Print ISSN: 2008-448X
Online ISSN: 2538-3310
International Journal of Business and Development Studies
University of Sistan and Baluchestan
Homepage: https://ijbds.usb.ac.ir

Investigating the Impact of Government Capital Expenditure Components on the Provincial Economy of Iran: Bayesian Approach

Hojat Parsa[1] **Hadi Keshavarz**[2] **Maryam Ashouri**[3]

[1] Associate Professor of Economic, Department of Economics, Faculty of Business and Economics, Persian Gulf University, Bushehr, Iran, hparsa@pgu.ac.ir
[2] Assistant Professor of Economic, Department of Economics, Faculty of Business and Economics, Persian Gulf University, Bushehr, Iran, (Corresponding Author), hd.keshavarz@pgu.ac.ir
[3] Master's of Economics, Department of Economics, Faculty of Business and Economics, Persian Gulf University, Bushehr, Iran, ashouri.maryam.69@gmail.com

ARTICLE INFO

Article type:
Research

Article history
Received: 21.09.2021
Accepted: 25.12.2021

Keywords:
Gross domestic product (GDP), Government capital expenditure, Bayesian approach.

JEL Classification:
C11, H11.

Abstract:
Economists and policymakers are interested in how government spending affects economic performance. The purpose of this study is to examine the effect of government capital expenditures by component on the GDP of Iran's provinces between 2011 and 2019 using a Bayesian approach. To do so, after estimating over 500,000 regressions and averaging the Bayesian model's coefficients, the five sub-categories of industry, judiciary, energy, health and information and communications technology were identified as the most effective sub-categories of government capital expenditures on provincial GDP. Then, a hierarchical Bayesian panel model was specified and estimated to determine the extent to which and how each of these subsections affects the provinces' GDP. Monte Carlo simulations using Markov chains indicate that while judicial and health expenditures reduced production during the study period, expenditures on industry, energy, information and communications technology increased production in Iran's provinces.

1. Introduction

Examining and recognizing the nature of the relationship between the extent of government intervention in the economy and the level of economic activity has always piqued economists' interest, particularly public sector economists. This subject has resulted in a diverse spectrum of schools throughout economics history. One group emphasizes the government's absence of interference in

Cite this article: H. Parsa, H. Keshavarz and M. Ashouri (2022). Investigating the Impact of Government Capital Expenditure Components on the Provincial Economy of Iran: Bayesian Approach. *International Journal Of Business and Development Studies*, 14 (1), 41-57. DOI: 10.22111/ijbds.2022.7437.

Publisher: University of Sistan and Baluchestan

economic activities, while another views the government as a source of growth and development.

In Iran, the government has a considerable economic presence and views its interventions in economic management as necessary. As a result, it is necessary to create the conditions for economic growth by strengthening the structure of the government budget and allocating resources to the most productive sectors.

Government spending falls into two categories: current (consumption) and capital (construction).(Bose, Haque, and Osborn 2007) demonstrated that current government spending has a negligible effect on the economic growth of developing countries. (Yovo 2017) demonstrated that current expenditures have a negative effect on Togo's economic growth, while capital expenditures have a positive effect. Comparing GDP statistics with current and capital expenditures in Iran between 2011 and 2019 reveals that current government expenditures have exhibited little correlation with GDP, whereas capital expenditures and GDP exhibit a strong correlation. As a result, this research focuses on the components of capital expenditures.

Iran's government capital expenditures are classified into four categories: public, defense, social, and economical, with each category further subdivided. Public and defense expenditures, collectively referred to as governance expenditures account for the smallest proportion of government capital expenditures. Social affairs, which includes expenditures on social activities, accounted for approximately 20% to 30% of government capital expenditures in recent years. Economic expenditures are those that support economic activity and account for the largest share of government capital expenditures (60 to 70 percent).

The first step toward achieving growth through government spending is to examine the separate effects of expenditure components on economic growth and identify the leading and influential components in production changes. Because conventional econometric methods are incapable of assessing the impact of all subcategories on GDP simultaneously, this study employs a Bayesian approach known as Bayesian model averaging. Thus, expenditures are ranked first using the Bayesian averaging method, and then the more significant subcategories influencing the GDP of Iran's 31 provinces between 2011 and 2019 are identified. A Bayesian model containing the most significant identified subcategories was then specified and estimated using Monte Carlo simulation with Markov chains based on the information criteria.

The research is structured as follows: The following section summarizes the research literature. The third section is devoted to methodology and analysis, and the final section is devoted to the research's conclusion.

2. Literature review

The effect of government spending on economic growth is a subject of discussion in various economic schools, and various theoretical models have been developed for this purpose. A group of emonomists, dubbed neoclassicists, has downplayed the relationship between government spending and economic growth, arguing that increasing government spending reduces private sector investment, thereby reducing economic growth. They argue that with the expansion of the government, the private sector and the government itself will suffer. This is because the government is compelled to levy various taxes on the private sector to increase its expenditures, which reduces the private sector's motivation to operate due to the tax burden. Finally, it reduces the country's tax base and forces the government to borrow from the central bank to finance its expenditures (Karagöz and Keskin 2016). However, some theorists, such as Keynesians, view the relationship between government spending and economic growth positively, arguing that a market-based economic system is inefficient and that government aids in increasing production and economic growth by providing necessary infrastructure and efficient services. (R.J. 1990)also incorporates government services as an input into production functions and believes that government spending is to correct side effects, monopolies, and public goods matters; it can bring about economic growth and development. Additionally, the government can use its spending to establish laws protecting property and ensuring security, stimulating economic growth. Another school of thought, known as the New Classics, rejects the notion of a causal link between government spending and economic growth.

Three types of studies exist on government spending and economic performance. The first group examined the relationship between government spending and economic growth in general; the second group divided government spending into current and capital expenditure categories and examined the effect of each on economic growth, and the third group has studied sectoral expenditures (separately) on economic growth.

In the first group, studies such as(Haque and Khan 2019),(Bahaddi and Karim 2017), (Al-Fawwaz 2015), (Ghosh Roy 2012), (Sudarsono 2015), and (Lamartina and Zaghini 2011) that found a positive relationship between government spending and economic growth can be noted.

(Yovo 2017)in Togo, (Karagöz and Keskin 2016)in Turkey, and (Gebreegziabher 2018) in Ethiopia concluded that current government spending has little or no effect on economic growth, while capital government expenditure has a positive effect. In comparison, (Ghosh and Gregoriou 2008) concluded that current expenditure positively affects economic growth in 15 developing countries, while (Devarajan, Swaroop, and Zou 1996) concluded that capital expenditure hurts economic growth in 43 developing countries.

The results are different in the third group, namely the effect of sectoral expenditures (separately) on economic growth, as detailed below according to the Iranian economy's budget division (defense, social, economic, and public). For instance, numerous studies have been conducted on defense spending (defense, public order, and security), and differing perspectives exist. In general, on the one hand, there are positive effects related to security on economic factors and supply-side spillovers. On the other hand, there is the negative impact of diverting resources from the civilian economy. Additionally, studies conducted in different countries produce disparate results. For example, (Alptekin and Levine 2012) discovered a positive relationship between defense spending and economic growth in developed countries but not in developing countries. In comparison, (Rana, Alam, and Gow 2020), (Chang, Huang, and Yang 2011) in an inter-country panel study of high- and low-income countries,(Azam 2020) in OECD countries, and (Manamperi 2016) in Turkey, discovered a negative relationship between defense spending and economic growth.

Social affairs include the subcategories of education, culture and art, mass media and tourism, health, welfare and social security, and sports. Social affairs is a set of government tasks that aim to increase the workforce's productivity and create better and happier environments for work and leisure. As a result, it is reasonable to anticipate that proper and timely allocation of these expenditures will boost production and economic growth. In this field, there are divergent views and no consensus among researchers. Extensive reports from the World Health Organization (WHO 2001) and the European Commission (European Commission 2005) demonstrate that increasing health spending helps developed and developing countries grow their GDPs (Ghorbel and Kalai 2016a). Numerous researchers (Odior 2011), (Naidu and Chand 2013), (Chaabouni, Zghidi, and Ben Mbarek 2016),(Mladenović et al. 2016), (Piabuo and Tieguhong 2017) and (Erçelik 2018) believe that increased health spending helps the economy recover.(Feldstein 1974), (Darby 1979), (Lozano et al. 2012), (Alesina, economics, and 1994 1991), (Jermann and Quadrini 2009), (Umar Faruk et al. 2022) and (Ghorbel and Kalai 2016b), on the other hand, are skeptical that social welfare spending results in economic growth. They argue that excessive government spending on social welfare stifles private savings, impeding capital accumulation and economic growth(Yang 2020). Yang (2020) concludes that the effect of health spending on economic growth varies according to the level of human capital. This effect is negative in countries with low levels of human capital, positive but not significant in countries with moderate levels of human capital, and in countries with high levels of human capital is positive.

Economic affairs also include expenditures on establishing production, distribution, and consumption facilities by establishing and developing economic capacities that contribute to economic balances. Agriculture and natural resources, water resources, industry and mining, environment, trade and cooperation, energy, transportation, communications and information technology, housing, and urban, rural, and nomadic development are subcategories of these expenditures. Spending on these subsectors is expected to have a range of effects on output and economic growth. (Muhammed 2014)and (Musaba, Chilonda, and Matchaya 2013)demonstrated in Malawi that agricultural and defense spending had a positive and significant relationship with economic growth, while education, health, social support, transportation, and communication costs had a negative and significant effect.

Gisore et al. (2014) examined the effect of government spending on economic growth in East Africa and discovered that health and defense spending had a significant positive effect on growth. In comparison, educational and agricultural costs had a relatively small impact on the economy. Berihun (2014) demonstrated that agricultural and defense spending hurts economic growth in Ethiopia, but the health and education sectors have a positive effect. Mohammed (2015) discovered that government spending on agriculture, health care, commerce, and industry Ethiopia's economy grew rapidly, but road transport and communications costs remained statistically insignificant. In Saudi Arabia, (Alshahrani et al. 2014) demonstrate that long-term economic growth positively correlates with state and private investment and health care expenditures. However, education, defense, and housing spending are negatively correlated with GDP growth in the long run. (Neduziak and Correia 2017) concluded that spending on education, culture, and legal expenditures has no effect on production in the Brazilian provinces.

Public expenditures include four subcategories: public administration, judicial affairs, financial services, technical services, management and planning, and science and technology development. In general, higher spending is expected to reduce the risk of economic activity and thus improve economic growth; however, this relationship cannot be expected from all subsections of this section. For (Neduziak and Correia 2017) concluded that administrative and planning costs, and judicial spending, had a positive effect on the production of Brazilian provinces.

As the literature review revealed, the findings in this area are highly contradictory, and additional research appears necessary. This research is novel in two areas. Initially, most studies consider government expenditures as a whole, either distinct from current and capital expenditures or as a component of expenditures. According to the authors, no study has examined the effects of all components and sub-branches of government spending on production in the Iranian economy. Thus this study can aid policymakers in allocating resources more efficiently. The second innovation is related to the model's research method, which utilized the Bayesian approach, which has not been studied previously. The advantage of this method is that it can assess the impact of all subsectors on GDP simultaneously, which is not possible with conventional econometric methods.

3. Methods of Research

3.1 Bayesian inference

Bayesian econometrics' central concept is Bayesian law, if Y is the data matrix (explanatory and dependent variables) and θ is the vector of parameters, Bayesian law can be represented as Equation (1). Given the available data set (i.e. $P(\theta|Y)$), the probability of the parameters is as follows:

$$P(\theta|Y) = \frac{P(Y|\theta)P(\theta)}{P(Y)} \quad (1)$$

The researcher's mental distribution of parameters ($P(\theta)$) occurs prior to viewing the data and is unrelated to it. As a result, it is referred to as the previous distribution function. The likelihood function ($P(Y|\theta)$) is also referred to as the data density function because it is dependent on the pattern parameters and is used to describe the data generation process. Whereas it is frequently assumed that errors have a normal distribution in linear models, this also implies that $P(Y|\theta)$have a normal density. $P(Y|\theta)$is also the output of Bayesian estimation, which is called the posterior function. It is calculated using a combination of previous functions and probability. Bayesian econometrics' fundamental principle is to treat models and associated parameters as stochastic factors and to estimate their distributions using prior information (Draper 1995).

3.1.1 Averaging of Bayesian models

Two types of variables are used in econometric models. The first category includes the primary variables that are supported by formal and robust theories explaining their inclusion in the model. The second category is suspicious (auxiliary) variables that, based on informal theories, justify their inclusion in the model but are less certain of their inclusion(Danilov and Magnus 2004).
The statistical framework used in this study is a form of linear regression (2).

$$y = X_1\beta_1 + X_2\beta_2 + u \quad (2)$$

Where y is a vector n × 1 of the dependent variable.X_j $(j = 1,2)$ is a matrix $n \times k_j$ of observations of explanatory variables that are non-random (X_1 contains major variables and X_2contains minor variables). u is also a random vector of perturbation components whose components are assumed to have an i.i.d N distribution (0, σ ^ 2). Since pattern uncertainty is limited to the k_2 variable of X_2, the number of possible patterns to be examined (number of models in the model space) based on the presence or absence of each of the subvariables is $I = 2^{k_2}$. From now on, $M_i$represents the i model of the model space.
The main idea of model averaging estimates is that first the desired parameters are obtained for each model condition in the model space and then a non-conditional average weighted average of these conditional estimates is calculated.

A model averaging estimate of $\beta_1$as a coefficient is one of the explanatory variables in relation to (3) (De Luca & Magnus, 2011).

$$\hat{\beta}_1 = \sum_{i=1}^{I} \lambda_i \hat{\beta}_{1i} \quad (3)$$

Where λ_i are non-negative random weights with a sum of one.

The Bayesian model averaging method combines the researcher's prior knowledge about the model's unknown parameters with the data. However, having information about all possible variables and leading models appears improbable, and the parameters associated with the previous function's distribution cannot be written for all 2^{k_2}models; thus, it is practically impossible to use the previous notification function to calculate the parameters for the "Bayesian model averaging" method. One solution to this problem is to have all models wear uninformed previous uniforms (uniform uniforms). However, because this type of anterior function allows for the calculation of the posterior function's probability ratio for only the parameters present in all models, only the origin's width and variance can be used for the previously uninformed (or uniform) distribution. While using the previous function in the absence of information significantly increases the probability of incorrect coefficient estimation. As a result, another previous function called g-prior is used for other sub-parameters. One of the advantages of the former function is that it can be automatically calculated and used by all algorithms for all models. Assuming that the model is correct, the probability function of the sample used in the model can be written as Equation (4):

$$P\left(y/\beta_1,\beta_{2i},\sigma^2,M_i\right)\sim(\sigma^2)^{-n/2}\exp\left(-\frac{\varepsilon_i^T\varepsilon_i}{2\sigma^2}\right) \quad (4)$$

Prior knowledge of the M_i model's parameters Consideration of an unconscious prior function for the$\beta_1$parameters and the error variance σ^2, in addition to an informed prior function for the β_{2i}subparameters, results in the following conditional anterior distribution:

$$P\left(\beta_1,\beta_2,\sigma^2\middle| M_i\right)\sim(\sigma^2)^{(k_{2i}+2)/2}\exp\left(-\frac{\beta_{2i}^T V_{0i}^{-1}\beta_{2i}}{2\sigma^2}\right) \quad (5)$$

Where V_{0i}^{-1}represents the variance-covariance matrix of the prior distributionβ_{2i}. After combining the likelihood function and the priorconditional distribution, the M_i model's conditional estimates for β_1 and β_{2i} are represented by relations (6) and (7).

$$\hat{\beta}_{1i} = \mathrm{E}(\mathrm{B}_1/y,M_i) = (X_1^T X_1)^{-1} X_1^T (y - X_{2i}\hat{\beta}_{2i}) \quad (6)$$

$$\hat{\beta}_{2i} = \mathrm{E}(\beta_{2i}/y,M_i) = (1+g)^{-1}(X_{2i}^T M_i X_{2i})^{-1} X_{2i}^T M_1 y \quad (7)$$

The researcher's knowledge and ideas about the model are presented under the assumption that each model is weighted according to its posterior probability, as specified in Equation (8):

$$\lambda_i = P(M_i/y) = \frac{P(M_i)P(y/M_i)}{\sum_{j=1}^{I} P(M_j)P(y/M_j)} \quad (8)$$

Where $P(M_i)$ denotes the previous probability for model M_i and $P(y/M_i)$ denotes a function of the model M_i's y-margin probability. By associating each model with the same prior probability and applying the aforementioned assumptions to the prior distribution, it is possible to demonstrate that:

$$\lambda_i = P(y/M_i) = c\left(\frac{g}{1+g}\right)^{k_{2i}/2} (y^T M_1 A_i M_1 y)^{-(n-k_1)/2} \quad (9)$$

After obtaining the conditional estimates β_{1i} and β_{2i} for the regression parameters of the model M_i and the model weights, the non-conditional estimates BMA for $\beta_1 \beta_2$ are calculated according to Equations (10) and (11):

$$\hat{\beta}_1 = E(\beta_1/y) = \int_{i=1}^{I} \lambda_i \hat{\beta}_{1i} \quad (10)$$

$$\hat{\beta}_2 = E(\beta_2/y) = \int_{i=1}^{I} \lambda_i T_i \hat{\beta}_{2i} \quad (11)$$

Where T_i denotes the $k_2 \times k_{2i}$ matrix defined by $T_i^{T} = (I_{k_{2i}}, 0)$. (Di Luca and Magnes, 2010).

3.2 Analyze the data and results of BMA estimation

The general pattern is $Y = a + bX_1 + cX_2 + e$, where y, X_1 and X_2 denote the logarithms of the provinces' gross domestic product, the set of major regulators (in this case, the logarithm of the capital-labor ratio), and the sub-regulators, respectively. Includes 19 variables). Indeed, this study uses the capital-labor ratio as a variable whose impact on production has been established by numerous researchers, including (Solow 1956) and (De Gregorio 1992), and is thus used in the majority of regressions.

To calculate the capital of each province (due to a lack of data on this variable), the ratio of the province's capital to the country's capital is multiplied by the province's production divided by the country's production.

It should be noted that all necessary data were extracted from information published by the Iranian Statistics Center, and to convert nominal variables to real ones, the Central Bank's price index for consumer goods and services (2011 = 100) was used. The results of BMA estimation are shown in Table (1).

Table 1. Results of model estimation using BMA method

Variables	Average Beta	pip	t	Lower bound	Upper bound
industry	0.50	1.00	6.43	0.42	0.58
K/L	0.06	1.00	4.48	0.05	0.08
judicial	-0.26	1.00	-3.81	-0.33	-0.19
energy	-0.11	0.97	-3.06	-0.15	-0.08
health	0.10	0.78	1.53	0.36	0.17
ICT	0.20	0.55	0.95	-0.01	0.12

public	**0.90**	**0.49**	**0.84**	**-0.02**	**0.20**
administration	**-0.01**	**0.33**	**-0.61**	**-0.03**	**0.01**
defense	**-0.03**	**0.29**	**-0.55**	**-0.08**	**0.02**
agriculture	**0.03**	**0.25**	**0.49**	**-0.03**	**0.08**
environment	**0.01**	**0.19**	**0.40**	**-0.01**	**0.04**
trade	**0.03**	**0.19**	**0.40**	**-0.05**	**0.12**
housing	**0.02**	**0.18**	**0.38**	**-0.03**	**0.38**
water resources	**0.10**	**0.15**	**0.33**	**-0.19**	**0.06**
science	**-0.01**	**0.11**	**-0.27**	**-0.06**	**0.03**
development	**-0.01**	**0.06**	**-0.12**	**-0.02**	**0.01**
welfare	**0.01**	**0.06**	**0.10**	**-0.01**	**0.01**
financial, planning	**0.01**	**0.06**	**0.07**	**-0.03**	**0.03**
transportation	**-0.01**	**0.06**	**-0.05**	**-0.03**	**0.03**
culture and art	**-0.00**	**0.06**	**-0.01**	**-0.02**	**0.02**
education					
sports					

Source: Research finding

The first column organizes the variables according to their importance. The second column contains the coefficient estimates for the variables, while the third, fourth, and fifth columns contain the pip, t-statistic, and confidence interval, respectively.

The posterior probability of the variable being present in the model is used to determine the explanatory variable's importance in the BMA method (pip). According (Raftery 1999), each variable with a pip greater than 0.5 is considered significant in this study. The first column of Table (1) organizes the variables by their importance and likelihood of being included in the model, with industry, judiciary, energy, health, and communications and information technology being more significant than other subcategories of government construction expenditures.

3.2.1Select the optimal model

To derive optimal models from various combinations Step-by-step selection algorithms such as forward selection and backward removal are now used to extract optimal models with various combinations of significant variables, and when the best subset option is chosen, the Leaps-and-Bounds algorithm is used to determine the best subset for The Schwartz Information Criterion (BIC), Acacia (AIC), Corrected Acacia (AICC), Adjusted Coefficient (R^2ADJ), and Mallows' C_p criterion are used to determine the number of explanatory variables(Lindsey and Sheather 2010). The results of this analysis indicate that the model with all six significant explanatory variables is the optimal model, based on the minimum values of BIC, AICC, AIC, and Mallows' $C_p$and the maximum value of R^2ADJ. The following table summarizes pertinent information criteria (2).

Table 2. Results of selecting the best model based on information criteria

Information criterion	BIC	AIC	AICC	R^2ADJ
Value of information criterion	210.76	186.16	890.56	0.36

Source: Research finding

Following the selection of the model with the optimal subset of significant variables, it is necessary to decide on Bayesian modeling of the selected variables using the minimum deviation information criterion (DIC). As a result of the studies and taking into account the panel nature of the data, the Bayesian model (12) with a deviance information criterion of -270.46 was chosen as the best Bayesian model.

$$GDP_{it} = \beta_0 + \beta' X_{it} + u_i + \epsilon_{it} = \beta' X_{it} + \tau_i + \epsilon_{it},$$
$$X' = (K/L, Judicial, Energy, Industry, ICT, Health)$$
$$\epsilon_{it} \sim i.i.d.N(0,\sigma_0^2)$$
$$\tau_i \sim i.i.d.N(\beta_0,\sigma_{id}^2) \qquad (12)$$

Where i and t denote the province and year, respectively.u_i represents the random effects specific to the i-th province, $\sigma_{id}^2$is the inter-provincial variance and $\sigma_0^2$is the variance component of the error.

The regression coefficients are assumed to have a normal prior distribution$(0,100)$, while the variance parameters are assumed to have a reverse gamma distribution$(0.001,0.001)$ (these background functions are common in Bayesian econometric literature and the combination of normal and gamma prior, when The distribution of the likelihood function is also normal, giving the conjugate prior function normal and the posterior function normal-gamma). It is worth noting that the mean of the random effect's prior distribution $\tau_i$is a regression constant of β_0, which has a normal prior distribution with a mean of 0 and a variance of 100; thus, this model is referred to as hierarchical. Indeed, when the states $\tau_i$are independent and their common distribution is dependent on an unknown parameterα_0, a hierarchical prior density function can be plotted, which when combined with the model likelihood function yields the posterior distribution. In general, this type of modeling is a useful tool for analyzing panel data because it increases intergroup independence and intragroup correlation in analyses, or in other words, it reduces variability between and within groups and improves model estimation accuracy (for further reading by (Gelman and Hill 2006) and(Goldstein 2010)). There are numerous statistical inference methods available today for performing statistical calculations on these models, one of which is the Monte Carlo integrated simulation method. While Monte Carlo simulation solves the Bayesian problem of posterior density moments by sampling the posterior distribution, this method has limitations that can be overcome by using Markov chains to generate sequences of sample points dependent on the amplitude of the posterior density distribution at the accepted acceptance rate.

3.2.2 Optimal model estimation

Since the most widely used distribution in economics is the normal distribution, this study assumes that the likelihood function of the model has a normal distribution, which is based on the dependent variable's normality. According to the results of this test, the GDP logarithm variable is normal at a significance level of 0.095.

Now, for statistical inference, the results of estimating the optimal model in STATA software using the Metropolis-Hastings algorithm have been obtained for 20,000 replications (as specified by the MCMC simulator) and for 10,000 samples as specified in Table (3).

Table 3. Model estimation results

Variables (1)	Mean (2)	Std (3)	Median (4)	Lower Bound (5)	Upper bound (6)
industry	0.35	0.034	0.35	0.29	0.41
K/L	0.73	0.04	0.72	0.66	0.79
judicial	-0.09	0.03	-0.09	-0.13	-0.04
energy	0.40	0.08	0.40	0.27	0.54
health	-0.36	0.05	-0.36	-0.44	-0.28
ICT	0.06	0.01	0.06	0.04	0.08
σ_0^2	0.28	0.01	0.27	0.25	0.30
σ_{id}^2	0.26	0.04	0.25	0.19	0.33

Source: Research finding

According to the results presented in Table (3), the posterior mean of the coefficients (column 2) are the elasticity of production to the changes of explanatory variables. The ratio of capital to labor is directly related to GDP, so that a one percent increase in the ratio of capital to labor increases by 0.73 percent of GDP. As a result, it can be concluded that decreasing the capital-labor ratio in Iran's provinces is detrimental to economic growth.

Health expenditures have a negative effect on GDP, with a 1% increase reducing GDP by 0.36 percent. The result mentioned above refers to the non-productive nature of these expenses and emphasizes the importance of monitoring how they are spent. This conclusion is consistent with(Ghorbel and Kalai 2016b).

Judicial expenditures also have a detrimental effect on economic growth, as increasing them by 1% reduces output by 0.085%. Therefore, the expenditures related to this subsection have either not been allocated correctly or have not been sufficiently compelling.

The findings indicate that a 1% increase in ICT expenditures results in a 0.06 percent increase in GDP. One could argue that government expenditures on this sub-sector have met expectations of economic growth, which, of course, theoretical expectations confirm. As a result, the government can reallocate expenses related to the ICT sub-chapter in order to maximize their impact on economic growth and development.

The expenditure coefficients for industry, mining, and energy are 0.35 and 0.4, respectively, indicating that the provinces are the primary engines of economic growth in the subcategories of economic affairs, energy, and industry. As a result, it is necessary to accelerate the growth process in these sectors by developing new capacities.

Each parameter's estimated posterior mean has a 5-percent confidence interval. Because none of the model variables have a value of zero in these two columns, all variables have a significant relationship with economic growth. The proximity of the median and mean of the posterior distribution of the parameters indicates their symmetry.

Additionally, in order to provide valid Bayesian inferences based on the sample obtained from MCMC simulation, the convergence of the algorithm's Markov chains was investigated using the effect diagram and posterior density autocorrelation of the model's explanatory variables. Diagrams relating to the parameters of other variables, as illustrated in Figure (1), demonstrate the algorithm's convergence when simulating the parameters.

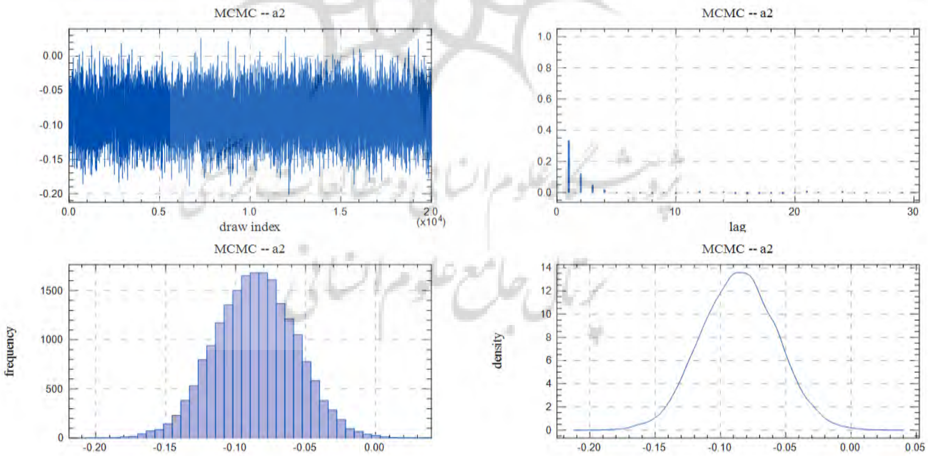

Figure (1). Multiple density posterior diagrams simulated with MCMC

Source: Research finding

4. Conclusion

The purpose of this article is to examine the government's role in the economy, more precisely, the effect of government capital expenditures by component on the GDP of Iran's provinces between 2011 and 2019.

As governments and policymakers seek to establish economic targets, assessing the response of economic variables to changes in expenditure can aid in policy formulation.

To this purpose, the Bayesian model averaging method was used to identify the components of government spending that have the most significant impact on GDP and then determine the extent and impact of these factors on provincial production. The findings indicate that the four sub-chapters of public affairs, defense, social and economic affairs, industry, judicial affairs, energy, health, and communications, and information technology have the greatest impact on the provinces' GDP. While expenditures on judicial affairs and health have a negative correlation with province production, expenditures on energy, industry, and information and communication technology have a positive correlation.

According to the findings, expenditures on health and justice have not increased the provinces' production capacity. The finding emphasizes the importance of reevaluating the allocation and spending of government expenditures in these sectors and recommends a reduction in the size of government in these areas. Because cutting unrelated expenditures will result in economic growth and reduce the budget deficit, which has been one of the primary concerns of recent governments.

Rather than increasing or decreasing government spending, it is proposed that policymakers decide on the optimal allocation of this spending by allocating resources to subsectors that affect economic growth and development.

Provincial funds should be allocated to the energy, industry, and information and communication technology sectors due to their impact on production, and their impact ratios can determine the allocation of resources to different sectors.

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بررسی تآثیر اجزای مخارج عمرانی دولت بر اقتصاد استان‌های ایران: رویکرد بیزین

چکیده :

چگونگی تاثیر مخارج دولت بر عملکرد اقتصادی از منظر ادبیات اقتصادی و سیاستگذاران حائز اهمیت است. هدف این پژوهش بررسی تأثیر مخارج سرمایه‌ای دولت به تفکیک مؤلفه بر تولید ناخالص داخلی استان‌های ایران طی سال‌های ۱۳۹۰ تا ۱۳۹۸ با استفاده از رویکرد بیزی است. برای این منظور ابتدا با برآورد بیش از ۵۰۰ هزار رگرسیون و میانگین‌گیری مدل بیزین از ضرایب، از میان زیرفصل‌های مخارج چهارگانه امور عمومی، دفاعی، اجتماعی و اقتصادی، پنج زیرفصل صنعت، امور قضایی، انرژی، بهداشت و سلامت و ارتباطات و فناوری اطلاعات به ترتیب، به عنوان موثرترین زیرفصل‌های مخارج عمرانی دولت بر تولید ناخالص داخلی استان‌ها شناسایی شدند. سپس جهت بررسی میزان و نحوه اثرگذاری هر یک از این زیرفصل‌ها بر تولید ناخالص داخلی استان‌ها، یک مدل سلسله مراتبی پانل بیزین، تصریح و برآورد شد. نتایج حاصل از شبیه‌سازی مونت‌کارلو با زنجیره‌های مارکف نشان می‌دهد که طی دوره زمانی مورد بررسی، مخارج امور قضایی و بهداشت و سلامت، تولید استان‌ها را کاهش داده اما مخارج مربوط به صنعت، انرژی و ارتباطات و فناوری اطلاعات تاثیر مثبت بر تولید استان‌ها داشته‌اند.

کلید واژه‌ها: اجزای مخارج دولت، عملکرد اقتصادی استان‌ها، میانگین‌گیری مدل بیزین، شبیه‌سازی مونت‌کارلو.

طبقه‌بندی JEL: C11, H11.