

REGIONAL FORECASTING ANALYSIS FOR THE KYUNGGI PROVINCE*

CHUL HWAN KIM**

This paper describes the specification, estimation, and simulation of a regional econometric model for the Kyunggi Province (KP), Korea. In view of not only the widespread interest in regional growth but also the beginning of local government autonomy in Korea, it is urgent that a comprehensive regional econometric model be formulated. By providing a simple econometric forecasting model for KP, this study tries to examine the growth pattern and underlying structure of this important provincial economy.

1. INTRODUCTION

Considerable efforts have been devoted to the construction of national level econometric models in Korea. Examples include Bank of Korea (1990), Lee and Kim (1991), and references therein. Unfortunately, to the best of the author's knowledge, no work has been directed to the development of econometric models at regional level, an essential ingredient for national policy analysis. The Bank of Korea and other economic research institutions seldom relate their forecasting values to the regions of Korea. This is because regional output itself has rarely been of interest from a national policy perspective.

The absence of regional forecasting analysis is a common practice throughout developing countries. Unlike developed industrial countries where various forms of regional forecasting models are available, the lower and middle income countries have generally not succeeded in the construction of meaningful regional econometric models. One exception is Murthy (1992), which covers the State of

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** Professor, Department of Economics, Ajou University.

Andhra Pradesh, India, emphasizing only the supply side rather than treating both the supply and the demand sides as do the traditional regional models now employed in developed countries. One reason for restricting the model to the supply side is related to data: statistics on demand aggregates are not available at the state level in India.

Data limitations are a major reason for the general lack of international regional forecasting analysis. There are two types of data problems: first, local governments do not keep adequate records on regional economic activities and on the flow of resources across local boundaries; second, even when they have kept records, the figures are either not known with any precision or not regularly tabulated for direct use in regional model building. Not surprisingly, data availability is crucial to the choice of variables and specification of model structures at the regional level.

Since 1990, the Bureau of Regional Economy, Kyunggi Province (KP hereafter), has made available annual times series data of several economic variables at the provincial level as far back as 1970 through its publication of the *Kyunggi Economic Indices*. This new source of information finally permits the construction of a regional econometric model at the provincial level in Korea. However, some of the data available at city and county levels date only to 1980 or 1985. As a result, there are a number of instances in which regression equations for important variables are not estimated.

Like many developing countries, local governments in Korea have neither played decisive roles in regional economic planning nor been involved in decision making processes. Development goals and resource allocation are mainly determined on a national basis. Local government executives, including Governors, have been appointed by the Ministry of Interior. The provincial legislature was not established until 1991. The province, therefore, has played only a limited role in integrating the framework of its own plan with national objectives.

In recent years, however, there have been drastic changes in regional Korean politics. Local autonomy was reinstated for the first time in thirty years. The governors, mayors, and administrative chiefs of local government bodies were elected in 1995, and the lower and upper level local councils have been functioning actively since 1991. Evolution toward a complete local autonomy, including legislative, administrative, and public financial independence of local governments seems inevitable. Increasing political decentralization makes it possible for local governments to have a greater leverage over the development of their own financial resources.

In view of the widespread interest in regional growth and even distribution of wealth among the provinces, as well as the trend toward local self-government, it is urgent that a comprehensive regional econometric model for KP be formulated. This will permit the relationship between regional and national economic growth be more carefully examined. By providing a simple econometric forecas-

ting model, this article intends to examine the growth pattern and explore the underlying economic structure of the KP. It is also designed to help bridge the gap between policy making and economic analysis.

The paper is organized as follows. The next section provides an overview of the KP economy. A brief description of the model follows in section three. Estimation results, simulation results, and long-run forecast results are summarized in section four. Suggestions for model enhancement are presented in the conclusion.

II. OVERVIEW OF THE KYUNGGI PROVINCE ECONOMY

The Kyunggi Province (KP) is located in the northwestern part of South Korea. Like an egg white, the KP embraces the capital city, Seoul, which plays a central role in various fields of Korean society including economic and industrial activities. The KP is divided into two regions: northern and southern. The northern region abuts the DMZ (demilitarized zone), the border line between South and North Korea. Since the distance from Seoul to the DMZ is so small (one hour by a car from the geographic center of Seoul), the central government has imposed strong measures restricting any potential development plans and has discouraged industrial location in this area on the ground of military strategy. In the northern part of the KP, there are only six small cities out of a total of 19 KP cities.

In contrast, the southern KP has prospered in terms of increasing population, manufacturing employment, regional gross product, and basic economic infrastructure. Rapid growth of population and manufacturing output in southern KP over the last two decades is mainly attributable to Korean government efforts to decentralize population. Industrial relocation from Seoul has helped foster more balanced regional development and directly benefitted southern KP.

Like many developing countries, Korea has also suffered excessive rural-urban migration. Migration from the countryside to Seoul metropolitan areas has led to an unprecedented urban population growth. Such population concentration in Seoul is likely caused by abundant employment opportunities due to rapid industrialization, the presence of higher educational institutions, convenient facilities for business, and the existence of high quality housing. However, rapid excessive growth in Seoul has given rise to many negative externalities: pollution, traffic congestion, overburdened public services, insufficient social infrastructure, and severe housing shortages, among other things. To alleviate these problems in Seoul, the Korean government employed a wide range of decentralization policies since the early 1970s.

The strategy to slow growth in Seoul accelerated population growth in KP and promote economic development. As a result, the share of national population growth in the KP has increased to 41.4 % over the 1980-85 period from 8.6% over the 1960-70 period (Kyunggi Province, 1992b, p. 361). As the share of

in-migrants to Seoul declined over the 1970-85 period, the corresponding share of the KP exhibited a reverse trend during the same period. The KP absorbed about one fifth of the nation's total population change since 1970. The decreasing share of both population growth and in-migrants by Seoul has been mostly accounted for by a corresponding increase in the KP, more specifically, by rapid growth of outlying cities surrounding the capital.

Indeed, population growth in outlying cities of Seoul far exceeded the national average. This phenomenon occurred partly because of the government's decentralization policy and partly because of the improved suburban electrified railroad network linked directly to the Seoul subway system. Skyrocketing housing costs in Seoul also played an important role in the expansion of new cities near Seoul. Among the latter, Songnam, Anyang, and Pucheon, which obtained urban status after 1970, have been the fastest-growing cities. The city of Incheon, another fast-growing municipality, was removed from the KP and given a completely separate administrative oversight in 1981 and was thus no longer a subordinate city of the province. Suwon, the capital of the KP, also maintained steady growth since the 1960s. The city of Uijongbu, adjoining northern Seoul, is the only exception, exhibiting a slow growth pattern due to government restriction.

A brief look at changes in manufacturing employment reveals the similar pattern. The KP's share of nation's manufacturing employment increased to 27.5% in 1985 from 12.1% in 1970, while that of Seoul continued to decline from 33.9% in 1970 to 19.8% in 1985 (Cho, 1993, p. 124). The KP had the highest provincial annual growth rate in manufacturing employment, almost twice the national average. It also acquired the largest share of manufacturing employment in the national total from 9.5% in 1968 to 27.5% in 1985. Most other provinces experienced the reverse, as manufacturing employment grew at or below the national annual growth rate. This is the result of the industrial redistribution policy to alleviate industrial over-concentration in Seoul area. The city of Ansan (originally named Panwol) in the KP, 25 miles southwest of Seoul, is an example of an industrial city which accommodated relocated manufacturing firms from Seoul in late 1970s. There are 11 such industrial sites in the KP, with four more sites expected to be added by 2001 (Kyunggi Province, 1992b, p. 72).

Uneven development, however, is an inevitable outcome associated with economic growth. Growth has not occurred everywhere in the KP. The KP contains less developed or lagging regions including remote islands and mountainous areas as well as well-developed urban and industrial areas. The existence and persistence of regional disparities have also provoked unbalanced development in various sectors, such as agriculture, and infrastructure. Korean agriculture is characterized by small family-operated farm units, rice-centered production, aging farmers, and a negative output growth. Nationally, agriculture comprises only 6.6% of GNP. The GNP growth rate of agriculture was a negative 0.6% in 1991, although the national economy achieved a record 8.4% growth rate. The growth

rate of agriculture has been negative since 1989 (Kang, 1993, p. 93). The KP was a no exception. The population in the agricultural sector in 1991 was 762 thousand, which was 50 thousand less than that in 1990 (Kyunggi Province, 1992b, p. 377).

Another unique characteristic of the KP economy is its strong dependence on the Seoul economy. The low level of local ownership of industries in the KP region may have served as a constraint on regional economic growth. Over 40% of the manufacturing firms with more than 300 employees in the KP are headquartered in Seoul (Kyunggi Province, 1992b, p. 67). The influx into the KP region of branch plants with headquarters in Seoul often failed to bring about a concomitant increase in locally produced goods and services. Much of the regional savings in the KP area are not invested into local area. Though many people work in the KP, they frequently spend their income in Seoul where they reside. Of course, these observations are natural consequences resulting from market-oriented economies.

III. MODEL OVERVIEW¹⁾

The KP model is presented below. Our model which consists of nine behavioral equations and three identities is not as much detailed as we like it to be. Selection of a relatively simple model is based on two reasons. First, and foremost, the data that are consistent with either traditional Korean macroeconomic models or with conventional regional US models are not available at the Korean provincial level. Second, whether "the need for regional economic projections really require the construction of a costly, complex regional model" is still an open question, as pointed out by Taylor (1982a). If a simple and readily implementable framework yields reliable predictions, then the simple model can be preferred to more complex ones. Consequently, this prototypical KP regional forecasting model utilizes a straightforward modeling construct. It is expected that the model provides some basic insight into the functioning of the KP economy and its relationship with national economic performance.

The conceptual framework of the KP model is straightforward. It consists of three parts: population, local employment by sector, and fiscal aspects of the local government. The system of equations is simultaneous. It is also a "satellite model" in the sense that national variables serve as important explanatory variables in the structural equations. Estimated equations include one equation for population growth, one equation for labor force participation, three equations for

¹ The original KP model specification was initially suggested by Carol Taylor West and Thomas Fullerton Jr., Bureau of Economic and Business Research, University of Florida, based on information provided by us. After a number of trial estimations, the model was reformulated in the form presented here.

sectoral employment, two equations for government revenues (general and special), and two equations for government expenditures (general and special). Six accounting identities are also included: three relating employment, unemployment, and the unemployment rate; three for the government general account balance, the special account balance, and the consolidated government account balance. A summary of general specifications for the variables of interest is presented below.

A conventional procedure in the estimation of population is individual treatment of the components of change: births, deaths, and net migration. Economic factors such as real per capita income, local wages, unemployment rates, and demographic factors such as the proportion of population over sixty-five, the population of women of childbearing age, and time trends are often incorporated into these estimates (Taylor, 1982a, pp.430-31; Charney and Taylor, 1984, pp. 234-35). Along these lines, population in KP (POP_K) is specified as

$$(1) \text{ POP}_K = a_0 + a_1 \text{ POP}_K(1) + a_2 \text{ DPOPS}$$

where POP_K(1) is one period lagged value of KP population, and DPOPS is the change in population in Seoul which serves as a proxy for migration into the KP area.

Usually, migration is induced by the desire to seek better jobs. People move out of areas with job shortages to areas where jobs are more readily available. Since the beginning of industrialization of Korea in the 1960s, Seoul, which is located in the center of the KP, has attracted rural migrants at an unprecedented rate, and hence faced serious housing and traffic problems. As a result, a large proportion of rural migrants to Seoul actually settled in outlying regions of Seoul in the KP. Population change in Seoul therefore may serve as a useful proxy for the migration into the KP area.²⁾

A change in the size of population itself or of the number working aged people does not translate into an equivalent increase in the size of labor force because not all individuals of working age are employed or seek employment. It is therefore helpful to formulate a separate labor force equation within any forecasting model of this type. Labor force participation is assumed to be determined by

² In the treatment of migration, two problems arise. First, the use of Seoul's population change as a proxy for net migration into the KP disregards population change due to births and deaths in Seoul. Since migration has been a dominating factor of the population change in Seoul, the approximation of changes of population in Seoul by net migration should not yield a serious problem. Second, it is more appropriate to specify a migration equation under the Harris-Todaro approach: net migration as a linear function of the real expected wage ratio between the KP and nation, and the ratio of job vacancies to the number of unemployed workers relative to that of the nation. Unfortunately, data limitation does not allow the estimation of this type.

the population of age 15 and over. Theory and empirical findings related to the discouraged worker hypothesis, furthermore, suggest that the size of total labor force would be influenced by the unemployment rate. The labor force in KP (LFK) is specified as a linear function of the KP population aged 15 and over (POPK15) and provincial unemployment rate (UNEMPK).

$$(2) \quad \text{LFK} = b_0 + b_1 \text{POPK15} + b_2 \text{UNEMPK}$$

Three types of employment are modeled: agriculture, forestry, and fishing employment (EMP1); industrial employment defined as that in mining plus manufacturing (EMP2); and employment not elsewhere classified (EMP3).

$$(3) \quad \text{EMPK} = \text{EMP1} + \text{EMP2} + \text{EMP3}$$

where EMPK is total employment in the KP. Employment in agriculture, forestry, and fishing is determined by wages and salaries paid in the manufacturing sector in the KP (WAGEK) and national exports (EXPN). Higher wages in manufacturing sector and increase in national exports induce labor movements from agricultural to manufacturing sector.

$$(4) \quad \text{EMP1} = c_0 + c_1 \text{WAGEK} + c_2 \text{EXPN}$$

Industrial employment is determined by national GNP (GNP) and exports for the KP (EXPK).

$$(5) \quad \text{EMP2} = d_0 + d_1 \text{GNP} + d_2 \text{EXPK}$$

Other employment, including retail trade, commerce, transportation, and government services, EMP3, is a function of industrial development and KP population.

$$(6) \quad \text{EMP3} = e_0 + e_1 \text{POPK} + e_2 \text{EMP2}$$

Two identities complete the specification of the labor market.

$$(7) \quad \text{UNEMPK} = \text{LFK} - \text{EMPK}$$

$$(8) \quad \text{URK} = (\text{UNEMPK}/\text{LFK}) \times 100$$

where UNEMPK is the number of unemployed persons, URK is the unemployment rate in the KP.

One essential ingredient for increased local autonomy is independent public

financial power. Local public finance has been neglected in Korea, but it will not be an ongoing aspect of the Korean political system. Reinstatement of local political autonomy has shed light on the importance of local public finance. It is, therefore, necessary for the local governmental authorities to analyze the statistical characteristics of local government revenues and expenditures.

Government revenues and expenditures are both modeled separately for general funds and specific funds. Local government revenues consists mainly of local taxes and central government grants.³⁾ Local taxes are composed of taxes on income, property and consumption. The major income tax is the inhabitant tax. Acquisition taxes, registration taxes, and property taxes, among others, comprise the taxes on property. These taxes are closely related to the numbers of households, which is the unit of taxation. Two of the factors considered in grant money allocation decision by the central government to local governments are regional economic and fiscal imbalances. Hence, per capita gross regional product is chosen as an explanatory variable for grants. Total local government general revenues (GENREV) are assumed to depend on the total number of household (NHOUSK) and per capita gross regional product (PCGRPK).

$$(9) \quad \text{GENREV} = f_0 + f_1 \text{NHOUSK} + f_2 \text{PCGRPK}$$

Special revenue (SPREV) is assumed to be influenced by population and a time trend.

$$(10) \quad \text{SPREV} = g_0 + g_1 \text{POPK} + g_2 \text{TREND}$$

Local government expenditures, general (GENEXP) and special (SPEXP), are explained by one period lags of their respective own values and local government revenues by source. This specification reflects balanced budget adjustment considerations and has been widely utilized in developing country econometric forecasting applications (Fullerton, 1993).

$$(11) \quad \text{GENEXP} = h_0 + h_1 \text{GENEXP}(1) + h_2 \text{GENREV}$$

$$(12) \quad \text{SPEXP} = i_0 + i_1 \text{SPEXP}(1) + i_2 \text{SPREV}$$

³ Other source of local government revenue is non-tax revenue. The central government grants is composed of specific grant and local share (or allocation) tax. The local share tax, known as general grants, are distributed to each local government to alleviate fiscal imbalances across regions. The proportion of the local share tax to total revenue has shrunk during the past ten years. In fact, the KP itself and other large cities in the KP are not allowed to receive it, whereas many local governments benefited from this revenue sharing scheme, which, in some regional governments comprise half of their total budget. For more details, see Lee(1992).

IV. ESTIMATION AND SIMULATION RESULTS

The nine stochastic equations have been estimated with either ordinary least squares (OLS) or a Cochran-Orcutt (CORC) iterative procedure⁴. Regression equation results are reported in Table 1. Also shown are the estimates for the coefficients of determination (R^2), standard errors of estimation (SE), and Durbin-Watson statistics for autocorrelation (DW). The statistical quality of these results is generally comparable to those obtained by previous studies for the US (Bell, 1967; Hall and Licari, 1974; Taylor, 1982b). The coefficient estimates are generally significant and have the expected signs and magnitudes.⁵

The statistical fit on the population equation is reasonable. The one period lagged value of population is statistically significant at the one percent level. KP population, however, is not statistically sensitive to changes in the population in Seoul. This result may not be surprising since use of the change in population in Seoul as a proxy for net migration into the KP overlooks population change due to births and deaths in Seoul. Also, it may be that, among the rural population migrating to Seoul, the proportion of persons moving to the KP area is not as large as hypothesized⁶.

The statistical results for the labor force equation are also relatively successful. The local unemployment rate coefficient in equation (2), however, is statistically insignificant. Empirically speaking, the results do not support the discouraged worker hypothesis in the KP economy. This may be due, in part, to the fact that most unemployed persons in the KP area can eventually find jobs in Seoul, and hence are unlikely to become discouraged by increases in the unemployment rate.

Statistical fits for the three employment functions are fairly good. The negative sign on manufacturing wages and salaries in equation (4) for agricultural employment can be interpreted in two different ways. If wages and salaries serve as a proxy for output, the negative sign implies that the KP economy underwent rapid industrialization. That is, as the KP economy grew, employment in the agricultural sector shrunk. An alternative interpretation is more straightforward. The wage increase in manufacturing sector induced a massive outflow of labor

⁴ Even though the data period (1971-1990) is too short to use two stage least squares (TSLS) estimation procedures, we estimated the model with TSLS. The estimated results are almost identical both in sign and in magnitude with OLS or CORC estimation. We reported the TSLS estimation results in the Appendix.

⁵ In a graphical analysis not presented here, we can see from visual inspection the predicted values are closely related to the actual values. These illustrations are available on request from author.

⁶ It is necessary to estimate equation (1) with instrumental variable(IV), using housing price in KP and Seoul, expected wage differential, and density, due to the endogenous nature of DPOPS, which was suggested by a referee. Data limitation does not allow us to do so, and future research in this direction is necessary.

[Table 1] Estimated Equation of the KP Econometric Model

Equ.No.	Dep.Var.	Regression Estimates	R ²	SE	DW	Method
1	POPK	537.38+0.96 POPK(1)-0.0008 DPOPS (0.92) (9.26) (-0.98)	0.87	278.32	2.02	OLS
2	LFK	-49.23+0.60 POPK15-9.52 URK (-0.23) (10.76) (-0.41)	0.97	61.69	1.77	CORC
4	EMP1	502.7+0.001 EXPN-0.0001 WAGEK (7.51) (3.05) (-5.19)	0.80	44.15	1.52	CORC
4'	EMP1	1235.7+0.001 EXPN-0.0001 WAGEK (2.81) (4.12) (-3.52) -0.001 POPS (-1.86)	0.84	39.20	2.07	CORC
5	EMP2	102.8+0.0003 GNP+0.00003 EXPK (3.28) (3.15) (4.08)	0.95	43.81	2.17	CORC
5'	EMP2	218.3+0.0002 GNP+0.00003 EXPK (3.82) (2.32) (5.04) -0.0003 DPOPS (-2.43)	0.96	39.01	2.39	CORC
6	EMP3	370.08-0.07POPK+1.41 EMP2 (1.36) (-0.80) (4.15)	0.89	84.5	2.29	OLS
6'	EMP3	742.8-0.20POPK+0.57 EMP2 (4.62) (-3.95) (2.51) +0.0009 GNP (7.50)	0.97	41.2	1.87	CORC
9	GENREV (log)	-9.17+1.12 NHOUSK+0.88 PCGRPK (-2.45) (3.72) (12.6)	0.99	0.08	1.70	CORC
10	SPREV (log)	4.80+0.43 POPK+0.24 TREND (0.34) (0.24) (3.99)	0.91	0.40	1.76	CORC
11	GENEXP (log)	0.65+0.14 GENEXP(1)+0.80 GENREV (4.62) (1.68) (9.99)	0.99	0.70	2.04	OLS
12	SPEXP (log)	5225.4-0.04 SPEXP(1)+0.77 SPREV (1.72) (-0.92) (55.16)	0.99	9028.7	2.11	OLS

Note: 1) The numbers in the parentheses below the coefficient estimates are
t-statistics

2) Estimation period: 1971-1990 (annual data)

from agriculture to manufacturing. The positive sign of the EXPN coefficient in equation (4) indicates that many of the agricultural product in the KP has been exported. The positive sign of the EXPK coefficient in equation (5) implies that

many manufacturing industries in KP tend to export their goods. The positive sign on the coefficient for GNP in the equation demonstrate that national economic growth also creates regional employment opportunities in KP. All parameters but that of population in equation (6) are statistically significant at the one percent level.

Although the results in employment equations are satisfactory, we have added a third explanatory variable to each equation. They include the levels and changes in population in Seoul in equations (4) and (5) respectively, and GNP in equation (6). Each coefficient is statistically significant. The negative sign of the parameter estimate for population and its change in Seoul suggests that many of those previously employed in agriculture and manufacturing in the KP move to Seoul for better job opportunities. The positive sign on the GNP coefficient in equation (5) can be interpreted as evidence of the expansion of the tertiary sector resulting from economic growth and development. The negative sign on the POPK coefficient in equation (5)' is hard to interpret.

The equation (9) was estimated in logarithmic form. Both the NHOUSK and PCGRPK variable demonstrated strong explanatory power at one percent levels of significance. The population parameter variable in the special revenue function is also statistically significant at the one percent level. The statistical fits on the government expenditures were also remarkably good. The parameters of the general expenditure function are statistically significant at the one percent level and demonstrate that government expenditure is sensitive to the revenue constraint, which coincides with previous studies (Hall and Licari, 1974; Murthy, 1992), and

[Table 2] MAPE Estimates for Selected Variables (%)

Variable	MAPE
POPK	6.26
LFK	3.49
EMP1	9.46
EMP2	7.96
EMP3	9.97
GENREV (log)	5.40
SPREV (log)	2.89
GENEXP (log)	3.51
SPEXP (log)	0.42

has a time trend. The implied elasticities of this equation are also reasonable. The special expenditures equation has one unexpected result, a negative coefficient on its own lagged value. The latter implies that KP special expenditures take place on a one-time basis and do not carry over into subsequent fiscal periods.

An estimate of model accuracy over the sample period was obtained by computing the mean absolute percent error (MAPE) for each endogenous variable. The MAPE values are presented in Table 2. On the whole, the MAPE statistics indicate the model to be a fairly useful tool for empirical analysis. With the exception of local government special revenues and expenditures, the average MAPE values are approximately 3.5 to 9.9 percent. The additional explanatory variables in each of the employment equations yielded a dramatic MAPE reductions for EMP1 and EMP3 (4.0 and 4.5 percent respectively) and a mild reduction in EMP2 (0.5 percent). The larger MAPEs for the employment sectors can be attributed to the poor proxy variable explaining the variation of local output as well as the lack of adequate data on wage rates in these sectors of the KP.⁷⁾

It is possible that the model's poor performances around the 1980 period is the result of the exclusion of Inchon from the KP. One may attempt to remedy this problem by introducing dummy variables. The use of dummy variables, however, contains the danger of picking up effects which are not attributable to the exclusion of Inchon, as pointed out by Latham et al. (1979, p. 8) in their Delaware model. To avoid this risk, data adjustments were introduced by combining the observations of Inchon with those of the KP. The combined data yielded much more satisfactory statistical results. Standard errors of regression were substantially reduced and the predictive power became strikingly better. While the MAPEs for LFK and EMP1 were slightly reduced (0.2 percent and 0.3 percentage points, respectively), that of POPK decreased from 6.26 to 0.88 percent.

The actual value of POPK is almost coincident with the model predicted value after adjustment.

Forecasting is one of the goals of the KP econometric model. Two types of forecasting experiments are conducted here: one is a simple forecasting of the endogenous variables based on the structural coefficients from our model; the other is to simulate the effects of policy changes on the KP economy, which allows us to test the sensitivity of the KP economy to political events in the KP as well as

⁷ Another way to examine model accuracy is to compare actual values with model predicted values for the endogenous variables over time. (See Adams et al., 1975; Hall and Licari, 1974; and Latham et al., 1979). A cursory look at these illustrations reveals a close correlation between the actual and predicted values. The predicted values of variables such as LFK, EMP2, EMP3, GENREV, and SPEXP closely track their actual values. The EMP1 equation was unable, however, to match its actual movements with much accuracy. This failure may have been caused by the lack of adequate adjustment for the exclusion of Inchon from the KP in 1980.

that of national economy.⁸⁾ First, we computed the forecasted value for POPK for 1994-2000 period based on equation (1). The DPOPS variable in equation (1) was dropped because it is insignificant and not easily forecast⁹⁾. Since the proportion of population age over 15 in the KP is unknown, we used the projected value for the national proportion for the years of 1995 (73.5%) and 2000 (75.0%) from the KDI (1986) as a proxy. For the remaining years, we arbitrarily constructed values proportional to these figures. Dropping the insignificant UNEMPK variable from equation (2), we projected the forecast value for the labor force in the KP. These values are reported in Table 3.

The second simulation represents an experiment on assessing the effect of policy on the KP's economic growth. This type of simulation can provide valuable information to local policy makers, especially those involved in economic development activities. A practical issue to consider is whether policy actions can yield significantly desirable effects in the regional economy. Based on the projected values of population and the labor force, we calculated forecast values for employment in each sector for 1995 and 2000. The combined data over the period 1971-1990 was used in the estimation. A 3 percent increase in wages and salaries in manufacturing sector will reduce agricultural employment to 15 percent by 1995, a 5 percent increase will lead to a 30 percent reduction. A 10 percent increase in KP exports, with all other exogenous variables held at their 1991 levels, will lead to an increase in annual rate of manufacturing employment of approximately 7.5 percent through the year 2000. In turn, this generates an average an-

[Table 3] Projected Value for POPK and LFK (unit : thousand person)

Year	POPK	LFK
1991	6301	2703
1992	6449	2771
1993	6597	2843
1994	6746	2916
1995	6896	2992
1996	7046	3070
1997	7197	3150
1998	7349	3231
1999	7501	3314
2000	7654	3403

⁸⁾ This type of experiment serves as another test of how well the model performs outside the sample period, known as ex ante tests.

⁹⁾ The estimated result using 1971-1990 data is as follow :

$POPK = -28340.6 + 1.004POPK(1), R^2=0.88, DW=2.06$

[Table 4] Projected Growth Rate for EMP2 & EMP3
(in case of a 3% and 5% increase in EXPK)

Year	5% increase		3% increase	
	EMP2	EMP3	EMP2	EMP3
1993	3.81	3.25	2.30	1.57
1994	3.85	3.35	2.32	1.65
1995	3.88	3.44	2.33	1.73
1996	3.92	3.51	2.34	1.80
1997	3.95	3.67	2.36	1.78
1998	3.98	2.94	2.37	1.04
1999	4.01	3.04	2.38	1.04
2000	4.04	3.36	2.40	1.23

nual of 7.8 percent increase in service sector employment. Table 4 presents a complete simulation results. Sensitivity of the KP economy to changes in national economic performance is also calculated. If the GNP growth rates for the 1994-1998 period projected by the government's "new economy plan" are successfully achieved, the KP manufacturing employment will, according to this analysis, grow at an average annual rate of 6.6 percent.

A note of caution. Since no regional forecasting history exists for implicit evaluation of the accuracy of these simulations, the forecast results must be interpreted with caution and regarded as an indication of the reasonableness and stability of the model's out-of-sample behavior. Further estimation and simulation analysis are obviously warranted.

V. CONCLUDING REMARKS

The regional econometric model for the KP developed in this study demonstrates generally satisfactory performance in terms of in-sample prediction. The KP model also provides useful insights with respect to the basic approach utilized in simultaneous equation modeling of an economic region. As new data become available, the development of additional detail such as sectoral output can be accomplished. In addition, incorporation of financial and banking detail may also become feasible. Cooperation with the provincial government not only in data accumulation but also in model development is essential. Accuracy in forecasting generally results from a high degree of cooperative effort between government analysts and policy makers.

APPENDIX : KP Econometric model (TOLS Estimation)

Equ.No.	Dep.Var.	Regression Estimates	R ²	SE	DW
1	POPK	-137.10+1.07 POPK(1)+0.106 DPOPS (-1.61) (122.01) (0.52)	0.9985	59.338	1.9810
2	LFK	639.07+0.62 POPK15-0.315 URK (0.05) (5.58) (-0.28)	0.9874	77.410	1.6146
4	EMP1	708.19+0.0001 EXPN-150.32 WAGEK (16.96) (3.14) (-4.75)	0.8726	39.658	2.0815
5	EMP2	194.46+0.00003 GNP+0.00004 EXPK (18.28) (2.39) (2.70)	0.9849	41.193	2.0571
6	EMP3	-318.98+0.141 POPK+0.639 EMP2 (-1.09) (1.50) (1.52)	0.9532	93.139	2.0325
9	GENREV (log)	50864.3+11.79 NHOUSK+100400.02 PCGRPK (0.17) (0.03) (0.56)	0.9913	91122.4	1.0146
10	SPREV (log)	5801174.8-1857.18 POPK+218450.83 TREND (3.70) (-3.59) (2.94)	0.9484	129525	2.2723
11	GENEXP (log)	9810.23+0.61 GENEXP(1)+0.3763 GENREV (1.88) (12.44) (16.22)	0.9989	21390.1	2.2375
12	SPEXP (log)	2619.15-0.006 SPEXP(1)+0.7348 SPRV (0.52) (-0.11) (26.46)	0.9986	15546.3	1.9439

Note: 1) The numbers in the parameters below the coefficient estimates are t-statistics.

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