

Regional Economic Variables and Local Employment Growth: The Case of Korea

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Abstract: This paper examines the effects of regional economic variables on local employment growth using panel data from 1998 to 2013 in South Korea. The employment equation is derived from a Constant Elasticity of Substitution (CES) production function. Employment growth is specified as a function of wage rate, output, local public expenditure, and research and development expenditure as a proxy for innovation. The demand for labor takes into account dynamics since the cost of adjustments in the demand for labor will be induced in the long-run. A Dynamic Panel Regression Model is employed considering the effect of lagged employment using regional panel data. The results show that public expenditure has positive effects on local employment growth and that the effect of public expenditure in the manufacturing sector is more elastic than that of the service sector. A one percent increase in public expenditure increases industrial employment in manufacturing by 0.14 percent and industrial employment in services by 0.04 percent. Total gross value added per capita (labor productivity) has a positive effect on employment growth in the manufacturing sector and a negative effect on the same in the service sector. Total fixed capital formation has positive effects on total industrial employment and industrial employment in the service sector. The effects of wage rates on employment growth in all industry sectors are negative.

Keywords: *Regional Economic Variables, Local Employment Growth, Dynamic Panel Regression Model, South Korea*

INTRODUCTION

Employment creation and economic growth are two important and sensitive issues considered in designing in economic policies around the world. South Korea has experienced low economic growth without an increase in employment in the recent past. A number of studies have looked at employment growth as a function of economic variables such as research and development (R&D), public finance, and industrial complex specialization and size. Commonly, dynamic panel GMM (Generalized Method of Moments) approach has been adopted. For example Van Reenen (1997) showed that the innovation¹ on the demand for labor is positive, using panel data of 598 UK firms over the period 1976-1982. Similarly Lachenmaier and Rottmann (2011) showed a positive effect of innovations on employment using German manufacturing firms' data from 1982 to 2002².

¹ Reenen (1997) matched innovations with the construction of a count of the number of innovations a firm commercialized.

² Lachenmaier and Rottmann (2011) classified the innovation input and innovation output and measured the innovation input as innovation expenditure (R&D expenditure) and the innovation output as patents.

Bogliacino *et al.* (2012) also examined technological innovation effects using European R&D expenditure data. They found that R&D expenditure can affect employment³ and showed that the service sector has a bigger positive R&D effect than the manufacturing sector (by classifying a ‘manufacturing business’ and a ‘service business’ sector). Furthermore, they demonstrated that the effect of the high-tech manufacturing sector is bigger than that of the non-high-tech manufacturing sector.⁴

In an agglomeration economy, Blien *et al.* (2006) and Kim and Min (2010) investigated the effects of diversity and specialization for different industries at the local level. They set up the dynamic panel model and defined explanatory variables such as sector specific effects, total regional size, specialization, diversity, and so on.

Lee and Kim (2014) estimated the impact of local variables on job creation in the South Korean industrial complex using the same model of Blien *et al.* (2006). They showed positive or negative impacts of GDP growth, exports, firm size, operation rate of facilities, etc. on job creation and suggested government support for entrepreneurship, firm incubation and raising the operation rate of facilities to create jobs. Kim and Min (2010) introduced a system GMM methodology and discovered long and short-run effects of agglomeration variables on the growth of local industry employment. They showed that specialization had a positive effect on employment growth in most industries, especially manufacturing industries and that the diversity effect had a greater impact in the service industry in the short-run, but that long-run diversity effects had more of an impact on the manufacturing industry than services.

This paper examines the effects of regional economic variables on local employment growth in Korea within the framework of the dynamic panel regression model using panel data from 1998 to 2014 in Korea. These regional economic variables including R&D expenditure and local public finance are hypothesized to affect local employment growth.

THE MODEL

To analyze the effects of regional economic variables on local employment growth, this paper proposes the employment equation model of Van Reenen (1997) and Bogliacino *et al.* (2012) derived from the CES production function. The behavior of profit maximizing firms in a perfectly competitive market was modeled. The CES production function was specified as follows.

$$Y = A[(\alpha L)^\rho + (\beta K)^\rho]^{\frac{1}{\rho}} \quad (1)$$

³Bogliacino *et al.* (2012) explained that an increase of R&D is one of the main targets of European economy policy in 2010.

⁴High-tech manufacturing includes pharmaceuticals, electrical machinery and apparatus, measuring, analyzing, controlling, instrument, and so on. Non high-tech manufacturing includes food & kindred products, fabricated metal products, chemicals and allied products, and so on.

where Y is output, and L and K are employment and capital, respectively. A represents a potential Hicks-neutral technological change and α and β are the parameters of the reaction of labor and capital to a technological shock ($0 < \rho < 1$). The demand for labor can be written as follows.

$$\ln L = \ln Y - \sigma \ln \frac{w}{p} + (\sigma - 1) \ln \alpha, \quad (2)$$

where $\sigma = 1/(1-\rho)$ is the elasticity of substitution between labor and capital. This equation can be rewritten in stochastic form as given below⁵.

$$l_{i,t} = \delta l_{i,t-1} + \gamma_1 gva_{i,t} + \gamma_2 w_{i,t} + \gamma_3 r\&d_{i,t} + \gamma_4 k_{i,t} + \varepsilon_i + \mu_{i,t}, \quad (3)$$

$i = 1, 2, \dots, 16; t = 1998, \dots, 2013$

The lower case letters represent natural logarithms. l is employment (number of employees), gva is output (total gross value added)⁶, w is real wage (average monthly wage), $r\&d$ is technological innovation (R&D expenditure), and k is investment (total fixed capital formation) at the local level. ε_i is an unobserved region-specific time-invariant effect which might be correlated with the explanatory variables but not with the usual error term $\mu_{i,t}$. Equation (3) includes 1 lagged value of the dependent variable and is called a dynamic panel regression model.

Equation (3) is switched to the first differences in order to remove the unobserved regional specification ε_i and is presented as (4).

$$\Delta l_{i,t} = \delta \Delta l_{i,t-1} + \gamma_1 \Delta gva_{i,t} + \gamma_2 \Delta w_{i,t} + \gamma_3 \Delta r\&d_{i,t} + \gamma_4 \Delta k_{i,t} + \Delta \mu_{i,t} \quad (4)$$

However it still has an endogeneity problem, i.e., the correlation between $\Delta l_{i,t-1}$ and $\Delta \mu_{i,t}$. The equation (4) is estimated using the Difference Generalized Method of Moments (GMM-DIF) estimation which was proposed by Arellano and Bond (1991) to resolve the endogeneity issue. This estimation uses the lagged value of dependent variables, i.e., $l_{i,t-2}$, $l_{i,t-3}$..as the Instrumental Variables (IV) of the explanatory variable, $\Delta l_{i,t-1}$.

In this model, $\Delta l_{i,t-1}$ is interpreted as the potential persistence toward equilibrium in the process of adjustment and shows the speed of employment growth in that region⁷. If

⁵See Bogliacino *et al.*, (2012).The model is augmented by including innovation

⁶Bogliacino *et al.*, (2012) added the output variable(sales) to one of explanatory variables in the employment equation introduced by Van Reenen (1997)to verify the business stealing effect of rival firms.

⁷ See Jiwattanakulpaisarn *et al.* (2009).They explained that the potential persistence for equilibrium employment is reflected by the parameter δ .

$0 < \delta < 1$, then the growth of local employment regresses to the mean in the long-run and if $\delta > 1$, then employment grows explosively⁸.

R&D expenditure may or may not affect employment in the South Korean regional model because South Korean R&D investment focused on economic growth and not employment. On the other hand, public expenditure such as social welfare expenditure focused on employment growth. Local public expenditure can affect local employment. For that reason, this paper uses public expenditure as an additional variable. The effect of public expenditure will be uncertain because there are large gaps between the service industry and manufacturing industry in terms of fiscal policy such as tax reduction or financial support. This paper classifies the dependent variable (number of employees) as a whole, and manufacturing sector, service sector, and the total gross value added for each sector were chosen as explanatory variables.

Accordingly, the following model was used for estimation;

$$\Delta l_{i,t} = \delta \Delta l_{i,t-1} + \gamma_1 \Delta gva_{i,t} + \gamma_2 \Delta w_{i,t} + \gamma_3 \Delta r\&d_{i,t} + \gamma_4 \Delta pe_{i,t} + \gamma_5 \Delta k_{i,t} + \Delta \mu_{i,t}, \quad (5)$$

Where *pe* is public expenditure. Equation (5) is divided into three models. Each model classifies the dependent variable by industry sector, and chooses the total gross value added for the explanatory variables by industry sector. Table 1 shows the total gross value added and the dependent variables included in the equation.

Table 1. Equations by Dependent Variable

Dependent Variable (Employment)	Explanatory Variable (Total Gross Value added)	Equation
Total Industry	Total Industry	(a)
Manufacturing Sector	Manufacturing Sector	(b)
Service Sector	Service Sector	(c)

South Korean regional data obtained from the Korean Statistical Information Service (KOSIS) was used for the estimation. The panel number is 16 (7 metropolitan councils and 9 provinces), time period was 1998 to 2013, and annual data was gathered⁹. The dependent variable was the number of regional employees and explanatory variables were general accounts of public expenditure, R&D expenditures¹⁰, total gross value added, average

⁸ Kim and Min, (2010) explained that $l_{i,t-1}$ can estimate the persistence of region-industry over time and it can capture the current and past impact of region-industry specialization.

⁹The Ulsan metropolitan city was promoted in 1998, and thus this paper uses the yearly data from 1998 to 2013.

¹⁰R&D expenditures sum to regional firms and government.

monthly wage, and fixed capital formation at the regional level. The data was converted to per capita basis and transformed into logarithms.

Table 2 displays sample statistics of the data. Total gross value added in the manufacturing sector is bigger than service sector and total industry. The employment of manufacturing sector has the biggest standard deviation at log-transformed variable and the total gross value added per capita in service sector has the smallest standard deviation at logarithm value.

RESULTS OF THE ESTIMATION AND DISCUSSION

Three versions of equation (5) were estimated to examine the effect of regional economic variables on employment growth. Table 3 reports the impacts of regional economic variables using the dynamic panel GMM(GMM-DIF) approach considering the IVs of explanatory variable¹¹, $\Delta l_{i,t-1}$, as $l_{i,t-2}$ and $l_{i,t-3}$.¹²

Table 2. Descriptive Statistics for Variables in the Estimation

variable	Mean	Max	Min	Std. Dev.	Obs	period
employment (1,000 people)	1,417	5,988	243	1,358	270	
manufacturing sector	265	1,130	8	276	270	1995-2013
service sector	1,030	4,726	163	1,115	270	
total gross value added per capita (1,000 KRW)	39,588	96,827	20,837	14,834	270	
manufacturing sector	72,454	299,631	9,027	57,923	270	1995-2012
service sector	35,643	57,175	23,881	6,357	270	
average monthly wage	1,966	2,920	1,292	382	270	1996-2013
R&D expenditure per capita	486	3,521	42	598	270	1996-2013
public expenditure per capita	1,941	5,313	594	1,004	270	1995-2013
fixed capital formation per capita	15,292	41,574	6,283	5,662	270	1995-2013
log(employment)	13.855	13.744	15.594	0.729	270	
log(manufacturing sector)	11.990	13.938	8.987	1.080	270	1995-2013
log(service sector)	13.488	15.369	12.002	0.767	270	
log(total gross value added per capita)	17.459	17.398	18.388	0.309	270	
log(manufacturing sector)	17.858	19.518	16.139	0.736	270	1995-2012
log(service sector)	17.382	17.862	17.029	0.168	270	
log(average monthly wage)	14.473	14.480	14.887	0.195	270	1996-2013
log(R&D expenditure per capita)	12.645	15.074	10.650	0.955	270	1996-2013
log(public expenditure per capita)	14.351	14.301	15.486	0.506	270	1995-2013
log(fixed capital formation per capita)	16.485	17.543	15.653	0.330	270	1995-2013

The results show that local public expenditure has a positive effect on local employment growth and that the effect of public expenditure in the manufacturing sector is more elastic

¹¹ This paper makes allowance for yearly data of time series, so the lag is 2.

¹² If the dependent variable follows the random walk, then the GMM-DIF estimation will be inefficient. To identify the existence of random walk, this paper tests the unit root of the dependent variable, rejects the null hypothesis which the dependent variable follows random walk and uses the GMM-DIF estimation.

than that of the service sector. If public expenditure increases by one percent, then industrial employment in manufacturing sector responds with an increase of 0.14 percent and industrial employment in the service sector by 0.04 percent. Total gross value added per capita, i.e., labor productivity, has a positive effect on local employment growth in the manufacturing sector and a negative effect on in the service sector. Total fixed capital formation has positive effects on total industrial employment and industrial employment in the service sector. However the wage has negative effects on local employment growth as found in previous research.

Table 3 shows that the parameter δ ranges from 0.218 to 1.012. The parameter estimate of the lagged dependent variable implies a potential persistence in reaching employment equilibrium¹³. The growth of regional employment is expected to regress to the average in the long-run, and the manufacturing sector's employment persistence is bigger than that of the service sector.

Table 3. Dynamic Panel GMM Estimation

variables	model	Dynamic panel -GMM		
		(1)	(2)	(3)
log(employment -1)		1.012*** (0.044)	0.739*** (0.055)	0.218*** (0.080)
log(total gross value added per capita)		-0.026 (0.034)		
log(manufacturing sector)			0.408** (0.093)	
log(service sector)				-0.547*** (0.040)
log(average monthly wage)		-0.134*** (0.020)	-0.684*** (0.092)	-0.076* (0.039)
log(R&D expenditure per capita)		-0.003 (0.006)	0.004 (0.022)	-0.001 (0.006)
log(public expenditure per capita)		0.057*** (0.017)	0.135** (0.068)	0.044*** (0.013)
log(fixed capital formation per capita)		0.043*** (0.013)	-0.021 (0.055)	0.030* (0.014)
Effects Specification				
J-statistic (H_0 : IV are over identified)		35.081	43.214	39.012

Notes: (): Standard Error.

*** p<0.01

CONCLUDING REMARKS

This paper examines the effects of regional economic variables on employment growth using panel data from 1995 to 2013 in South Korea and analyzes relationships between local employment growth and regional economic variables such as public expenditure, wages, technical innovation, total gross value added, and total fixed capital formation. This paper

¹³ See Jiwattanakupaisarn *et al.* (2009),

also estimates dynamic relationships among regional panel data using a Dynamic Panel Regression Model which considers the endogeneity of the explanatory variables.

This paper shows that local public expenditure has a positive effect on local employment growth in all industrial sectors and that the effect of public expenditure in the manufacturing sector is more elastic than that of service sector. In South Korea's economic growth, tax incentive, infrastructure, and financial support policy have been concentrated on the manufacturing industry sector. Since the productivity of the manufacturing sector is larger than that of the service sector, it is easy for the manufacturing sector to create value added. For example, tax reduction covers all types of businesses in manufacturing industry but only knowledge basis business in service industry. The gap of fiscal support between manufacturing industry and service industry exists during economic growth. This implies that financial support or tax incentives enhance job creation and employment growth in the service sector.

This study also shows that gross value added per capita (or labor productivity) has a positive effect on manufacturing sector employment growth, but a negative effect on the service sector. The R&D expenditure does not have significant effects on employment growth. As mentioned earlier, the productivity of the service sector is quite small. This implies that the productivity of the service industry has negative effect on employment since its productivity is too low even though the expenditure on R&D is increased. The R&D expenditure in service industry can be used as a sunk cost because it is difficult for service production technology innovation to commercialize. In addition, the R&D variable acts as an endogenous variable of labor productivity. Thus it needs a new approach to control the other endogenous problem.

Total fixed capital formation has a positive effect on total industrial employment and industrial employment in service sector. However, the wage rate has a negative effect on employment growth as in previous studies. The lagged variable of employment has a positive effect on current employment. This shows that in the long-run, potential persistence exists to go towards employment equilibrium and that the speed of employment growth in the manufacturing industrial sector is faster than that of the service sector.

These results imply that the central or local government should consider a policy mix in terms of fiscal support such as financial aid and tax deduction for R&D activity which improves productivity to promote local employment growth.

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