Government Expenditures and Economic Growth in South Korea: A VAR Approach

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This paper examines the causality between government expenditure and economic growth along with money supply in a trivariate framework by applying a VAR techniques to South Korean data for the period 1954-94. The Phillips-Perron (PP) unit roots tests and Johansen's tests of cointegration are performed. The diagnostic tests for adequacy of the model also performed and passed. This study finds that there is a bidirectional causality between government expenditures and economic growth in South Korea. It is also found that money supply affects economic growth as well. The results are consistent with some of the past studies that detect a feedback between GDP and expenditure.

I. Introduction

Much attention has been given to the remarkable economic success of the East Asian Newly Industrialized Countries (NICs), including South Korea, Taiwan, Hong Kong, and Singapore. The success is often attributed to the government role and export orientation of these countries. The dominant view among economists as well as public policy makers is that the government has played a very important role in guiding and orchestrating the rapid export growth and economic development in South Korea (Korea hereafter). As noted by Kuznets (1982), government in Korea acts by providing information, reducing risks, and altering incentives.

Nevertheless, the relationship between government expenditure (to be proxy for government activity) and economic growth is not without controversy in the empirical literature. On the one hand, Singh and Sahni (1984), Ram (1986), and Holmes and Hutton (1990) conclude that government expansion has a positive effect on economic growth. Other the other hand, Landau (1983, 1986), Barth, Keleher, and Russek (1990) find the opposite is true that government expansion tends to exert a negative impact on economic growth for many developed and less-developed countries. In another study, Ram (1986) examines 63 developed and developing countries but detects no consistent causal pattern between government expenditure and economic growth.

The purpose of this paper is to examine the causality between government expenditure and economic growth in South Korea by applying the techniques of Sims (1980), Johansen's cointegration (1988, 1990), and Hsiao's (1981) version of the Granger causality method to post-Korean war data. Unlike other studies, we choose one single country with an attempt to make a more in-depth investigation and analysis. The country of Korea is selected for this study because it is well-documented in the literature (1989, 1986, 1985, 1990) that the government of Korea has played

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an important role in its successful economic development, yet little, if any, work has been undertaken to provide evidence to support this proposition empirically. In addition, the Korean case is a special one not appropriate for generalized conclusions relating to government spending and economic growth (e.g., the Korean economy was deeply impacted by a major war, divided into two parts, affected by U.S. defense forces, influenced by threats from the north, etc.).

The remainder of the paper is organized as follows. Section II presents the methodology and models. The third and final sections report the empirical results, conclusions, and policy implications, respectively.

II. Methodology and Models

The methodology employed in this study is that of vector autoregressive (VAR)/Granger causality analysis developed by Sims (1980) and Granger (1969). The VAR is used in conjunction with Hsiao's version of the Granger-causality method to test for Granger causality (see Barnhart and Darrat (1989)) between government expenditure and economic growth in Korea. The estimated VAR model in this study consists of three related macroeconomic endogenous variables: economic growth, government expenditure, and money supply. The conventional simultaneous equations technique or structural modelling procedure have been criticized as simply too restrictive, and the selection of endogenous and exogenous variables is far too arbitrary and judgmental. On the other hand, in a VAR system all the variables in the model are endogenous and that each can be written as linear function of its own lagged values and the lagged values of all other variables in the system. Additionally, one of the usages of VAR has been in testing for causality between two or more variables. Moreover, the results of testing for causality with a multivariate VAR model are much more reliable compared with the typical bivariate causality tests, see Barnhart and Darrat (1989). Furthermore, by adopting a multivariate model, it may avoid biased causality inferences due to the omission or exclusion of relevant variables, see Lutkepohl (1982).

In this study, our investigative procedure consists of five main steps. First, the Phillips-Perron (1988) (PP) tests of stationarity and Johansen (1988, 1990) test of cointegration are performed; second, instead of arbitrarily choosing the lag lengths, the final prediction error (FPE) criterion as defined by Akaike (1969) is employed to select the optimum lag for each equation in the system; third, the sequence in which each variable enters the estimating equation is determined by specific gravity criterion (SGC) as proposed by Cains, Keng, and Sethi (1981); fourth, we use Hsiao's version of the Granger causality method to estimate a one-sided Granger causality for each equation; and finally, the adequacy of the lag-length specification for each equation is examined by performing the conventional diagnostic tests.

1. The model

The theoretical relationship between government expenditure and economic growth is well-documented in the literature and therefore it will only be briefly discussed here. There are two major divergent theories in economics concerning the relationship between government expenditure and economic growth. While conventional macroeconomic theory has generally assumed that increased government expenditure tends to lead to high aggregate demand and in turn, rapid

economic growth, Wagnerian theory, however, leans toward the opposite view. The latter contends that an increase in national income causes more government expenditure. Additionally, Ahsan, Kwan, and Sahni (1990, 1992) suggest that GDP be formed as a function of government expenditure and money supply, and causality tests be carried out in a trivariate model where the third variable is either money supply or the budget-balance (budget surplus or deficit). The monetarists are known to assert that changes in money supply exert a dominant influence on changes in nominal GDP and the primary cause of fluctuations of output are fluctuations in monetary growth rate, whereas the neo-Keynesian believe that monetary policy parameter exerts a great influence on output and income of a country. In light of this, money is added to the income/expenditure equation. The variable of money supply is chosen over exports as the third variable for the latter have been consistently found to be insignificant in relation to economic growth in Korea in the empirical literature. Note all variables are in logarithmic form and in real terms.

While we are aware that the three variable setup might not be adequate to fully evaluate the Granger-causal relations among the variables, given the constraint of the number of sample periods that are available, we are simply not allowed to include more variable in the model. Thus, this model can be transformed into one trivariate VAR system and rewritten by specifying a vector autoregressive model as follows:

$$\text{Log } y = f (\log x, \log z), \qquad\qquad (1)$$

where y = GDP (in 1975 wons) or RGDP,
$\quad x$ = government expenditure 1975 wons (G), and
$\quad z$ = money supply in 1975 wons, measured in M_1 (M).

$$(1-L)\begin{pmatrix} \log\ y_t \\ \log\ x_t \\ \log\ z_t \end{pmatrix} = \begin{pmatrix} \alpha_1 & \delta_1 \\ \alpha_2 & \delta_2 \\ \alpha_3 & \delta_3 \end{pmatrix}\begin{pmatrix} 1 \\ e_{t-1} \end{pmatrix} + \sum_{i=1}^{P}(1-L)\begin{pmatrix} \beta_{11i} & \beta_{12i} & \beta_{13i} \\ \beta_{21i} & \beta_{22i} & \beta_{23i} \\ \beta_{31i} & \beta_{32i} & \beta_{33i} \end{pmatrix}\begin{pmatrix} \log\ y_{t-i} \\ \log\ x_{t-i} \\ \log\ z_{t-i} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \\ v_{3t} \end{pmatrix}, \qquad (2)$$

where L is the lag operator and $(1-L)=d$ is the difference operator such that $(1-L)y_t = y_t - y_{t-1}$ represents the first difference and e_t is the stationary residuals from the cointegration equation below:

$$y_t = a_0 + a_1 z_t + e_t. \qquad\qquad (3)$$

Thus, e_{t-1} represents the error-correction term (ECM). Note that x is excluded from equation (3) because x is found to be $I(0)$, as discussed below. The essential points is that the error-correction representation necessitates the two variables to be cointegrated of order $CI(1,1)$. In applying the error-correction modeling, we follow Miller (1991) and choose the conditioning (left-hand-side) variable which maximizes the adjusted R-squared. Notice that equation (2) above can be broken down into three equations: economic growth equation, government expenditure equation, and money supply equation. Each equation is estimated independently and separately using Hsiao's version of Granger causality method (see Appendix).

Hsiao's method requires the series of all variables to be stationary. The Phillips-Perron

(PP) test is the formal test for unit roots and stationarity in this study. The PP test is robust for a variety of serial correlation and time-dependent heteroscedasticity. Both the Johansen cointegration test and the Engle-Granger two-step residual-based cointegration test are performed to check cointegration nature of the variables in the model.

III. Data and Empirical Results

Prior to presenting the empirical results, a word about the data is in order. Annual data on government expenditure (the central government expenditure), GDP, CPI, and money supply for the period 1959-93 used in this study are obtained from *International Financial Yearbook* (1981 and 1994).

1. Results from Stationarity and Cointegration Tests

The results from Phillips-Perron (PP) tests, as shown in Table 1, reveal that the series of government expenditure is I(0), while the series of GDP and money supply are each found to be I(1). It has been shown that using non-stationary data in causality tests may yield spurious causality results. Nevertheless, the two I(1) variables each become I(0) after the first differencing.

The Engle-Granger two-step cointegration tests for the two I(1) variables are performed first using different variables as the dependent variable, but find only small differences in the results (which are not reported in the paper) indicating that the two I(1) are not cointegrated. The Engle-Granger test has a rather low power in rejecting the no-cointegration null hypothesis even when a long-run equilibrium relationship in fact holds.

Note that the Engle-Granger test is bivariate in design. In contrast, Johansen cointegration test is a more powerful cointegration test, particularly when a multivariate model is used. Moreover, the Johansen cointegration test is robust to various departures from normality in that it allows any of the three variables in the model to be used as the dependent variable while maintaining the same cointegration results. In addition, Johansen's test allows some variables to be I(1) and some I(0), as is the case in this paper. Thus, there are tow options to run the Johansen test in this case: One is to test only the two I(1) variables, the other is to test the I(1) variables along with the one I(0) variable. We choose the latter because by incorporating the I(0) variable into the Johansen test, it improves the efficiency of cointegration estimates.

Accordingly, Johansen's tests for the two I(1) and one I(0) variables are performed and the results indicate the existence of more than one cointegrating vector among the two I(1) variables, as shown in Table 2 and we therefore conclude that the two I(1) variables (RGDP and money supply) are cointegrated. Furthermore, the existence of more than one cointegrating vector may indicate that the system under examination is stationary in more than one direction and hence more stable. According to Engle and Granger (1987), cointegrated variables must have an ECM representation. Thus, error-correction terms should be incorporated into all equations with the exception of the government expenditure equation in determining the causality (note that the series of government expenditure is found to be I(0).).

2. Results from Hsiao's Version of the Granger Causality Tests

Ad hoc lag selection approach has been widely used in most earlier studies of government expenditure and economic growth cited above. The deficiency of this approach is that it lacks theoretical justification in assuming that two or more related variables must have identical predetermined lag lengths. To remedy this deficiency, Hsiao's approach is employed in this study. For details of this approach see appendix.

Table 1 Results of Phillips-Perron (PP) Unit Root Tests Before and After Differencing of the Data

	PP value Before Differencing	PP value After Differencing	Critical Value
Real GDP	-1.8270	-4.2056*	3.13
Money Supply (M)	-2.5538	-5.1699*	3.13
Government Expenditure (G)	5.5294*	n/a	3.13

Notes: n/a = non-applicable.
* denotes stationary.

Table 2 Johansen's Cointegration Tests

	Maximal Eigenvalue Test				Trace Test			
Null H	Alterna-tive H	Eigen-Value	C. V.		Alterna-tive H	LR Ratio	C. V.	
			90%	95%			90%	95%
r=0	r=1	39.3*	18.0	21.9	r≥1	65.45*	32.1	35.1
r≤1	r=2	20.1*	13.8	15.6	r≥2	26.11*	18.0	20.2
r≤2	r=3	6.0	7.6	9.1	r≥3	6.0	7.6	9.1

Notes: C. V.= critical value; H=hypotheses and PP=Phillips-Perrin.
* denotes significant at the 5% level.

After transforming the original data, we proceed to perform the one-sided causality tests for each equation in the VAR system.

Table 3 Results of FPE and the Specific Gravity Criterion (SGC) for the Economic Growth (Y) Equation

Lag	FPE of Y**	FPE of Y-G***	FPE of Y-M****	FPE of Y-G-M*****
1	0.3284959E-02	0.3646398E-02	0.3537693E-02	0.2488749E-02
2	0.2943722E-02*	0.3862774E-02	0.3280687E-02*	0.2383657E-02*
3	0.3276798E-02	0.3416856E-02	0.3492837E-02	0.2522641E-02
4	0.3458882E-02	0.3574867E-02	0.3637693E-02	0.2779100E-02
5	0.3892266E-02	0.3666142E-02	0.3746389E-02	0.3198563E-02
6	0.3981726E-02	0.3837237E-02	0.4120733E-02	0.3666029E-02
7	0.3481403E-02	0.4244244E-02	0.4758704E-02	0.4309447E-02
8	0.3601788E-02	0.3025431E-02	0.5195001E-02	0.4530863E-02
9	0.4069224E-02	0.2909751E-02*	0.6039329E-02	0.4944291E-02
10	0.4847733E-02	0.3426320E-02	0.4983805E-02	0.3804942E-02

Notes: * denotes the smallest FPE or the largest SGC; Y denotes RGDP.
** $Y = f(e_{t-1}, Y_{t-i})$; *** $Y = f(e_{t-1}, Y_{t-1}, Y_{t-2}, G_{t-i})$;
**** $Y = f(e_{t-1}, Y_{t-1}, Y_{t-2}, M_{t-i})$; ***** $Y = f(e_{t-1}, Y_{t-1}, Y_{t-2}, G_1, \cdots, G_9, M_{t-i})$.

**Table 4   Results of FPE and the Specific Gravity Criterion (SGC)
Tests for the Government Expenditure (G) Equation**

Lag	FPE of G[**]	FPE of G-Y[***]	FPE of G-M[****]	FPE of G-Y-M[*****]
1	0.9480126E-02	0.3209777E-02	0.3607787E-02[*]	0.3019210E-02[*]
2	0.9490784E-02	0.3478947E-02	0.3837998E-02	0.3160344E-02
3	0.1035396E-02	0.2878583E-02	0.3781793E-02	0.3143275E-02
4	0.8976408E-02	0.2775028E-02[*]	0.3942488E-02	0.3458895E-02
5	0.7249619E-02	0.3021105E-02	0.4051447E-02	0.3823767E-02
6	0.6933242E-02	0.3301368E-02	0.4430281E-02	0.4294605E-02
7	0.3364770E-02[*]	0.3940307E-02	0.5050776E-02	0.4499993E-02
8	0.3573102E-02	0.4274225E-02	0.5199580E-02	0.5543055E-02
9	0.3634643E-02	0.4654715E-02	0.5215326E-02	0.5264426E-02
10	0.3763390E-02	0.5539872E-02	0.5725918E-02	0.5897429E-02

Notes: * denotes the smallest FPE or the largest SGC; ** $G = f(G_{t-i})$;
      *** $G = f(G_{t-1} \cdots G_{t-7}, Y_{t-i})$; **** $G = f(G_{t-1}, \cdots, G_{t-7}, M_{t-i})$;
      ***** $G = f(G_{t-1}, \cdots, G_{t-7}, Y_1, \cdots, Y_4, M_{t-i})$.

Table 5   Results of FPE Test for the Money Supply Equation

Lag	FPE of M[**]	FPE of M-Y[***]	FPE of M-G[****]	FPE of M-G-Y[*****]
1	0.1813326E-01	0.1666032E-01	0.1670052E-01	0.1540431E-01
2	0.1575012E-01[*]	0.1528287E-01	0.1506358E-01	0.1389506E-01
3	0.1596720E-01	0.1356874E-01[*]	0.1377206E-01	0.1459153E-01
4	0.1678460E-01	0.1443078E-01	0.1394058E-01	0.1565314E-01
5	0.1741411E-01	0.1386118E-01	0.1337679E-01[*]	0.1272106E-01[*]
6	0.1905421E-01	0.1495634E-01	0.1358346E-01	0.1499684E-01
7	0.2153942E-01	0.1382199E-01	0.1714058E-01	0.1278202E-01
8	0.2336601E-01	0.1380507E-01	0.1736497E-01	0.1306153E-01
9	0.2122851E-01	0.1513676E-01	0.1709133E-01	0.1378838E-01
10	0.2006225E-01	0.1601403E-01	0.1923960E-01	0.1446995E-01

Notes: * denotes the smallest FPE or the largest SGC; ** $M = f(e_{t-1}, M_{t-i})$;
      *** $M = f(e_{t-1}, M_{t-1}, M_{t-2}, Y_{t-i})$; **** $M = f(e_{t-1}, M_{t-1}, M_{t-2}, G_{t-i})$;
      ***** $M = f(e_{t-1}, M_{t-1}, M_{t-2}, G_{t-1}, \cdots, G_{t-5}, Y_{t-i})$.

The results show that for the RGDP equation, as indicated in Table 3, GDP is added first and since 0.2909751E-02 < 0.2943722E-02 we therefore conclude that government expenditure Granger-causes RGDP. Subsequently, money supply is added to the equation and we conclude that money supply Granger-causes RGDP since 0.2383657E-02 < 0.2943722E-02. In sum, both government expenditure and money supply Granger-cause RGDP in Korea. By the same token, for the expenditure equation (Table 4), RGDP is entered into the equation first and since 0.2775028E-02 < 0.3364770E-02, we therefore conclude that RGDP Granger-causes government expenditure. Next, money supply is entered into the equation and since 0.3019210E-02 > 0.2775028E-02, we therefore infer that money supply does not Granger-cause government expenditure. In sum, only RGDP Granger-causes government expenditure.

      Likewise, the results for the money supply equation (Table 5) indicate that government expenditure Granger-causes money supply since 0.1337679E-01 < 0.1575012E-01. Subsequently,

RGDP expenditure is added to the equation and we conclude that RGDP Granger-causes money supply since 0.1272106-01 < 0.1337679E-01.   Thus, both economic growth and government expenditure Granger-cause money supply.   Note that the causality results are sensitive to the order in which the variable are entered into each equation.

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Table 6   Results from the Diagnostic Tests

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Name of the Tests	Economic Growth Equation	Government Expenditure Equation	Money Supply Equation
Misspecification			
Ramsey RESET(2)	0.0036 (1,10)	0.00826 (1,15)	1.4721 (1,14)
RESET(3)	1.0903 (2,9)	0.94191 (2,14)	4.6945 (2,13)
RESET(4)	1.4866 (3,8)	0.72639 (3,13)	2.9518 (3,12)
Normality test Jarque-Bera	4.2185 (2)	0.3383 (2)	1.6532 (2)
Heteroscedasticity Glejser Test	9.9990 (14)	9.0130 (11)	10.6660 (13)
Residual Correlation LM Test	2.9250 (7)	3.9200 (8)	6.2750 (8)

Notes: Numbers in parentheses are degrees of freedom (DF) for the Chi-squared tests or F tests. The null hypothesis
        for each test is not rejected at the 5% level of significance.

As reported in Table 6, a number of conventional diagnostic test statistics indicate the robustness of the adopted models: all three equations in the VAR system pass the LM residual correlation tests, the tests for heteroscedasticity (the Glejser test), and the Jarque-Bera normality tests.   Ramsey RESET misspecification tests suggest that the models have no misspecification problems.   Thus, the specification of our model is an adequate representation of the data.

3. Discussion of the Empirical Results

The test results obtained from the first two equation in the VAR system essentially are equivalent to those obtained from one causality equation. It is found that there is a bidirectional causal linkage between government expenditure and economic growth along with money supply in Korea. In other words, government expenditure and economic growth are related by a feedback causal mechanism, which is fully consistent with conventional macroeconomic theory as well as Wagnerian hypothesis.   These findings support the bivariate study by Ram (1986) who tested for 70 countries and found bidirectional causality between government expenditure and national income for Korea. This result also reaffirms the recent study by Ahsan, Kwan, and Sahni (1992), who conducted tests with both bivariate and trivariate models and find bidirectional causality in France and Italy. Nevertheless, our finding is only partially supportive of the studies by Singh and Sahni (1984) and Ram (1986) that concluded that causality unidirectionally runs from government expenditure to economic growth without feedback.

Several of the earlier studies employed regression analysis method in their study of the relationship between government expenditure and economic growth. As indicated, the main weakness of their approach is that they attempt to equate correlation with causality. As Granger (1980)

noted, it is conceivable that two variables may be highly correlated, but not necessarily causally linked.

For an illustration of the problem of equating correlation with causality, take $y_t = f(x_t)$ as an example. Econometric theory indicates that y_t is explained by x_t if x_t is weakly exogenous (i.e., y_t does not also explain x_t.). It is strongly exogenous if also the lagged value of y_t does not explain x_t. In other words, the argument that correlation equates with causality is true only if x_t is strongly exogenous; otherwise the parameter estimates are biased and inconsistent. Thus, the reliability of these previous studies depends on the implicit assumption that x_t is strongly exogenous. Consequently, these studies, using regression method instead of the causality technique, are seriously flawed in their methodology. Therefore, the hypothesis of economic growth as a function of government expenditure and other relevant macroeconomic variables adopted by those earlier studies should not be taken as an assertion of causality. Instead, it should be considered only as an assertion of correlation unless it is proved to be strongly exogenous.

Furthermore, like more of the earlier studies, the study ny Ahsan, et al. (1992) did not conduct test for stationarity and cointegration and selected lag length a priori. One difficulty that arises when employing regression with clearly non-stationary series is the spurious problem which is particularly likely when the adjusted coefficient of determination (R^2) exceeds the D-W statistics. To wit, high R^2s may only indicate correlated trends and not true economic relationships while low D-W statistics may reflect non-stationary residuals. In such situations, the usual significance tests performed on the regression coefficients can be quite misleading.

As expected, money supply is found to Granger-causes RGDP. This is consistent with the monetarist view, yet it is at odds with the study by Nam (1984) that concludes that real economic activity is hardly affected by an increase money supply in Korea. Economic growth is also found to Granger-cause government expenditure in our study. Several earlier studies (e.g., Baghestain and McNown (1994), Singh and Sahni (1984)) found that RGDP causes government expenditure. The theoretical support of this was provided by Wagnerian theory. According to Wagner (1890), increased government activity and the corresponding increase in government expenditure is an inevitable result of economic growth due to (a) increased friction in society causing greater demand for government services, (b) as the society is growing richer, it requires the government to provide quality goods and services, and (c) the demand for such goods and services is highly income elastic. This indicates that change in national income can cause change in government expenditure. The result obtained from the money supply equation show that both economic growth and government expenditure Granger-cause money supply. As noted, money is issued to facilitate that transaction of goods and services. Therefore, an increase in RGDP requires in increase in money supply. Likewise, increased government expenditure tends to cause increased money supply if tax revenues are not sufficiently enough to meet the expenditure needs. Barnhart and Darrat (1989) noted that the Fed has tended to expand money growth in response to higher federal deficits in the U.S..

We are aware that annual data for the 1959-1993 post Korean war period yield only about 35 data points. Although econometric concerns always prefer more observations to less, Henry (1986) argued, however, that increasing the sample size by simple "time disaggregation" (i.e., from years to months) is not likely to reveal the long-run relationship. In addition, high-frequency data are not seasonally adjusted. Engle et al. (1989) noted that seasonal economic series might

also contain seasonal unit roots, besides the autoregressive unit roots. Any study using unadjusted high-frequency data could produce spurious causality. In this study, annual data are used so that there should not be a seasonal root problem.

4. The Relevance of the Empirical Results to Korean Development

The findings of this study furnish supportive evidence that the government has played an important role in the economic development of Korea. Although the role of the government in the economic success of these newly industrializing countries, as indicated, is well-documented in the literature, we deem it necessary to further address this issue in conjunction with our empirical findings. In addition to providing infrastructure, establishing a modern education system, and stabilizing labor relation, the Korean government has played an influential role in the following three areas:

(i) Establishing large conglomerates: To achieve complementarity and forward and backward linkages of different industries, beginning in the early 1960s, the Korean government adopted the Japanese model of growth by encouraging large conglomerates to spearhead the drive for development. By selecting certain products for their high employment multiplier potential, and providing leading entrepreneurs with generous financial assistance, more than a dozen multinational conglomerates were formed. Along with Korea's other major industrial corporations they are transforming the nation from a pushcart economy into high-tech economy.

One of the major characteristics of this industrialization policy was the government's deep involvement in the decision-making process. The government assisted with investment projects by providing direct and indirect assistance for the construction of plants and facilities. The government's direct investment in these industries increased rapidly, raising the heavy and chemical industries' share in the total economic development budget to a high level. Further, using the industrial development as its guide, the government also directly allocated financial resources, see Park (1990).

(ii) Adopting the export-oriented development policy: Using the export-oriented strategy, Korea has always been able to adjust to international market conditions by reducing various market distortions that would have worked against its economic efficiency. Amsden (1989) observed that the government of Korea intervenes with subsidy deliberately to distort relative prices in order to stimulate economy activity. As we know, Korea is small, possessing virtually no natural resources and has very limited domestic markets. However, Korea has an abundant supply of labor, labor that could be utilized in large-scale, labor-intensive productive processes. Equipped with active export promotion policies, Korea was able to penetrate foreign markets, enabling its industries to achieve scale economies. An important component of the export promotion policies was the gradual breaking up of the barriers in the competitive system with assistance of government.

To promote exports, several policy measures were adopted by the government in the early 1960s. These measures include adopting a simple unified exchange rate, instituting a tariff-free imports, exempting firms from import duties on intermediate goods and raw material imports for export processing; providing trading companies with loans for exports at preferential interest rates that were usually lower than the market rate, and other export incentive programs. The export success has transformed a resource-poor nation with pitifully low per capita income into the 12th

largest trading country on the globe over the course of three decades.

In sum, as noted by Amsden (1989), the crucial role of government is not only in subsidizing certain industries to stimulate growth, but also in establishing strict performance standards in exchange for the subsidies. In the initial stage of development, a developing country tends to lack, among other things, entrepreneurs experienced in international trade and a well-developed financial system and thus can benefit from participation and involvement by the government in industrial and trade activities. Nevertheless, it has been found that government once put in place has been unwilling and unable to adjust their role to changing circumstances. These rigidities account for the government inefficiencies in Korea that appeared in 1970s. Furthermore, Park (1990) noted that government's support for industrial groups created moral hazard problems as well. That is, the government loan guarantee policy tended to encourage or even induce these industrial groups to make hasty and risky massive investments. These mistakes were largely responsible for the dramatic deterioration in Korea's industrial performance that occurred at the end of the 1970s.

IV. Summary and Conclusion

Using VAR approach in conjunction with Hsiao's version of the Granger-causality method, the paper examines the relationship between government spending and economic growth along with money supply in several dimensions. First, by testing for cointegration, we ascertain that the simple Granger causality method is inappropriate in the study of the relationship between government expenditure, national income, and money supply in south Korea. Second, by employing Hsiao's version of the Granger's causality method, we use FPE criterion to estimate the optimum lag length, which improves the statistical estimation on the relationship between the three variables. Third, by including the additional variable (money supply) in the model, statistical biases due to the omission of relevant variables are avoided or at least reduced to a minimum. Finally, we conduct the conventional diagnostic tests to ensure that the models are not misspecified.

In conclusion, the results of this study provide evidence to support the well-documented proposition in the literature that the government has played an important role in economic development of Korea. The findings of this research also support both the conventional Keynesian framework that causality runs from government expenditure to national income and the Wagnerian theory that national income causes government expenditure.

Appendix

The procedure used to implement the Hsiao's version of Granger-causality tests reported in the paper is as follows:

1. As indicated in the text, all variables are in logarithmic form and each variable is required to be stationary. Equation (2) can be broken down into three VAR equations: economic growth equation, money supply equation, and government expenditure equations. The economic growth equation in turn can be converted into three one-sided causality equations, namely univariate equation, bivariate equation and trivariate equation as follows:

$$(1 - L)y_t \ = \ \alpha_0 + \delta_{1e-1} + \sum_{i=1}^{M} \alpha_i \ (1 - L)y_{t-i} + v_{1t}, \tag{4}$$

$$(1 - L)y_t \ = \ \alpha_0 + \delta_{1e-1} + \sum_{i=1}^{M} \alpha_i \ (1 - L)y_{t-i} + \sum_{j=1}^{N} \beta_j \ (1 - L)x_{t-j} + v_{2t}, \tag{5}$$

$$(1 - L)y_t \ = \ \alpha_0 + \delta_{1e-1} + \sum_{i=1}^{M} \alpha_i \ (1 - L)y_{t-i} + \sum_{j=1}^{N} \beta_j \ (1 - L)x_{t-j} + \sum_{k=1}^{P} \phi_k \ (1 - L)m_{t-k} + v_{3t}. \tag{6}$$

2. Using equation (4) for illustration, in step one we initially treat the dependent variable, y_t, as a one-dimensional autoregressive process. We then compute the sum of squared errors (SSE) using equation (4) with the maximum order of lags varying from 1 to M. The corresponding final prediction error (FPE) is calculated by using the following equation and then choose the order which yields the smallest FPE, say m^*.

$$FPE(m) \ = \ \frac{(T + m + 1)}{(T - m - 1)} \cdot \frac{SSE}{T}, \tag{7}$$

Where T = total number of observations,
    m = the order of lags varying 1 to M, and
    SSE = the sum of squared errors.

3. In step two, focusing on equation (5), we treat y_t as a controlled variable, with the order of lags set at m^*, and x_t as a manipulated variable. Using equation (5) and following the same procedure, we again compute the FPE of y_t by varying the order of lags of x_t from 1 to N and determine the order which yields the smallest FPE, say n^*. The corresponding two-dimensional FPE is calculated using the equation below:

$$FPE(m^*, n) \ = \ \frac{(T + m^* + n + 1)}{(T - m^* - n - 1)} \cdot \frac{SSE(m^*, n)}{T}, \tag{8}$$

where n = the order of lags on $x(t)$ varying from 1 to N, and

m^* = the optimum number of lags computed from (4).

If $FPE(m^*, n^*)$ is less than $FPE(m^*)$, we then conclude that government expenditure (x_t) Granger-Causes economic growth (y_t). Conversely, if $FPE(m^*, n^*)$ is larger than $FPE(m^*)$, we have to exclude x_t from the equation.

4. Hsiao's method works well for a bivariate model. For a multivariate equation model, however, it does not ensure that the results of the AR equation will remain the same when the order in which regressors are introduced is changed. In this study, the specific gravity criterion (SGC) proposed by Caines, Keng, and Sethi (1981) is used to determine the sequence in which the regressors are added at each stage.

The multivariate specification thus is constructed as follows. First the regressors (x_t and z_t) that are found to cause y_t in step 3 are ranked according to their minimum FPEs. The regressor, say x_t, with the smaller minimum FPE is selected and added to the autoregression equation first along with the same number of lags as found for y_{t-1} in step 3. Any remaining regressors are then added to the model one at a time and the FPEs are calculated at varying lag structures. If the minimum FPE of the additional regressor, say z_t, is below the minimum FPE of x_t, then retain this variable; otherwise drop it. The corresponding three-dimensional FPE is calculated using the following equation:

$$FPE(m^*, n^*, p) = \frac{(T + m^* + n^* + p + 1)}{(T - m^* - n^* - p - 1)} \cdot \frac{SSE(m^*, n^*, p)}{T}. \tag{9}$$

If $FPE(m^*, n^*, p)$ is less than $FPE(m^*, n^*)$, we than conclude that government expenditure (x_t) and money supply Granger-cause economic growth (y_t).

5. By using the same procedure for the government expenditure equation, causality from economic growth and money supply to government expenditure may also be estimated. Subsequently, by repeating the same procedure for the money supply equation, causality from GDP and government expenditure to money supply can also be estimated.

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