use the national trend in productivity, $QR/E$, where $QR$ is real national output and $E$ is national employment. Thus,

(1) $\log(QR_j) = \alpha \log(KR_j) + \beta \log(E_j) + \tau (QR/E) + \delta D$

Personal Consumption

Real personal consumption expenditure ($PCER_j$) constitutes the largest component of final demand (e.g., $PCER_j$ averaged 56 percent of real Gross Regional Product of Region 7 during the period 1975-86). We specify a simple Keynesian formulation: consumption expenditure is a linear function of disposable income ($DINR_j$). $PCER_j$ is expected to increase as disposable income increases. National consumption trends, as reflected in the national personal consumption expenditure ($PCER$), are expected to influence regional consumption. Thus,

(2) $PCER_j = f(DINR_j, PCER)$

with $PCER$ having some lag structure.

Investment

Private investment in capital assets depends on the cost of capital and expectations on the future of the regional economy. The cost of capital is reflected by the real interest rate which is largely determined by national variables; hence, it is exogenous to the regional model. The expectations on the future of the regional economy is indicated by the change in output lagged one period, $DQR_j(-1) = QR_j(-1) - QR_j(-2)$, a form of the multiplier-accelerator principle. Since a portion of regional investments is made by industries that have national markets, we include national investment trends as an explanatory variable. Thus, for investment in private construction ($FCPR_j$), we have

(3) $FCPR_j = f(FCPR, INT, DQR_j(-1))$

where $FCPR$ is total investment in private construction, $INT$ is real interest rate, and $DQR_j$ is the change in output.

Investment in durable equipment ($DER_j$) is taken as exogenous since the data include both the private and public components. The public component, which depends solely on the decisions of policymakers, has made the data less amenable to model fitting. Government construction ($FCGR_j$) is also an exogenous variable since it is a policy variable.

## Capital Consumption

Capital consumption ($KCR_j$) depends on existing capital stock ($KR_j(-1)$ and the intensity of economic activity represented by real gross regional product ($QR_j$), i.e.,

(4) $KCR_j = f(KR_j(-1), QR_j)$.

Capital stock ($KR_j$) is then given by the identity

(4a) $KR_j = KR_j(-1) + GFIR_j - KCR_j$.

where $GFIR_j$ is gross fixed investment.

## National Government Consumption

National government consumption expenditure in region $j$ ($GCE_j$) depends on the national trend in government consumption expenditure ($GCE$), reflecting national fiscal policies. How much the national government allocates to the region depends on the size of the region as measured by the region's population ($POP_j$). $GCE_j$ will increase with increasing population as the government has to provide more services. Moreover, local government officials usually request budgets that exceed the previous year's allocation. Thus, we have

(5) $GCE_j = f(GCE, POP_j, GCE_j(-1))$

Government expenditure is in current pesos since government budgetary allocations are made on this basis.

## Employment and Labor Force

Employment ($E_j$) is specified as a demand-for-labor function of the level of output ($QR_j$) and real wage rate ($W_j/P_j$), expressed in logarithmic form:

(6) $\log(E_j) = \beta_0 + \beta_1 \log(QR_j) + \beta_2 \log(W_j/P_j)$.

This formulation may be derived from the first-order condition for profit maximization with a Cobb-Douglas production function (Intriligator, 1978).

Labor force ($LF_j$) is given as a function of population ($POP_j$) and the lagged value of regional employment ($E_j(-1)$). The lagged value $E_j(-1)$ acts as an expectations variable; a rising $E_j$ indicates an increasing number of jobs, attracting more people to join the labor force because of a higher probability of finding a job. Thus,

(7) $LF_j = f(POP_j, E_j(-1))$.

Employment rate is then given by

(7a) $ER_j = E_j/LF_j$

Taxes

We distinguish between national taxes and local taxes. National taxes ($NT_j$) and local taxes ($LT_j$) collected from the region are aggregations of different types of taxes; hence, we use regional output ($Q_j$) as the tax base. We, therefore, express taxes as linear functions of output. We also include the lagged values of the dependent variables to capture changes in the tax structure. We have

(8) $NT_j = f(Q_j, NT_j(-1))$

(9) $LT_j = f(Q_j, LT_j(-1))$

Regional Prices and Wage Rate

Regional prices are basically determined by national prices. Factors affecting prices (e.g., money supply, exchange rate) work their way through the national price variable (Klein, 1989). However, some regional variables (e.g., local wage rate) can influence the regional price level. Accordingly, regional price ($P_j$), represented by the Gross Regional Product (GRP) deflator, is expressed as a function of the national price level ($P$), represented by the Gross Domestic Product (GDP) deflator, and the regional wage rate ($W_j$). Similarly, the regional consumer price index ($CPI_j$) is estimated as a function of the national consumer price index ($CPI$) and the regional wage rate.

Thus we have

(10) $P_j = f(P, W_j)$

(11) $CPI_j = f(CPI, W_j)$.

The regional wage rate ($W_j$) is expressed as a function of national wage rate ($W$), the consumer price index ($CPI_j$), and the legislated minimum wage rate ($WL$), i.e.,

(12) $W_j = f(W, CPI_j, WL)$

National wages affect regional wages as local wage rates must kept competitive in order to attract workers. The consumer price index reflects the workers' demand for cost-of-living wage increases. The frequent upward adjustments of the minimum wage rate affect not only the wages of the lowest paid workers but also those of other workers as wage differentials are maintained. In equations (10)-(12), some lag structures may be appropriate.

A government consumption expenditure deflator ($PGCE_j$) is included in the model in order to convert government consumption expenditure in current pesos ($GCE_j$) to real government consumption expenditure ($GCER_j$):

(13) $PGCE_j = f(P)$.

<u>Local Government Expenditures and Nontax Revenues</u>

Local government expenditures ($ELG_j$) depends upon local government revenues ($RLG_j$) while an increase in population ($POP_j$) puts pressure on the local government for more services. Thus,

(14) $ELG_j = f(RLG_j, POP_j)$

Local nontax revenue ($ROTH_j$) is a function of the gross product of the rest of the country outside region $j$ ($QOC_j$), i.e.,

(15) $ROTH_j = f(QOC_j)$,

because a large portion of nontax revenue flows from trade with other regions (e.g. port fees).

Local government revenue ($RLG_j$) is defined as the sum of local taxes ($LT_j$) and nontax revenues ($ROTH_j$).

*3.2 Identities and Definitions*

Gross Domestic Product of the Rest of the Country in Constant Pesos

(16) $QOCR_j = QR - QR_j$

Gross Domestic Product of the Rest of the Country in Current Pesos

(17) $QOC_j = (QOCR_j)\,(POC_j)$

Price Deflator for GDP of the Rest of the Country

$$(18)\ POC_j = \frac{QR}{QOCR_j}P - \frac{QR_j}{QOCR_j}\,P_j$$

The price deflator $POC_j$ is derived from the identity

(18a) $(QR)\,(P) = QOCR_j)\,(POC_j) + (QR_j)\,(P_j)$

where
- $QR$ = real gross domestic product of the country
- $P$ = gross domestic product deflator
- $QOCR_j$ = real gross domestic product, rest of the country outside region $j$
- $POC_j$ = gross domestic product deflator, rest of the country outside region $j$
- $QR_j$ = real gross regional product
- $P_j$ = gross regional domestic product deflator.

Equation (18a) is then solved for $POC_j$.

Gross Regional Product in Constant Pesos

(19) $QR_j = EXP(LOGQR_j)$

Gross Regional Product in Current Pesos

(20) $Q_j = (QR_j)\,(P_j)$

Government Consumption Expenditures in Constant Pesos

(21) $GCER_j = GCE_j/PGCE_j$

Capital Stock

(22) $KR_j = KR_j(-1) + DER_j + FCPR_j + FCGR_j - KCR_j$

Disposable Income

(23) $DINR_j = QR_j - (NT_j + LT_j) / P_j$

Local Government Revenues

(24) $RLG_j = LT_j + ROTH_j$

Residual

(25) $RESR_j = QR_j - (PCER_j + DER_j + FCPR_j + FCGR_j + GCER_j)$

Employment

(26) $E_j = EXP(LOGE_j)$

Employment Rate

(27) $ER_j = E_j / LF$

## 4. Data and Estimation

The model was estimated for Region 7 (Central Visayas) with time series data for the years 1975-1986. Most of the data were obtained from the National Economic Development Authority (NEDA) and the National Statistical Coordination Board (NSCB). The regional expenditure accounts of the NSCB include personal consumption, durable equipment, private construction, change in stocks, government consumption, government construction and net exports. Regional exports and imports could not be estimated because land-transported commodity flows are unrecorded.

The national tax data were obtained from the Bureau of Internal Revenue, the Bureau of Customs, and the Philippine Ports Authority while the local tax data were obtained from the Commission on Audit. Wage rates were obtained from the Bureau of Labor and

Employment Statistics while the legislated wage rates were obtained from the National Wages Council.

The equations were estimated by ordinary least squares. In some equations, the Cochrane-Orcutt procedure was used to correct for serial correlation (Cochrane and Orcutt, 1949).

## 5. Estimated Model for Region 7 (Central Visayas)

### *5.1. Overview of the Central Visayas Economy*

Central Visayas consists of four provinces in central Philippines with a land area of 14.95 thousand square kilometers, about 6 percent of the country's land area. Its population grew from 3.39 million in 1975 to 4.28 million in 1986, representing an average annual growth rate of 2.1 percent.

In terms of real gross regional product, Central Visayas accounted for 7.1 percent of the country's real gross domestic product and ranked fifth among the 13 regions of the country in 1986.[2] Real gross regional product (GRP) stood at ₱4654 million in 1975 (6.8% of the country's real gross domestic product) and grew to ₱6990 million in 1981, increasing its share of the country's gross domestic product to 7.1 percent. This period was a relatively high growth period for Central Visayas, averaging 7.1 percent annually, higher than the average national growth rate of 5.8 percent for the same period. This was partly due to the high growth of investments; for example, public and private construction had average annual growth rates of 25 percent and 17 percent, respectively.

Growth slowed down in 1982-1983 as the economy started to feel the effects of the foreign debt crisis and fell with the rest of the nation during the crisis years 1984-1985. When the national economy turned around in 1986, Central Visayas was among the regions that took the lead in the economic recovery.

[2]For planning purposes the Philippines had been divided into 13 regions. The National Capital Region (Metro Manila) led in 1986 with 29.20% of the country's real gross domestic product and 12.76% of the country's population.

### 5.2. *List of Variables*

Endogenous Variables

| Variable Name | Description |
|---|---|
| *CPI7* | consumer price index |
| *DINR7* | real disposable income |
| *E7* | employment |
| *ER7* | employment rate |
| *ELG7* | local government expenditure in current pesos |
| *FCPR7* | real investment in private construction |
| *GCE7* | national government consumption expenditure in current pesos |
| *GCER7* | real national government consumption |
| *KCR7* | capital consumption |
| *KR7* | capital stock |
| *LF7* | labor force |
| *LOGE7* | natural logarithm of *E7* |
| *LOGQR7* | national logarithm of *QR7* |
| *LT7* | local taxes |
| *NT7* | national taxes |
| *P7* | gross regional product deflator |
| *PCER7* | real personal consumption expenditure |
| *PGCE7* | government consumption expenditure deflator |
| *POC7* | gross domestic product deflator, rest of the country outside of region 7 |
| *Q7* | gross regional product in current pesos |
| *QOC7* | gross domestic product, rest of the country outside region 7, in current pesos |
| *QR7* | real gross regional product |
| *QOCR7* | real gross domestic product, rest of the country, outside region 7 |
| *RESR7* | residual (net exports and statistical discrepancy) |
| *RLG7* | local government revenue in current pesos |
| *ROTH7* | local government revenues other than taxes |
| *W7* | wage rate in current pesos |

Exogenous Variables

| | |
|---|---|
| *CPI* | consumer price index, Philippines |
| *DER7* | investment in durable equipment |
| *D* | dummy for economic crisis |

| | |
|---|---|
| $D_1$ | dummy for the change in the definition of local taxes and other revenues |
| $D_2$ | dummy for large outmigration |
| *E* | national employment |
| *FCGR7* | real government construction |
| *FCPR* | real national private construction |
| *GCE* | national government consumption |
| *INT* | real interest rate |
| *P* | gross domestic product deflator, Philippines |
| *PCER* | real national personal consumption |
| *POP7* | population |
| *QR* | real gross domestic product, Philippines |
| *W* | national wage rate |
| *WL* | legislated minimum wage rate |

*5.3. Stochastic Equations*

Explanatory Notes:

(1) Numbers in parenthesis below the regression coefficients are t-statistics.
(2) $\bar{R}^2$ is the adjusted coefficient of determination.
(3) *DW* is the Durbin-Watson statistic.
(4) *SER* is the standard error of regression.
(5) *F* is the F-statistic.
(6) *RHO* is the coefficient of serial correlation.

(1) $$LOGQR7 = \underset{(26.65)}{0.8535067}*LOG(KR7) + \underset{(1.51)}{0.1913229}*LOG(E7) + \underset{(2.02)}{0.0001088}*QR/E - \underset{(0.83)}{0.0427101}*D$$

$\bar{R}^2 = 0.90$ $SER = 0.03$ $DW = 2.07$ $F = 33.05$

(2) $$PCER7 = \underset{(35.77)}{1333.7700} + \underset{(2.09)}{0.0227821}*DINR7 + \underset{(34.05)}{0.0345848}*(PCER + PCER(-1))/2$$

$\bar{R}^2 = 0.99$ $SER = 11.97$ $DW = 2.00$ $F = 2085.31$

(3) $$FCPR7 = -72.715080 + 0.0666049*FCPR - 0.2671241*INT + 0.0359686*(QR7(-1) - QR7(-2))$$
(1.69) (8.94) (0.28) (1.37)

$\bar{R}^2 = 0.93$ $SER = 25.09$ $DW = 2.26$ $F = 41.03$

(4) $$KCR7 = -73.929855 + 0.0207470*KR7(-1) + 0.0492818*QR7$$
(1.32) (5.54) (4.72)

$\bar{R}^2 = 0.93$ $SER = 12.29$ $DW = 1.90$ $F = 64.92$

(5) $$GCE7 = -334.56582 + 0.0243382*GCE + 0.2867402*GCE7(-1) + 100.88130*POP7$$
(0.247) (3.237) (1.009) (0.24)

$\bar{R}^2 = 0.98$ $SER = 61.23$ $DW = 1.82$ $F = 152.274$

(6) $$LOGE7 = -4.3815745 + 0.7751429*LOG(QR7) - 0.2775642*LOG(W7/P7) - 0.1724391*D_2$$
(1.98) (3.40) (3.84) (4.27)

$\bar{R}^2 = 0.84$ $SER = 0.04$ $DW = 1.95$ $F = 16.62$

(7) $$LF7 = -0.4246720 + 0.3561569*POP7 + 0.4246062*E7(-1) - 0.1496636*D_3$$
(1.20) (2.22) (1.88) (3.94)

$\bar{R}^2 = 0.93$ $SER = 0.04$ $DW = 1.47$ $F = 42.87$

(8) $$NT7 = 166.39472 + 0.0100243*Q7 + 0.4840248*NT7(-1)$$
(1.13) (2.93) (1.64)

$\bar{R}^2 = 0.85$ $SER = 75.73$ $DW = 1.52$ $F = 28.84$

(9) $$LT7 = -14.678369 + 0.0069192*Q7 + 0.5651204*LT7(-1) - 145.83114*D_1$$
(1.08) (10.60) (7.19) (9.71)

$\bar{R}^2 = 0.96$ $SER = 11.63$ $DW = 2.11$ $F = 92.55$

(10) $P7 = -0.0584482 + 0.9587135*P + 0.00001467*W7(-1)$
$\quad\quad (0.80) \quad\quad (40.70) \quad\quad (0.40)$

$\bar{R}^2 = 0.99 \quad SER = 0.05 \quad DW = 1.46 \quad F = 5152.37$

(11) $CPI7 = -0.1586935 + 0.9073527*CPI(-1)$
$\quad\quad (1.43) \quad\quad (14.40)$

$+ 1.0966593*(CPI - CPI(-1)) + 0.00007876*W7$
$\quad\quad (17.96) \quad\quad (1.60)$

$\bar{R}^2 = 0.99 \quad SER = 0.05 \quad DW = 1.82 \quad F = 1430.28$

(12) $W7 = 1422.8195 + 0.2447712*W + 116.09531*CPI7(-2)$
$\quad\quad (4.36) \quad\quad (2.56) \quad\quad (0.19)$
$+ 62.171422*WL(-2)$
$\quad\quad (1.44)$

$\bar{R}^2 = 0.95 \quad SER = 267.51 \quad DW = 2.30 \quad F = 56.23$

(13) $PGCE7 = 0.1079046 + 0.3792252*P + 0.6009202*PGCE7(-1)$
$\quad\quad (1.72) \quad\quad (10.04) \quad\quad (9.64)$

$\bar{R}^2 = 0.99 \quad SER = 0.07 \quad DW = 1.91 \quad F = 2077.32$

(14) $ELG7 = -421.97119 + 0.7254608*RLG7 + 130.25751*POP7$
$\quad\quad (1.71) \quad\quad (5.63) \quad\quad (1.74)$

$\bar{R}^2 = 0.99 \quad SER = 14.39 \quad DW = 2.40 \quad F = 356.12$

$RHO = -0.4992$

(15) $ROTH7 = 9.1928443 + 0.0002508*QOC7 + 150.56806*D_1$
$\quad\quad (1.17) \quad\quad (7.43) \quad\quad (13.45)$

$\bar{R}^2 = 0.99 \quad SER = 8.50 \quad DW = 1.99 \quad F = 906.96$

## Identities and Definitions

(16) $QOCR7 = QR - QR7$

(17) $QOC7 = QOCR7*POC7$

(18) $POC7 = \frac{QR}{QOCR7} * P - \frac{QR7}{QOCR7} * P7$

(19) $QR7 = EXP(LOGQR7)$

(20) $Q7 = QR7*P7$

(21) $GCER7 = GCE7/PGCE7$

(22) $KR7 = KR7\,(-1) + DER7 + FCPR7 + FCGR7 - KCR7$

(23) $DINR7 = QR7 - (NT7 + LT7)/P7$

(24) $RLG7 = LT7 + ROTH7$

(25) $RESR7 = QR7 - (PCER7 + DER7 + FCPR7 + FCGR7 + GCER7)$

(26) $E7 = EXP(LOGE7)$

(27) $ER7 = E7/LF7$

## 6. Dynamic Simulations

To evaluate the model's performance, a dynamic simulation was performed on the complete model over the sample period 1977-1986. This means that the model was solved dynamically for each of the years from 1977 to 1986, i.e., the model was solved with the lagged endogenous variables taking their estimated values. (In contrast, in a static simulation the lagged endogenous variables take their actual values.) Table 1 presents the mean absolute percent errors (MAPE), defined for an endogenous variable $y$ as

$$MAPE\,(y) = \frac{1}{T}\sum_{t=1}^{T} \mid (y_t^a - y_t^s) \mid y_t^a \mid$$

where $y_t^a$ is the actual value of $y$, $y_t^s$ is the simulated (estimated) value of $y$, and T is the length of the simulation period.

**Table 1 – Mean Absolute Percent Errors: Dynamic Simulation, 1977-1986**

| Variable | MAPE |
|---|---|
| *CPI7* | 1.66 |
| *DINR7* | 2.55 |
| *E7* | 3.20 |
| *ELG7* | 4.50 |
| *ER7* | 3.10 |
| *FCPR7* | 4.83 |
| *GCE7* | 4.45 |
| *GCER7* | 4.25 |
| *KCR7* | 1.30 |
| *KR7* | 0.12 |
| *LF7* | 1.99 |
| *LT7* | 2.59 |
| *NT7* | 9.77 |
| *P7* | 1.06 |
| *PCER7* | 0.25 |
| *PGCE7* | 1.14 |
| *POC7* | 0.07 |
| *Q7* | 3.04 |
| *QOC7* | 0.22 |
| *QOCR7* | 0.20 |
| *QR7* | 2.61 |
| *RESR7* | 9.63 |
| *RLG7* | 2.82 |
| *ROTH7* | 6.23 |
| *W7* | 4.80 |

The results show generally small MAPEs (less than 10% with an unweighted mean of 3.05%). Twenty-two (or 88%) of the endogenous variables have MAPEs of less than 5% while 14 (or 56%) have MAPEs of less than 3%. (See Table 2.)

**Table 2 – Distribution of MAPE Statistics**

| | | |
|---|---|---|
| 5.01% - 10.0% | 3 | 12% |
| 3.01% - 5.00% | 8 | 32% |
| 0.00% - 3.00% | 14 | 56% |
| | 25 | 100% |

The general picture of the simulation may be seen from the graphs (Figures 1-8) of the actual and simulated values of some of the endogenous variables representing the range of MAPE values. The graphs show that the simulated values track the actual values of the endogenous variables fairly well. Among the expenditure components, real personal consumption has the smallest relative errors (MAPE = 0.25%, Figure 2) while real private construction has the largest (MAPE = 4.83%, Figure 3). The national tax variable (NT7) has the largest MAPE at 9.77%. The fact that this variable is an aggregate value and is expressed as a simple function of nominal output as the tax base hides the diversity of taxes (e.g., property taxes are paid regardless of output). It could explain the failure of this tax function to perform well.

## 8. Ex-Post Forecasting Results

A further evaluation of the performance of an econometric model is done by looking at its predictive ability outside the sample period. Since the 1987 data have become available, we performed an ex-post forecast for 1987. Table 3 shows the actual and forecasted values of the endogenous variables. The results are encouraging. Eighteen (or 72%) of the endogenous variables were predicted to within 5% of their actual values. These include the variables of special interest such as gross regional product, personal consumption, government consumption, private construction, labor force, employment, disposable income and price level, most of which were predicted to within 3% of their actual values. The national tax variable is conspicuous for having the largest absolute percent error. This was foreshadowed by its relatively poor performance in the historical dynamic simulation. It would help the tax submodel if taxes are disaggregated and respecified using the appropriate tax base.

## 9. Applications: A Forecast and a Policy Simulation

### *9.1. Forecast for Central Visayas: Control Forecast*

In this section we present the forecast for Central Visayas corresponding to a national forecast for the forecast horizon 1988-1992. The values of the national variables for 1988-1989 are actual estimates while those for 1990-1992 are forecasts of the NEDA-

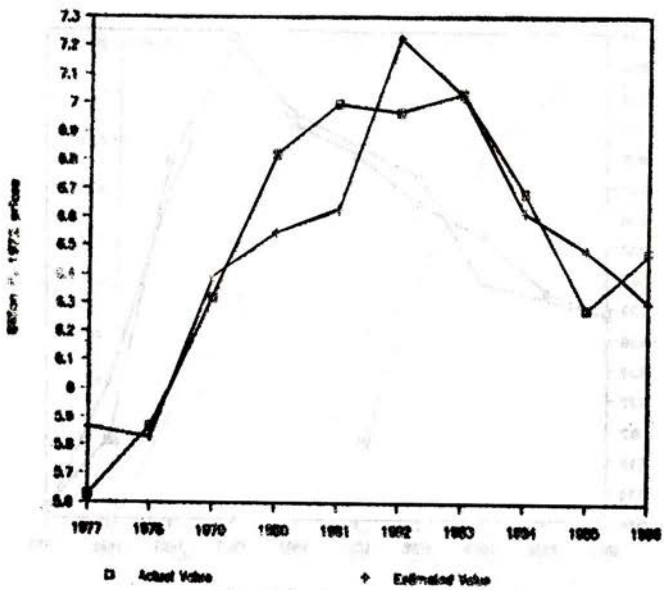


Fig. 1 – Gross Regional Product

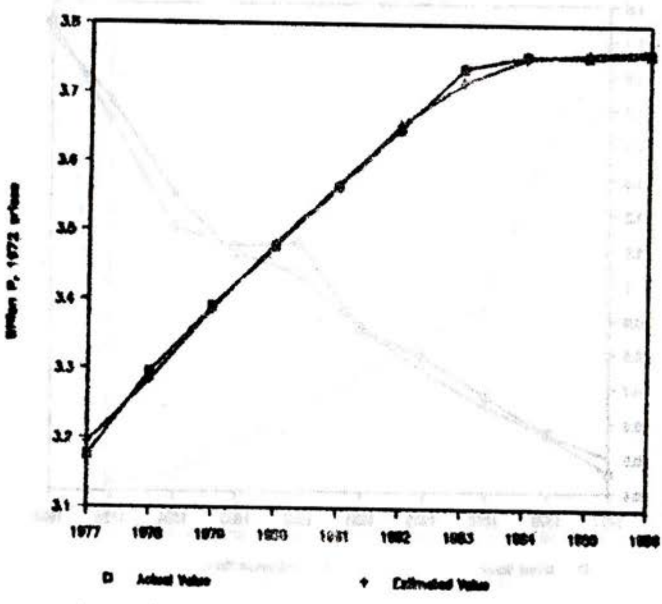


Fig. 2 – Personal Consumption

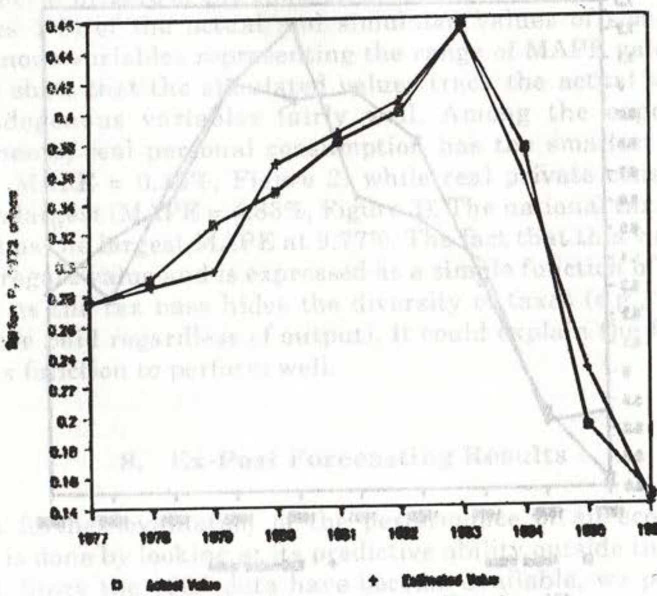


**Fig. 3 – Private Construction**

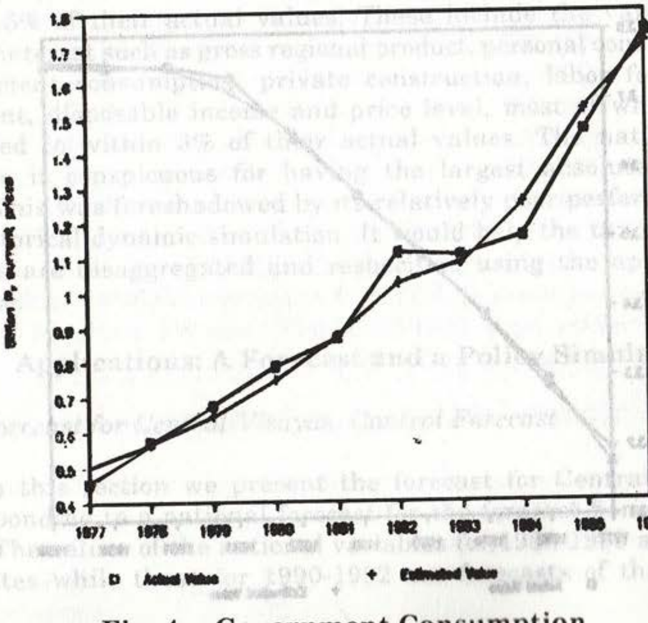


**Fig. 4 – Government Consumption**

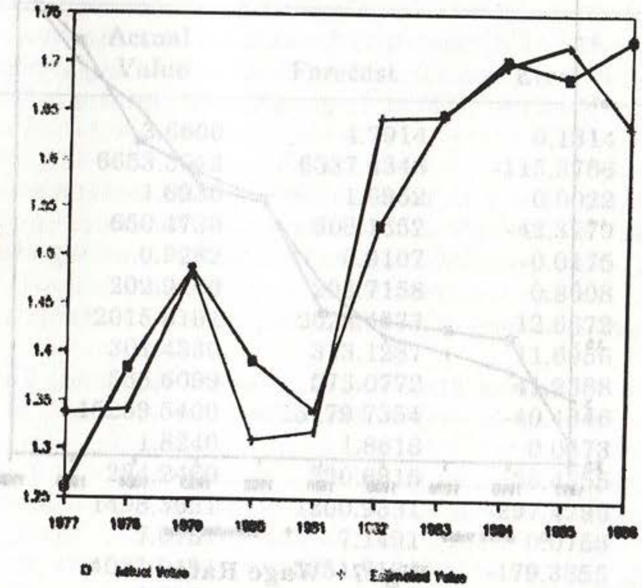


**Fig. 5 - Employment**

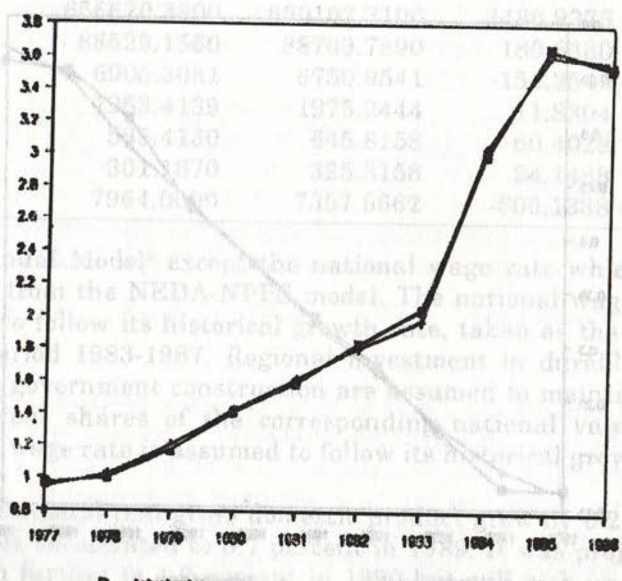


**Fig. 6 – Consumer Price Index**

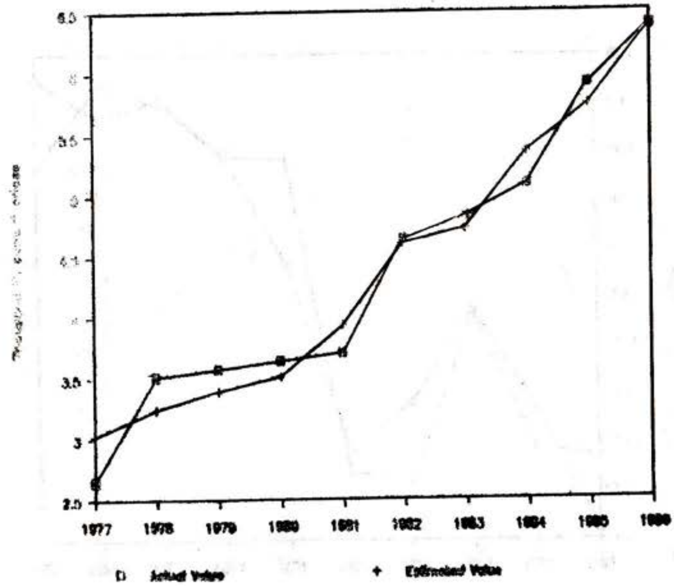


Fig. 7 - Wage Rate

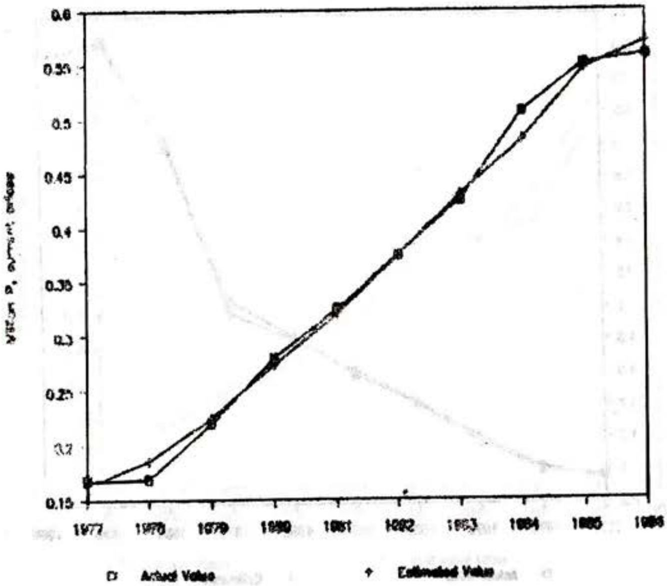


Fig. 8 – Local Government Revenue

**Table 3 – Ex-Post Forecast: 1987**

| Variable | Actual Value | Forecast | Error | Percent Error |
|---|---|---|---|---|
| *CPI7* | 3.6600 | 4.7914 | 0.1314 | 3.59 |
| *DINR7* | 6653.3042 | 6537.4346 | -115.8706 | -1.74 |
| *E7* | 1.6930 | 1.6952 | 0.0022 | 0.12 |
| *ELG7* | 650.4730 | 608.1552 | -42.3179 | -6.50 |
| *ER7* | 0.9282 | 0.9107 | -0.0175 | -1.88 |
| *FCPR7* | 202.9150 | 203.7158 | 0.8008 | 0.39 |
| *GCE7* | 2015.8101 | 2028.4773 | 12.6672 | 0.62 |
| *GCER7* | 301.4330 | 313.1287 | 11.6956 | 3.88 |
| *KCR7* | 535.6099 | 573.0772 | 41.2388 | 7.75 |
| *KR7* | 15259.5400 | 15179.7354 | -40.4346 | -0.26 |
| *LF7* | 1.8240 | 1.8613 | 0.0373 | 2.04 |
| *LT7* | 284.2460 | 320.6815 | 36.4355 | 12.81 |
| *NT7* | 1498.3621 | 1200.9331 | -297.4290 | -19.85 |
| *P7* | 7.0737 | 7.1491 | 0.0753 | 1.06 |
| *PCER7* | 4031.0491 | 3851.7136 | -179.3355 | -4.44 |
| *PGCE7* | 6.6874 | 6.4781 | -0.2093 | -3.13 |
| *POC7* | 7.4170 | 7.4409 | 0.0239 | 0.32 |
| *Q7* | 48846.3590 | 48284.0980 | -562.2617 | -1.15 |
| *QOC7* | 656620.3800 | 660107.3100 | 3486.9375 | 0.53 |
| *QOCR7* | 88529.1560 | 88709.7890 | 180.6330 | 0.20 |
| *QR7* | 6905.3081 | 6750.9541 | -154.3540 | -2.23 |
| *RESR7* | 1963.4139 | 1975.2444 | 11.8304 | 0.60 |
| *RLG7* | 585.4130 | 645.8158 | 60.4028 | 10.31 |
| *ROTH7* | 301.1670 | 325.3158 | 24.1488 | 8.01 |
| *W7* | 7964.0000 | 7357.8662 | -606.1338 | -7.61 |

NPPS annual Model[3] except the national wage rate which is not available from the NEDA-NPPS model. The national wage rate is assumed to follow its historical growth rate, taken as the average for the period 1983-1987. Regional investment in durable equipment and government construction are assumed to maintain their 1987 percent shares of the corresponding national values. The minimum wage rate is assumed to follow its historical growth.

The national real gross domestic product grew by 6.2 percent in 1988 but decelerated to 5.7 percent in 1989. It was projected to slow down further to 4.9 percent in 1990 but will pick up in 1991 with a growth rate of 6.5 percent, accelerating to 7.0 percent in

[3]The forecasts used here were made in April 1990, two months before the killer earthquake and three months before the Gulf War.

1992. National employment, which surged by 5 percent in 1989 is projected to slow down to 3 percent in 1990 but will pick up as the economy picks up in 1991. The deceleration and the acceleration of the economy are accompanied by a rising and falling of the inflation rate which peaks in 1990 at 12 percent and declines to 7.5 percent in 1992.

With the above assumptions the regional model was simulated from 1987 to 1992. There was no attempt to force the model to "predict" the actual 1987 regional values by some adjustment procedures. The forecast (referred to as the control forecast) for 1988-1992 of selected regional variables is presented in Table 4.

**Table 4 – Control Forecast of Selected Regional Variables: 1988-1992**

N.B. Numbers in parenthesis are growth rates in percent.

| | 1988 | 1989 | 1990 | 1991 | 1992 |
|---|---|---|---|---|---|
| Gross Regional Product (Million Pesos) | 7035 (4.2) | 7232 (2.8) | 7538 (4.2) | 7799 (3.5) | 8226 (5.5) |
| Personal Consumption (Million Pesos) | 3997 (3.8) | 4149 (3.8) | 4300 (3.6) | 4453 (3.6) | 4622 (3.8) |
| Employment (Millions) | 1.778 (4.8) | 1.840 (3.5) | 1.887 (2.6) | 1.924 (2.0) | 1.980 (2.9) |
| Consumer Price Index (1978=100) | 414.39 (9.0) | 458.15 (10.6) | 517.11 (12.9) | 567.18 (9.7) | 612.69 (8.0) |
| Unemployment Rate (Percent) | 5.35 | 5.75 | 6.20 | 6.78 | 6.09 |

The outlook for Central Visayas is for continued growth although the GRP growth rates, averaging 4 percent, are lower than those before the 1984-85 crisis which averaged 5.4 percent. This is partly due to the low levels of assumed government construction expenditures for the forecast horizon (averaging P107 million) while the pre-crisis levels averaged P189 million. Regional employment rises from 1.778 million in 1988 to 1.980 million in 1992, an average annual growth of 3.2 percent. This, however, is not enough to absorb the growing labor force so that the unemployment rate rises from 5.4 percent in 1988 to 6.1 percent in 1992. National tax collection grows at an average annual rate of 10.2 percent while local tax collection grows at the faster pace of 23.3 percent. This allows the local government to increase its expenditures by 15.4 percent annually without incurring a deficit. Inflation rate rises from 9.3 percent in 1988 to 12.9 percent in 1990 and declines to 8.0 percent in 1992, reflecting essentially the national inflation rate.

### 9.2. *Alternative Forecast: Effects of an Increase in Government Construction Expenditure*

We compare the control forecast in Section 9.1 with an alternative forecast obtained by using a growth rate in government construction expenditure equal to the average growth rate (25.42%) during the five-year period 1976-1980, a period with consecutive positive growth rates. This means raising the average regional share of government construction expenditure to 1.67 times its share in the control forecast. However, the new average regional level of government construction expenditure at P183M is still less than the average level for the period 1976-1980. Table 5 shows the alternative and the control forecasts for gross regional product and employment.

As expected, the increase in government expenditures increased the levels as well as the growth rates of regional output and employment. (The other variables affected by government investment showed similar effects.) We note, in particular, that the unemployment rate rises very slowly; in fact, it declines in 1992 to a rate lower than its 1988 value, keeping the unemployment rate in check.

**Table 5 – Comparison of the Alternative Forecast with the Control Forecast**

| | Gross Regional Product (Growth Rate) | | Unemployment Rate | |
|---|---|---|---|---|
| | Control Forecast | Alternative Forecast | Control Forecast | Alternative Forecast |
| 1988 | 4.20 | 4.35 | 5.35 | 5.25 |
| 1989 | 2.81 | 3.06 | 5.75 | 5.50 |
| 1990 | 4.24 | 4.65 | 6.20 | 5.75 |
| 1991 | 3.46 | 4.09 | 6.78 | 5.87 |
| 1992 | 5.51 | 6.21 | 6.09 | 5.00 |

## 10. Concluding Remarks

This paper has demonstrated the feasibility of building supply-determined top-down regional econometric models for developing countries like the Philippines. It has also shown that, as in national econometric modelling, many of the features of developed country regional models carry over to developing countries.

The present model suffers from the absence of some important variables such as regional exports and imports and migration. At this time it is not possible to have an export and an import equation because land-transported commodity flows are unrecorded. Current work to improve the model includes incorporating a net migration submodel that interacts with labor force, employment, population, and wages. Sectoral disaggregation of output and employment is also being done to enhance the usefulness of the model and set the stage for constructing a model with bottom-up features.

Future work should include incorporating an energy demand submodel, disaggregating investment in durable equipment into its public and private components, disaggregating taxes and respecifying the tax functions using the appropriate tax bases, and developing the local government submodel in order to make it more useful to local government officials.

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