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A TOP-DOWN ECONOMETRIC MODEL
FOR A PHILIPPINE REGION

by

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for a Philippine Region

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Abstract

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 and could be used to determine regional forecasts consistent with a national forecast.

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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 policy makers 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 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 has 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 (e.g., the NEDA-NPPS annual 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 results of a forecast and a policy simulation for Region 7.

[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 expenditure 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 national 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
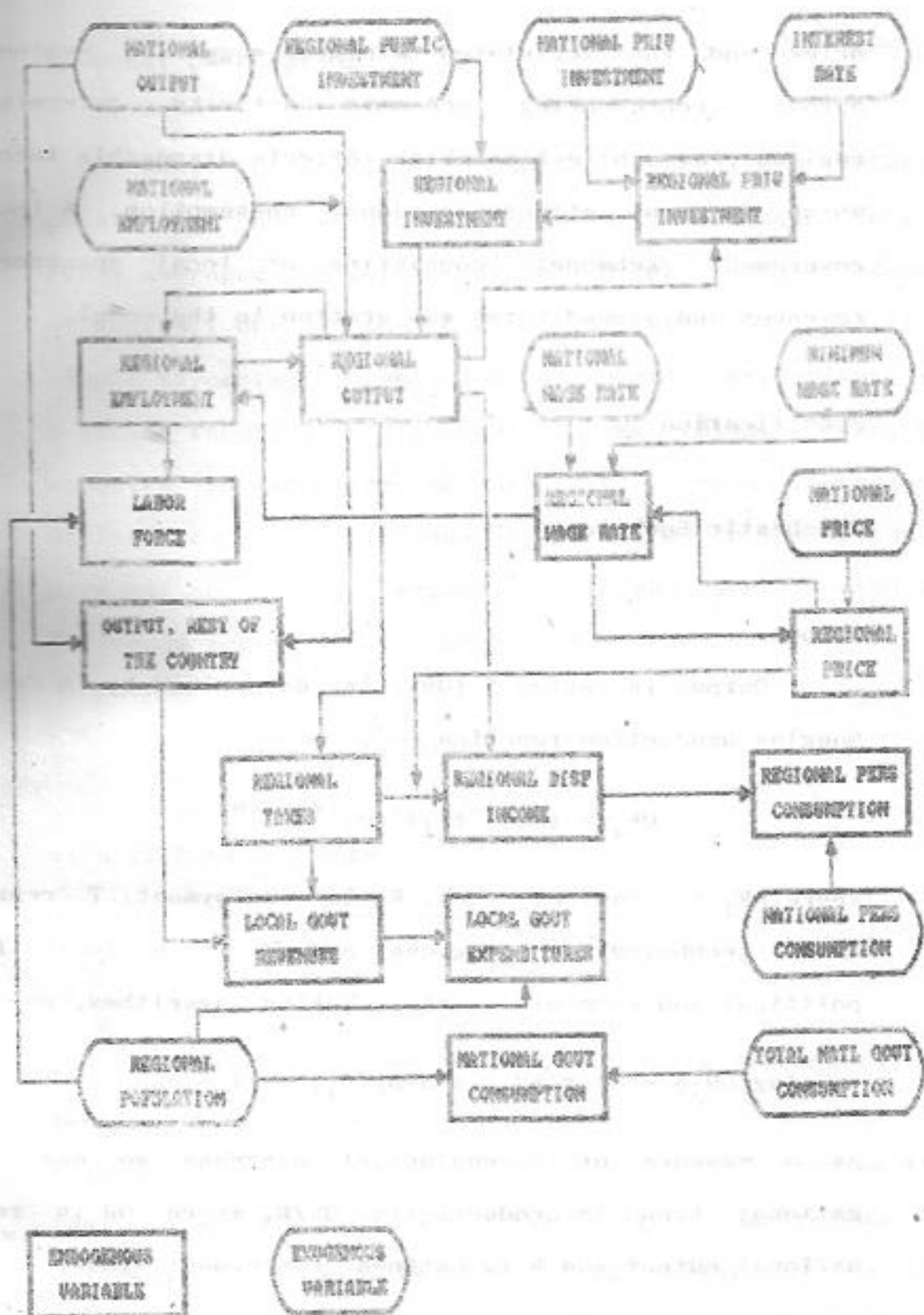
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FIGURE 1. SCHEMATIC DIAGRAM OF THE MODEL

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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

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

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,

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

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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,

$$PCER_j = f(DINR_j, PCER) \tag{2}$$

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

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lagged one period. $DQR_i(-1) = QR_i(-1) - QR_i(-2)$, a form of the multiplier-accelerator principle. Since a portion of regional investments are made by industries that have national markets, we include national investment trends as an explanatory variable. Thus, for investment in private construction ($FCPR_i$), we have

$$FCPR_i = f(FCPR, INT, DQR_i(-1)) \qquad (3)$$

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

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

Capital Consumption

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

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

Capital stock (KR_j) is then given by the identity

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

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

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

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

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Employment and Labor Force

Employment (E_i) is specified as a demand-for-labor function of the level of output (QR_i) and real wage rate (W_i/P_i), expressed in logarithmic form:

$$\log(E_i) = \beta_0 + \beta_1 \log(QR_i) + \beta_2 \log(W_i/P_i). \tag{6}$$

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

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

$$LF_i = f(POP_i, E_i(-1)). \tag{7}$$

Employment rate is then given by

$$RE_i = E_i/LF_i \tag{7a}$$

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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

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

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

Regional Prices and Wage Rate

Regional prices are basically determined by national prices. Factors affecting prices on the national level (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

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Domestic Product (GDP) deflator, and the regional wage rate (W_i). Similarly, the regional consumer price index (CPI_i) is estimated as a function of the national consumer price index (CPI) and the regional wage rate. Thus, we have

$$P_i = f(P, W_i) \tag{10}$$

$$CPI_i = f(CPI, W_i). \tag{11}$$

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

$$W_i = f(W, CPI_i, WL) \tag{12}$$

National wages affect regional wages as local wage rates must be kept competitive in order to attract workers. The consumer price index reflects the workers' demand for cost-of-living wage increases. The regular 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) – (13), some lag structures may be appropriate.

A government consumption expenditure deflator ($PGCE_i$) is included in the model in order to convert government consumption expenditure in current prices

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(GCE$_i$) to real government consumption expenditure (GCER$_i$):

$$PGCE_i = f(P). \tag{13}$$

Local Government Expenditures and Nontax Revenues

Local government expenditures (ELG$_i$) have been found to be strongly related to local government revenues (RLG$_i$) while an increase in population (POP$_j$) puts pressure on the local government for more services. Thus,

$$ELG_i = f(RLG_i, POP_i,) \tag{14}$$

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

$$ROTH_i = f(QOC_i); \tag{15}$$

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

Local government revenue (RLG$_i$) is defined as the sum of local taxes (LT$_i$) and nontax revenues (ROTH$_i$).

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3.2. Identities and Definitions

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

$$QOCR_j = QR - QR_j \qquad (16)$$

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

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

Price Deflator for GDP of the Rest of the Country

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

The price deflator POC_j is derived from the identity

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

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.

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Gross Regional Product in Constant Pesos

$$QR_i = EXP(LNQR_i) \qquad (19)$$

Gross Regional Product in Current Pesos

$$Q_i = (QR_i)(P_i) \qquad (20)$$

Government Consumption Expenditures in Constant Pesos

$$GCER_i = GCE_i/PGCE_i \qquad (21)$$

Capital Stock

$$KR_i = KR_i(-1) + DER_i + FCPR_i + FCGR_i - KCR_i \qquad (22)$$

Disposable Income

$$DINR_i = QR_i - (NT_i + LT_i)/P_i \qquad (23)$$

Local Government Revenues

$$RLG_i = LT_i + ROTH_i \qquad (24)$$

Residual

$$RESR_i = QR_i - (PCER_i + DER_i + FCPR_i$$
$$+ FCGR_i + GCER_i) \qquad (25)$$

Employment

$$E_i = EXP(LNE_i) \qquad (26)$$

Employment Rate

$$RE_i = E_i/LF_i \qquad (27)$$

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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]).

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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% 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%.

In terms of real gross regional product, Central Visayas accounted for 7.1% 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 P4654 million in 1975 (6.8% of the country's real gross domestic product) and grew to P6990 million in 1981, increasing its share of the country's gross domestic product to 7.1%. This period was a relatively high growth period for Central Visayas, averaging 7.1% annually, higher than the average national growth rate of 5.8% 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% and 17%, respectively.

[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.

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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.

5.2. List of Variables

Endogenous Variables

Variable Name	Description
1. CPI7	consumer price index
2. DINR7	real disposable income
3. E7	employment
4. ELG7	local government expenditure in current pesos
5. FCPR7	real investment in private construction
6. GCE7	national government consumption expenditure in current pesos
7. GCER7	real national government consumption
8. KCR7	capital consumption
9. KR7	capital stock
10. LF7	labor force
11. LOGE7	natural logarithm of E7
12. LOGQR7	natural logarithm of QR7
13. LT7	local taxes

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14. NT7   national taxes

15. P7   gross regional product deflator

16. PCER7 real personal consumption expenditure

17. PGCE7 government consumption expenditure deflator

18. POC7   gross domestic product deflator, rest of the
           country outside of region 7

19. Q7   gross regional product in current pesos

20. QOC7   gross domestic product, rest of the country
           outside region 7, in current pesos

21. QR7   real gross regional product

22. QOCR7 real gross domestic product, rest of the
           country. outside region 7

23. RE7   employment rate

24. RESR7 residual (net exports and statistical
           discrepancy)

25. RLG7   local government revenue in current pesos

26. ROTH7 local government revenues other than taxes

27. W7   wage rate in current pesos

Exogenous Variables

1. CPI   consumer price index, Philippines

2. DER7   investment in durable equipment

3. D   dummy for economic crisis

4. D₁   dummy for the change in the definition of
           local taxes and other revenues

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5. D_2 dummy for large outmigration

6. E   national employment

7. FCGR7   real government construction

8. FCPR   real total private construction

9. GCE   national government consumption

10. INT   real interest rate

11. P   gross domestic product deflator,
                Philippines

12. PCER   real national personal consumption

13. POP7   population

14. QR   real gross domestic product, Philippines

15. W   national wage rate

16. 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 = 0.8535067*LOG(KR7) + 0.1913229*LOG(E7)
              (26.65)   (1.51)

       + 0.0001088*QR/E - 0.0427101*D
         (2.02)   (0.83)

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

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(2)   PCER7 = 1333.7700 + 0.0227821*DINR7
                (35.77)   (2.09)

                      + 0.0345848*(PCER + PCER(-1))/2
                        (34.05)

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

(3)   FCPR7 = -72.715080 + 0.0666049*FCPR - 0.2671241*INT
                 (1.69)   (8.94)   (0.28)

           + 0.0359686*(QR7(-1) - QR7(-2))
             (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)
                 (0.247)   (3.237)   (1.009)

                      + 100.88130*POP7
                        (0.24)

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

(6)   LOGE7 = -4.3815745 + 0.7751429*LOG(QR7)
                 (1.98)   (3.40)

             - 0.2775642*LOG(W7/P7) - 0.1724391*D_2
               (3.84)   (4.27)

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

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(7) $LP7 = -0.4246720 + 0.3561569*POP7 + 0.4246062*E7(-1)$
        (1.20)   (2.22)   (1.88)

              $- 0.1496636*D_3$
                   (3.94)

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

(8) $NT7 = 165.39472 + 0.0100243*Q7 + 0.4840248*NT7(-1)$
        (1.13)   (2.93)   (1.64)

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

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

              $- 145.83114*D_1$
                   (9.71)

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

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

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

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

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

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

(12) $W7 = 1422.8195 + 0.2447712*W + 116.09531*CPI7(-2)$
     $(4.36) \qquad (2.56) \qquad (0.19)$

     $+ 62.171422*WL(-2)$
     (1.44)

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

(13) $PGCR7 = 0.1079046 + 0.3792252*P + 0.6009202*PGCE7(-1)$
     $(1.72) \qquad (10.04) \qquad (9.64)$

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

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

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

$RHO = -0.4992$

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

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

Identities and Definitions

(16) $QOCR7 = QR - QR7$

(17) $QOC7 = QOCR7*POC7$

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

(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) RE7 = 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

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

where y_t^a is the actual value of y, y_t^s is the simulated

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(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
Output	
QR7	2.61
Q7	3.04
QOCR7	0.20
QOC7	0.22
Personal Consumption	
PCER7	0.25
Government Consumption	
GCE7	4.45
GCER7	4.25
Private Construction	
FCPR7	4.83
Labor Force and Employment	
LF7	1.99
E7	3.20
RE7	3.10
Prices and Wage Rate	
P7	1.06
CPI7	1.66
PGCE7	1.14
POC7	0.07
W7	4.80
Taxes	
LT7	2.59
NT7	9.77

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Local Revenues and Expenditures

RLG7	2.82
ROTH7	6.23
ELG7	4.50

Capital Stock and Capital Consumption

KR7	0.12
KCR7	1.30

Disposable Income

DINR7	2.55

Residual

RESR7	9.63

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%

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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.
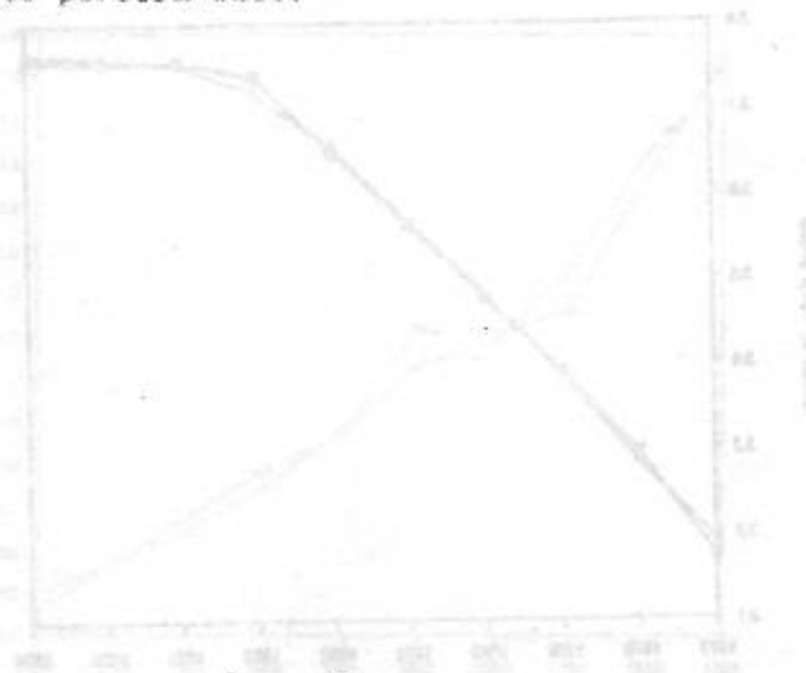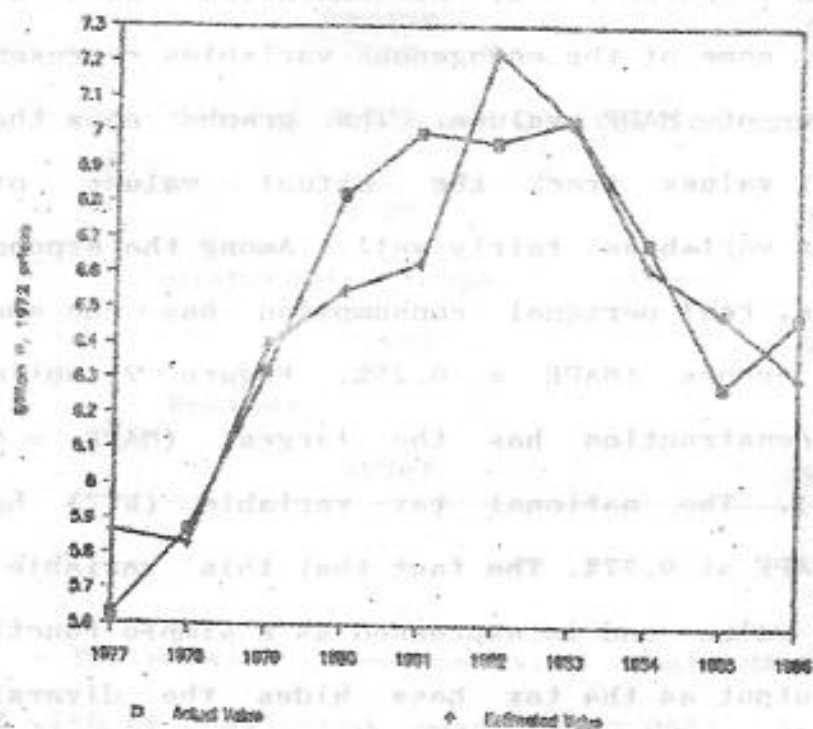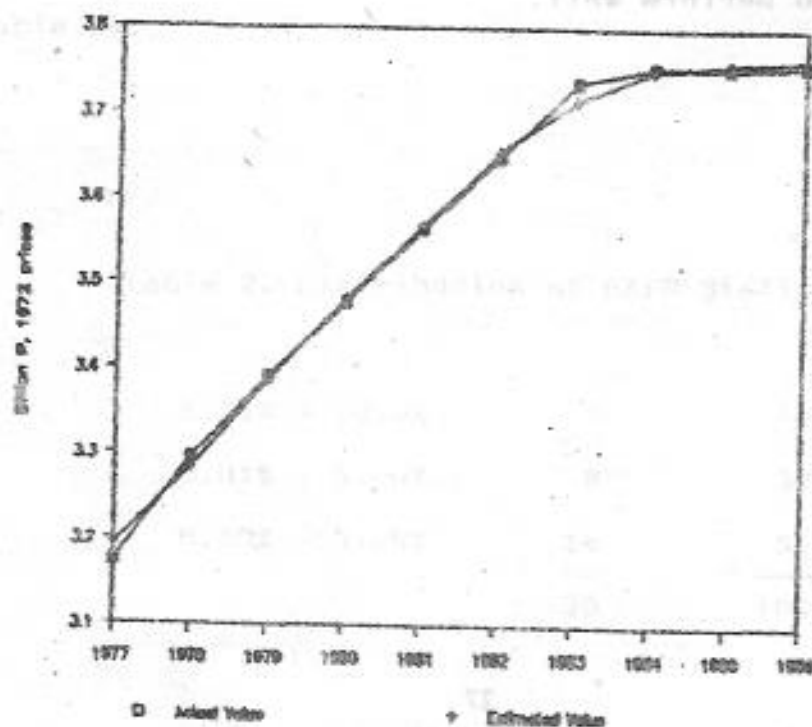
Fig.1. GROSS REGIONAL PRODUCT

Y-axis: Billion P, 1972 prices (7.3, 7.2, 7.1, 7, 6.9, 6.8, 6.7, 6.6, 6.5, 6.4, 6.3, 6.2, 6.1, 6, 5.9, 5.8, 5.7, 5.6)

X-axis: 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

□ Actual Value   ◆ Estimated Value

Fig.2. PERSONAL CONSUMPTION

Y-axis: Billion P, 1972 prices (3.8, 3.7, 3.6, 3.5, 3.4, 3.3, 3.2, 3.1)

X-axis: 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986

□ Actual Value   ◆ Estimated Value

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Fig.3. PRIVATE CONSTRUCTION

Fig.3. PRIVATE CONSTRUCTION

□ Actual Value   + Estimated Value

Fig.4. GOVERNMENT CONSUMPTION

Fig.4. GOVERNMENT CONSUMPTION

□ Actual Value   + Estimated Value

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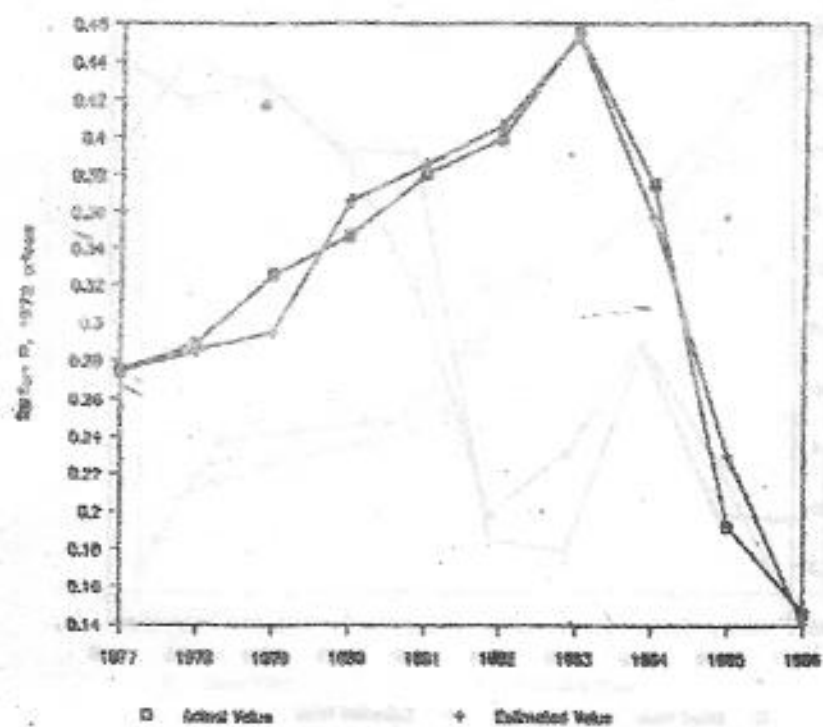
Fig.5. EMPLOYMENT

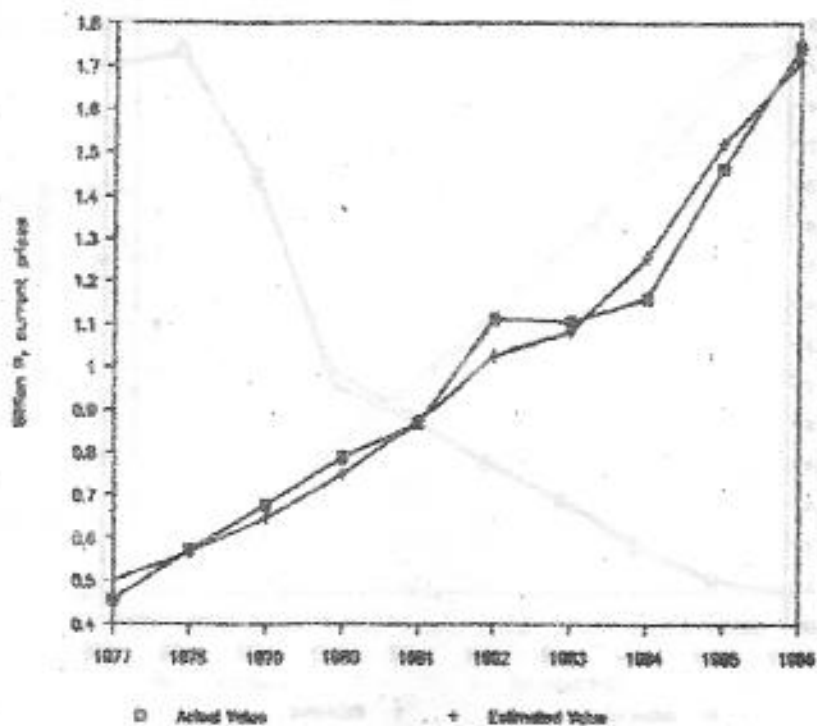
Fig.5. EMPLOYMENT

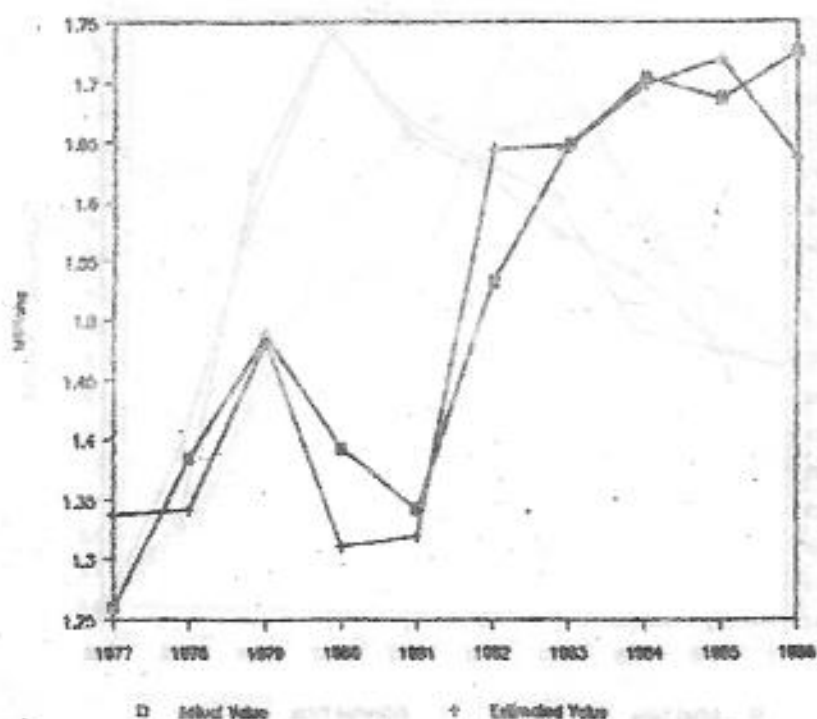## Fig.6. CONSUMER PRICE INDEX
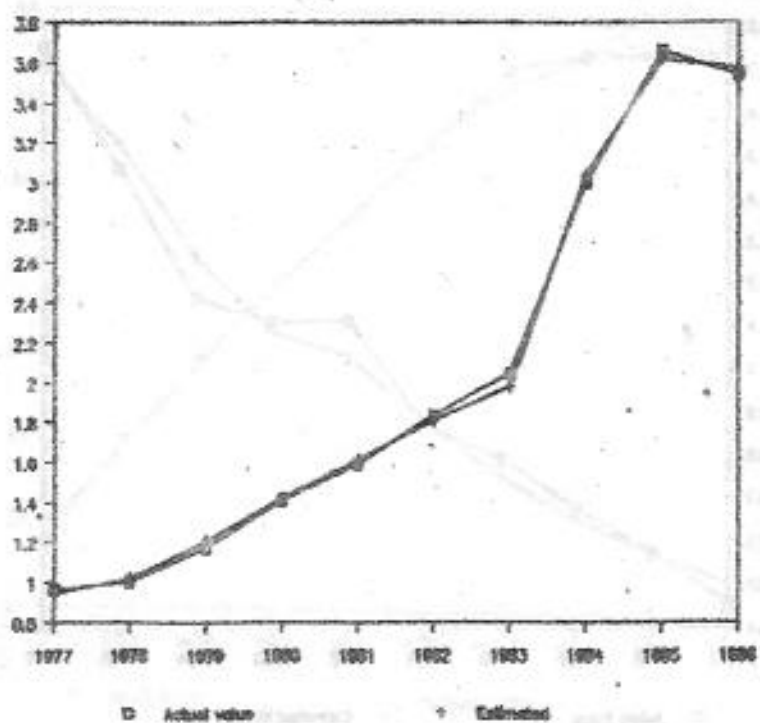

Fig.6. CONSUMER PRICE INDEX
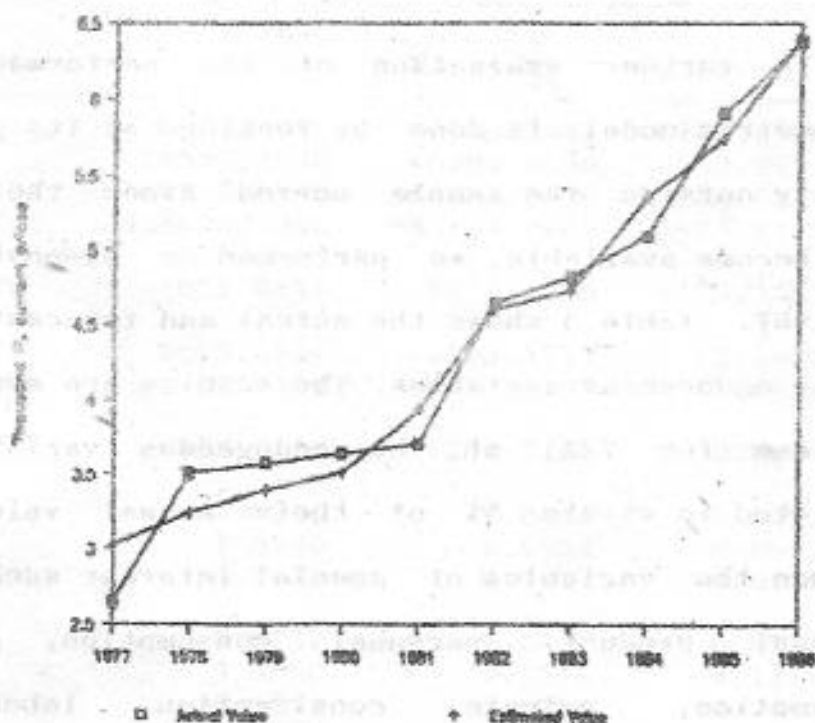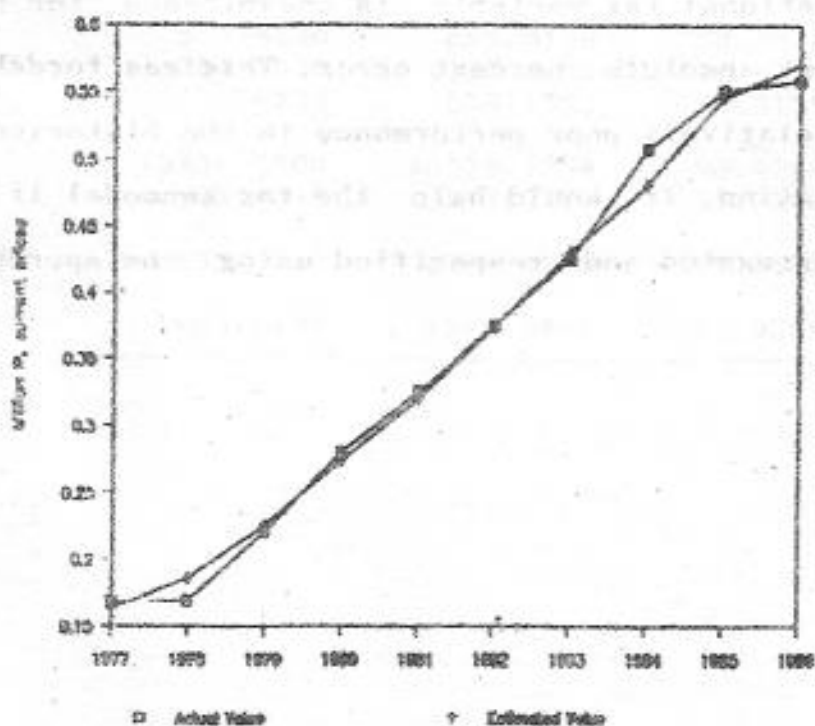
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Fig.7. WAGE RATE

Fig.8. LOCAL GOVERNMENT REVENUE

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.
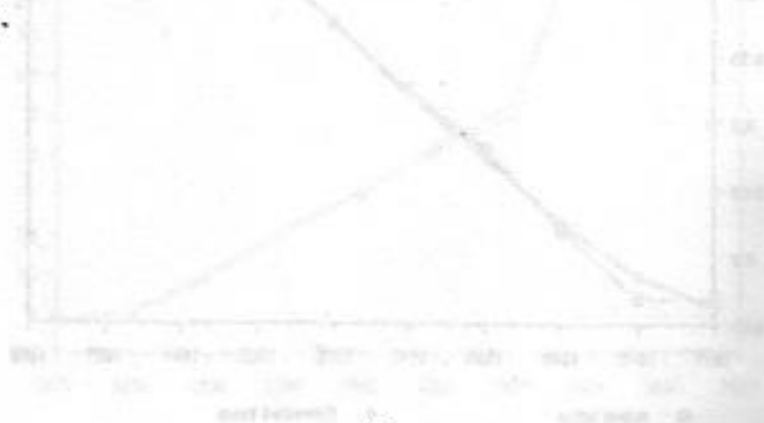
Table 3. Ex-Post Forecast: 1987

Variable	Actual Value	Forecast	Error	Percent Error
QR7	6905.3081	6750.9541	-154.3540	-2.23
Q7	48846.3590	48284.0980	-562.2617	-1.15
QOCR7	88529.1560	88709.7890	180.6330	0.20
QOC7	656620.3800	660107.3100	3486.9375	0.53
PCER7	4031.0491	3851.7136	-179.3355	-4.44
GCE7	2015.8101	2028.4773	12.6672	0.62
GCER7	301.4330	313.1287	11.6956	3.88
FCPR7	202.9150	203.7158	0.8008	0.39
LF7	1.8240	1.8613	0.0373	2.04
E7	1.6930	1.6952	0.0022	0.12
RE7	0.9282	0.9107	-0.0175	-1.88
P7	7.0737	7.1491	0.0753	1.06
CPI7	3.6600	3.7914	0.1314	3.59
PGCE7	6.6874	6.4781	-0.2093	-3.13
POC7	7.4170	7.4409	0.0239	0.32
W7	7964.0000	7357.8662	-606.1338	-7.61
LT7	284.2460	320.6815	36.4355	12.81
NT7	1498.3621	1200.9331	-297.4290	-19.85
RLG7	585.4130	645.8158	60.4028	10.31
ROTH7	301.1670	325.3158	24.1488	8.01
ELG7	650.4730	608.1552	-42.3179	-6.50
KR7	15259.5400	15179.7354	-40.4346	-0.26
KCR7	535.6099	573.0772	41.2388	7.75
DINR7	6653.3042	6537.4346	-115.8706	-1.74
RESR7	1963.4139	1975.2444	11.8304	0.60

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-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% in 1988 but decelerated to 5.7% in 1989. It was
projected to slow down further to 4.9% in 1990 but will
pick up in 1991 with a growth rate of 6.5%, accelerating
to 7.0% in 1992. National employment, which surged by 5%
in 1989 is projected to slow down to 3% in 1990 but will
pick up as the economy picks up in 1991. The deceleration

        [3]The forecasts used here were made in April, 1990,
two months before the killer earthquake and three months
before the Iraqi invasion of Kuwait. Both exogenous
events shook the Philippine economy.

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and the acceleration of the economy are accompanied by a rising and falling of the inflation rate which peaks in 1990 at 12% and declines to 7.5% 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 are 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%, are lower than those before the 1984-85 crisis which averaged 5.4%. This is partly due to the low levels of assumed government construction expenditures for the forecast horizon (averaging ₱107 million) while the pre-crisis levels averaged ₱189 million. Regional employment rises from 1.778 million in 1988 to 1.980 million in 1992, an average annual growth of 3.2%. This, however, is not enough to absorb the growing labor force so that the unemployment rate rises from 5.4% in 1988 to 6.1% in 1992. National tax collection grows at an average annual rate of 10.2% while local tax collection grows at the faster pace of 23.3%. This allows the local government to increase its expenditures by 15.4% annually without incurring a deficit. Inflation rate rises from 9.3% in 1988 to 12.9% in 1990 and declines to 8.0% 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

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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 ₱183M 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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