Provincial Growth Factor Determinants and Convergence: Evidence from Nine Provinces in Lower Northern Thailand

Kittipat Santaveesuk[1]

[1]Faculty of Business, Economics and Communications, Naresuan University

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Abstract

This study aims to discover the main factors that drive cross-provincial economic linkages, focusing on nine provinces in the lower northern part of Thailand. Using Solow model (1956), this involves analyzing the convergence patterns of per capital income levels and examining the core industrial clusters within this region. The findings indicate that the key drivers of economic growth in nine provinces are loans, urbanization, and labor force. Tourism spending and government expenditure are also significant but their effects are currently subtle. The analysis of economic convergence across the region confirms that integration of government policy enables the improvement of economic development within the nine provinces in accordance with the selected cluster groups for goods and services.

Keywords: 1) Provincial economic growth factors 2) Economic convergence 3) Economic cluster creation

[1] Lecturer, Department of Economics; E-mail: kittipats@icloud.com

Introduction

The economies of nine provinces in the lower northern part of Thailand, comprising Nakhon Sawan, Uthai Thani, Kamphaeng Phet, Phichit, Phitsanulok, Tak, Sukhothai, Uttaradit and Phetchabun, can be grouped into two main development areas. Both groups have consistent development strategies. Also, they are located nearby and their transportation structures are closely linked together. This supports a mix of economic activities that make the region an important source of agriculture and rice cultivation, as well as a center for industrial plants and service businesses. Linkages within the provincial economic system are also important for the economic expansion and transformation of cities. Moreover, this degree of inter-connection encourages changes and economic development in each province.

In general, the main characteristics of the provincial economy are the coherence of the factors of production that affect economic growth. These include the size of the local population, which represents the labor force behind economic production as well as the source of purchasing power to consume goods and services in the economy. Other factors include the amount of deposits and borrowings of financial institutions, which are capital factors that affect the expansion of investment within the private sector.

According to the neoclassical economic theory proposed by Robert Solow (1957), the production of goods and services in an economy can be measured, with their value describing the change in the use of the production factors in the economy as a decreasing marginal product to each growth factor. Besides this, the theory also explains the substitution of each factor of production in the economic system.

In an economy with low labor costs, for example, human labor is used more than capital to produce goods and services (in other words, it is labor-intensive), while other economies with high labor costs rely more on capital than labor (i.e., they are capital-intensive).

Solow also describes a “residual” or “technology change” factor, which consists of government policy influences, household consumption behavior, natural resources, and human resources, among others. This indicates the performance of the economy in terms of production or total factor productivity (TFP). TFP considers the use of those production factors within each economy that are less in production to produce equal production. The TFP is measured using educational level, gender, and age to indicate workforce potential, as well as the use of information technology and production technology. This is also referred to as factor augmentation.

In Solow's growth model, analysis of the convergence of connected economies is conducted by examining the per capita income levels of each province. An economy with low levels of per capita income initially has faster economic growth than those economies that already have high per capita income levels. Therefore, this article studies the factors that affect the economic growth of these provinces. Analysis of the convergence of local economies can lead to recommendations for the development of economic clusters in the nine lower northern provinces of Thailand.

Research Objective

The objectives of this research are (a) to examine the main factors affecting economic growth in the lower northern provinces of Thailand, (b) to study the empirical pattern of economic convergence of the income per capita growth rate of each province, and (c) to identify ways to develop the economic cluster in the nine provinces concerned.

Literature Review

This study of economic growth factors and the interconnection of economies in the production of goods and services began with the growth model developed by Solow (1957). In a more recent study by Mankiw, Romer, and Weil (1992), cross-sectional data were used to analyze the differences in income per capita in many countries using an augmented Solow growth model, which focuses on physical capital, human capital, labor, and capital accumulation as well as investment in human capital and consumption. They find that physical capital has a greater effect on income per capita than Solow described. An economy with a high savings rate increases its income per capita as well as its TFP. In addition, when comparing countries with similar levels of technology and the same rate of population growth, the population growth rate has an inverse effect on the rate of change in income per population of the country.

The findings also show that the convergence of different economic systems increases as they expand. A study by Limpanonda, S. (2015) on the convergence of provincial-level data in Thailand found that the growth during the years 1988–2009 resulted in convergence in terms of development at the provincial level. Nonetheless, provinces that have certain advantages in terms of production capabilities, geographical location, government policies, and the local labor force, among other benefits, will grow at a different rate from other provinces. A study by Vidyattama, Y. (2016) on population migration in Indonesian provinces from 1975-2005 found that the effect on convergence was very high and was the reason for the linked development of each province.

Knight, Loayza, and Villanueva (1993) further studied the proposals of Mankiw, Romer, and Weil (MRW) using panel data to determine the effect of specific economic systems on income per capita over time. Their results resemble those of MRW, but the degree of effect differs between developing and developed countries. Moreover, the effect of trade openness has a positive effect on economic expansion. Meanwhile, a study by Barro (1999) of growth in 100 countries using panel data found that higher scores for investment, growth in international trade, the number of years of schooling, law enforcement, and democracy all have positive effects on economic growth. Conversely, government spending, the birth rate, and the inflation rate can have a negative effect on economic growth.

In another study of the factors contributing to economic growth in developing countries, Dollar (1992) used cross-sectional data to find that the real exchange rate has an inverse effect on the long-term growth of the

group of economies concerned. In addition, the investment rate can have a significant impact on long-term growth.

By studying the development of clusters at the local scale, Xiangfeng, L. (2007) describes the cross-provincial use of production resources in China. The formation of clusters at the local level is found to be imperative for the government to play a crucial role in encouraging provincial development. The government must play a role not only in terms of marketing and identifying production factors that are cost competitive, but must also plan to develop both the ecosystem for doing business as well as linking upstream and downstream industries. Moreover, it is important to develop labor skills to encourage technology transfer and to develop new knowledge from research for product development.

In Thailand, the economic systems of the nine provinces studies here are similar in that they all combine agriculture, industry, and services. However, the production value of each province in 2011 (the last year used in the study) varies considerably. Table 1 lists the provinces by economic size, ranked from largest to smallest in terms of provincial gross domestic product (GDP), sometimes also referred to locally as gross provincial product (GPP): Nakhon Sawan, Kamphaeng Phet, Phitsanulok, Phetchabun, Tak, Sukhothai, Phichit, Uttaradit, and Uthai Thani.

Table No. 1 Economies of Nine Selected Provinces, 2011

Province	Provincial GDP in million baht (per capita figure in brackets)	Economic Characteristics
Nakhon Sawan	88,469.8919 (76,509.33)	Agriculture accounts for more than 25% of the total production value, while the wholesale and retail services sector has increased in value, as has the industrial sector.
Kam phaeng Phet	88,785.5225 (122,780.83)	The share of industrial production is high, at more than 45%, while the service sector and agricultural sector have a lower share, although agricultural production has increased.
Phitsanulok	63,983.6633 (75,157.21)	Service sector production is increasing as a share of the total each year as the province is a center of government and tourism. The value of agricultural production has decreased.
Phetchabun	57,855.8798 (55,562.37)	Agriculture accounts for more than 25% of total production while the expansion of the service sector is largely due to tourism. The value of production in the industrial sector is also increasing rapidly.

Province	Provincial GDP in million baht (per capita figure in brackets)	Economic Characteristics
Tak	35,506.1051 (64,610.05)	The proportion of production from the industrial sector has increased, while service sector production has also tended to grow due to border trade. The agricultural sector tends to decline.
Sukhothai	30,217.8301 (53,057.83)	The value of production from the agricultural sector is higher than 25%, though is decreasing. The value of service sector production is the second largest and increasing while the value of production in the industrial sector has decreased.
Phichit	35,998.6549 (59,966.97)	It is notable that agricultural production counts for more than 25% of the total, although it is on a downward trend, while the value of service production shows a slight increase.
Uttaradit	29,310.1891 (59,746.11)	The value of production in the agricultural sector is higher than 25% of the total. The service sector has seen little change, while the value of industrial production tends to decline.
Uthai Thani	19,378.5507 (74,386.61)	The share of agricultural production accounts for more than 30%, while the industrial and service sectors tend to increase slightly.

Source: The National Statistical Office Thailand

Methodology

For this study, the researcher used panel data, which is a mix of cross sectional and time series data from nine provinces from 2006 to 2011. A feature of panel data is to control the differences in each province's data (individual heterogeneity), reducing data bias.

The variables used in determining economic expansion at the provincial level are different for each area. For example, these can range from the budget management of each province to government policies for budgetary support to address poverty, such as village funds that may be distributed throughout a province. These variables may also differ over time. However, panel data analysis has the ability to identify the essential characteristic of variables, meaning they can be included in an analysis without bringing in the problem of linear relationships (collinearity) between variables. The greater degree of freedom in analyzing panel data results in a more efficient

estimation than when using many other types of data.

The provincial-level data used in the analysis consists of:

• Gross provincial product (GPP): The provincial product reflects the value of all final products of goods and services produced within the provincial boundary in a period of one year. Each province has a production structure which combines three main sectors: agriculture, industry, and services. This study uses the gross provincial product data at constant prices provided by the Office of the National Economic and Social Development Council (NESDC) of Thailand for analysis. This data set is used to calculate the GPP per capita to enable the comparison of provincial products without the overall size of each province having any bearing on the analysis. Using the same data set, the rate of change of GPP per capita is then calculated.

• Provincial loan data: In Solow's model, capital changes are reflected by increasing investment in the economy but also by capital depreciation. However, in the provinces under study, accumulated assets depend on private investment, with funds coming from both personal savings as well as borrowing from available credit in the province. Provincial loan data is prepared as a percentage of the population size and the rate of change is also calculated for further analysis.

• Labor data is an essential factor that affects economic expansion, as it is key to production in agriculture, industry, and services. Here, population statistics form the main part of the analysis, as estimates of the labor force are generated from a survey by the provincial statistical office into working conditions among the labor force. This also provides data on the issue of employment and unemployment in the economy. Labor force numbers can be derived from figures for those ready to work in the provincial area. Labor force migration can also play an important role in changing economic growth rates, although this is not investigates in depth in this study. The labor data is taken from the Labor Force Survey by the National Statistical Office. In addition, labor data is prepared as a percentage of the total population, while the rate of change is also calculated for further analysis.

• Urbanization: urban information here focuses on the change in the population of an urban or municipal area compared with the total population of a province, as migration into urban areas can affect economic changes within the province. In urban areas, there tend to be more advanced economic activities, such as wholesale and retail services, that generate higher incomes for workers than in rural areas. Being the center of advanced medicine production or a major link in a supply chain for the overall economy can result in urbanization factors that affect the economic growth of the province. Urbanization is represented here by municipality population data, which is prepared in the form of a ratio to the total population, and is also calculated in terms of the rate of change for further analysis.

• Tourism: the tourism industry involves many linked businesses and professions such as travel, accommodation, restaurants, souvenirs, leisure and health services, etc.

Essentially each business is linked to other provincial economic activities, such as farming and food production in the case of restaurants. Therefore, tourism can have a significant effect on economic change at the provincial level. In addition, tourist spending is a key contributor to other economic activities. The data used in the analysis includes the total number of tourists, not separating Thai visitors from foreigners. This data is also used to prepare information on tourist numbers as a ratio of the population, as well as to calculate the rate of change for further analysis.

• Government spending: Government expenditure in the provinces is represented by two aspects, namely, the investment budget and the regular budget. The latter is the budget for salaries, wages, and regular expenses of government agencies in provincial areas, which can affect economic growth in terms of consumption. However, the investment budget, which covers procurement, is a direct creator of employment in the economy. In addition, many businesses operate in relation to the investment budget, such as construction. These may in turn lead to the building of public utilities that affect other businesses, as well improve people's standard of living within the province: thus the investment budget can be the source of continuous economic activity. For the purposes of analysis, this study uses annual budgetary expenditure data for each province. This is also prepared in the form of spending as a ratio of the population, and is further used to determine the rate of change in spending per capita each year for further analysis.

Table No. 2 Economic Variables and Sources of Data

Variables	Source	Unit of Analysis	Code	Relevant data/ measure
Gross provincial product (GPP)	Office of the National Economic and Social Development Council www.nesdc.go.th	Bath	lnrgpppc	GPP per capita
Provincial loan data	Bank of Thailand (www.bot.or.th)	Bath	lnloanpc	Annual data for outstanding loan balances in the provinces
Urbanization	The National Statistical Office www.nso.go.th	People	lnurban	Population of urban areas relative to the total population
Labor data	The National Statistical Office www.nso.go.th	People	lnlaborpc	Employment per total population
Tourism	The Department of Tourism www.dot.go.th	People	lntouristpc	Tourist numbers per total population

Variables	Source	Unit of Analysis	Code	Relevant data/ measure
Government spending	Budget Bureau www.bb.go.th The National Statistical Office www.nso.go.th	Bath	lngovpc	Government spending per total population

Panel data is characterized by cross-sectional analysis in association with time series data. In regression analysis, the data in both rows and columns must be analyzed over time. Therefore, the panel data analysis has the following characteristics:

$$y_{i,t} = \alpha + x'_{i,t}\beta + \mu_{it}$$

$y_{i,t}$ is GPP per capita which is a dependent variable, where i represents the province and t represents the time interval. Furthermore, α and β are parameter values, where α is a scalar value, while β has the magnitude k x 1, and $x_{i,t}$ is the independent variable x at time t which represent in table 2.

In the panel data analysis, there are other variables such as those related to the change in time, as well as omitted variables. These variables are not defined as an explanatory variable in the analysis but may nevertheless affect dependent variables. Therefore, in the analysis of the panel data, the relationship of omitted variables. There is a change in each time period which will affect the relationship of independent variables in the same group (within-group variation), causing other variables that may have an effect on the dependent variable which is defined to have a specific influence on only province i.

Therefore, a number of k variables are used to describe the variable values based on y, while the error value is a one-way error, and the error value of the panel analysis consists of

$$\mu_{i,t} = \mu_i + \upsilon_{i,t}$$

where μ_i represents the error of the system of equations. Moreover, it represents the unverifiable value of the variable i that affects $y_{i,t}$ (unobservable effect) and is not a variable in this regression equation. Meanwhile, $\upsilon_{i,t}$ represents the remaining noise of the system of equations, which not only changes according to the value of each province but also changing times. In this study, the rate of change of GPP per capita for each province is the dependent variable, or $y_{i,t}$ resulting from the independent variable or $x_{i,t}$, which is the value of loans, deposits, continuing education rates, and tourism, etc. in the province. This will affect the change in per capita income in provinces when compared across time periods.

The data has a stationary test, which is an analysis of mean and variance with low volatility or stablility without change as time changes. Otherwise, if the data does not have stationary or non-stationary properties, then the data is composed of the unit root, which represents the stochastic process of randomly occurring problematic data. The stationary test used is the Levin-Lin-Chu test (Levin, A., Lin, C. F., and Chu, C. S. J. 2002) where the unit root test is a regression test of the augmented

Dickey-Fuller (ADF) equation for each unit of cross-sectional data analysis. The equation is as follows:

$$\Delta y_{it} = \rho_i y_{i,t-1} + \sum_{l=1}^{p_i} \emptyset_{i,l} \Delta y_{i,t-l} + \alpha_i d_{it} + \varepsilon_{it}$$

where d_{it} represents deterministic components: when analyzing the coefficient $\rho_i = 0$, it indicates that the variable y will have a unit root process in all regions i. However, if $\rho_i < 0$, the variable y has a stationary process. So, the hypothesis of this test is as follows:

H0: $\rho_I = 0$ the variable has a unit root.

H1 : $\rho_I < 0$ the variable has a stationary

However, in the analysis by Levin, Lin, and Chu, cross-sectional data assumptions are independent of each other. For this data, the demean option is used to apply the cross-sectional mean factor to reduce the effect of correlation in cross section data on this panel.

Table No. 3 The Levin-Lin-Chu Test

Variable	Levin-Lin-Chu Test, Demean		Levin-Lin-Chu Test	
	Adjusted t	p-value	Adjusted t	p-value
lnrgpppc	-3.5224	0.0002	2.4937	0.9937
lnloanpc	-2.6192	0.0044	2.8128	0.9975
lnurban	-16.0816	0.0000	-20.9607	0.0000
lnlaborpc	-40.1779	0.0000	-21.6260	0.0000
lntouristpc	-2.8729	0.0020	-0.8220	0.2055
lngovpc	-5.9000	0.0000	4.1653	1.0000

Analysis of factors affecting economic growth at the provincial level

Conducting this research, the regression analysis tool for the panel data is applied using (a) fixed-effect analysis, which emphasizes the observational differences that affect different areas, including variations in the cultural and lifestyle factors of people in those areas, and (a) random-effect analysis, which is an analysis of panel data that varies according to the effect of different random factors in each area and periods, such as the management style of the provincial governor in each province. In each observation, the results of these different factors will be analyzed together in the model.

Table No. 4 The Regression Analysis Results

Independent variable	Dependent variable: lnrgpppc Model 1		Dependent variable: lnrgpppc Model 2	
	Random effect	Fixed effect	Random effect	Fixed effect
lnloanpc	0.305 (0.000)***	0.305 (0.000)***	0.285 (0.000)***	0.271 (0.000)***
lnurban	0.115 (0.064)*	0.114 (0.076)*	0.106 (0.091)*	0.107 (0.097)*
lnlaborpc	0.328 (0.011)**	0.333 (0.014)**	0.277 (0.040)**	0.276 (0.046)**
lntouristpc			0.052 (0.246)	0.0205863 (0.48)
lngovpc			-0.027 (0.394)	-0.023 (0.481)
Constant	7.901 (0.000)***	7.901 (0.000)***	8.294 (0.000)***	8.392 (0.000)***
R-squared within	0.757	0.757	0.767	0.768
F		109.64		38.348
Prob>F		(0.000)***		(0.000)***
Chibar2(01)			191.834	
Prob>Chibar2			(0.000)***	
Hausman Test				
Chi-square	0.91		5.376	
P-value	(0.822)		(0.372)	
*** p<0.01, ** p<0.05, * p<0.1				

The Generalized Method of Moment to Explain β Convergence

To analyze the expansion from the dynamic equation, it is necessary to solve the problem of cross section analysis, which has three main problems. These are: (1) the problem of errors (error term) related to independent variables, which are caused by the fact that these variables are affected by each other, such as capital causing investment or investment causing capital accumulation in the economy; (2) the effects of changes in geographical factors, population structures, and other variables over time, whereby the different characteristics of each economy are affected by the fixed effects, which are repre-

sented in the error term; (3) an independent variable which is the lag of GDP per capita in the past year, which will give the opportunity to increase the autocorrelation problem.

A generalized method of moment (GMM) to analyze dynamic panel data was devised by Holtz-Eakin, Newey and Rosen (1988) and Arellano-Bond (1991). This method uses first-difference values to solve the fixed-effect problem caused by the difference in area and other variables. Over time:

$$\Delta y_{i,t} = \alpha + \beta_1 \Delta y_{i,t-1} + \beta_2 x'_{i,t} + \mu_{i,t}$$

where:

$$\mu_{i,t} = \mu_i + \upsilon_{i,t}$$

and $y_{i,t}$ is the average per capita income of the provincial economy. This shows the difference in economic development in each province, as well as considering the rate of change. The value of first-difference is the independent variable in the analysis as well as the group of $x'_{i,t}$ variables, which are the independent variables that affect changes in economic development in the area, such as capital, labor factors, etc. In this case, $\mu_{i,t}$ is the differential factor of the system, where μ_i is the fundamental factor of each different province, whereas $\upsilon_{i,t}$ is an idiosyncratic shock or fluctuation such as a drought or floods, for example, which are factors that do not occur regularly in each province.

The moment condition is the lagged variable of the $y_{i,t-1}$ variable as an instrumental variable to approximate the first-differenced GMM.

Table No. 5 Generalized Method of Moment

Independent variable	GMM: dependent variable: lnrgpppc		
	Model 1	Model 2	Model 3
L1 lnrgpppc	-0.2336248	-0.081	-0.009
	(0.379)	(0.667)	(0.966)
lnloanpc	0.393	0.393	0.371
	(0.000)***	(0.000)***	(0.000)***
lnurban		0.066	-0.059
		(0.524)	(0.593)
lnlaborpc	0.176	0.142	0.148
	(0.273)	(0.391)	(0.356)
lntouristpc			0.036
			(0.356)
lngovpc			-0.053
			(0.128)
Constant	7.525	7.763	7.637
	(0.000)***	(0.000)***	(0.000)***
Wald Chi2	51.97	66.81	78.66
Prob>Chi2	0.0000	0.000	0.000

*** p<0.01, ** p<0.05, * p<0.1

The σ convergence

The σ convergence model can be used in an analysis to explain the convergence of economic growth, which is described by the standard deviation of the GPP per capita growth rate of each province during the study period. The standard deviation, representing the difference in GPP per capita of the provinces, is compared with the mean of the nine provinces over time. If the value increases, it signifies that provincial economic development does not converge. If, on the other hand, the value has continued to decrease, this indicates the development of a connected economy. For this study, the correlation coefficient is calculated accordin g to the following formula, which is not weighted by the population, and shows the difference in area:

$$CV = \frac{\sqrt[2]{\sum_{i=1}^{n}(y_i - \bar{y})^2}}{\bar{y}}$$

where y_i is the per capita income of the province, and $\bar{y}$ is the average per capita income each year. The results of the calculations are shown in the table.

Table No. 6 Results of the σ Convergence

Year	Standard Deviation	The average of GPP per capita	Coefficient of variation
2006	16227.630	51905.85959	0.3126
2007	17396.97806	54513.67474	0.3191
2008	18005.00896	61245.20524	0.2939
2009	16065.32242	61704.96552	0.2604
2010	16717.25237	65045.62961	0.2570
2011	21180.6297	71308.59541	0.2970

Research Results

• The results of regression analysis using fixed effects and random effects show that the two models of Hausman test values reveal no difference between either option, so the random effect was chosen. In Model 1, there are three independent variables, which are loans, urbanization, and labor force, with the statistically significant coefficient showing the main factors affecting the rate of change in income per population of the province. In addition, the loan per capita change rate is 0.305, the urbanization rate is 0.115, and the labor force change per capita rate is 0.328. Otherwise, the factors with no other statistical significance are the rate of change in the number of tourists in the province per capita, at 0.052, and the rate of change in government budget per capita, which is 0.027. Therefore, only the independent factors of urbanization, labor, and capital accumulation, which is generated from the rate of change from loans, are significant.

• From the GMM analysis in Model 2, it was found that the change in the borrowing rate per capita only influenced the change

in income per capita in each province. In the dynamic analysis, the accumulation of capital in the economy arises from loans from financial institutions, which are an important source of funds for doing business at the provincial level. Instead, other variables do not significantly affect the change in income per capita. However, the lagged variable, lnrgpppc, had a negative coefficient. This reflects the convergence of the economic systems of all nine provinces, where those of a small economic size had better growth rates than provinces with large economies. This does not show statistically significant values. Therefore, it cannot be concluded that the economies of the lower northern provinces converge in a β convergence manner.

• From the analysis of σ convergence using the correlation coefficient (CV), it is found that the economic correlation coefficient of all nine provinces tend to decrease during the study period, which shows that the economic systems of the nine provinces in the lower northern are converging. This convergence arises from the nature of production in these provinces, as there is a transfer of production technology and a linking of production factors between them in terms of both capital and labor. However, in the year 2011, the CV value has been adjusted. As a result, the development of some provinces indicates higher income per capita than other provinces on average. Therefore, the next study into this topic will be able to examine how the analysis of different periods may affect the convergence of the provincial economic systems differently.

Discussion and Conclusions

In the course of the research, it was found that the main factor affecting the economic growth of the nine provinces in the lower northern region of Thailand is the accumulation of capital through borrowing. This has a significant effect on the economic growth of each province. The accumulation of capital also affects both small and medium -sized enterprises that are able to start new businesses as well as existing companies that want to expand their business to support economic growth.

A study of economic growth in Pakistan by Bari and Cheema (2005) found that small and medium-sized businesses had the effect of adding value to local products. At the same time, they provide a good source of employment in the area.

In addition, households may want to buy a house, which is a form of investment in the local economy. A provincial-level study by Chen, Guo, and Zhu (2011) found that building and buying homes was associated with provincial GDP growth in China, both in the short term and long term. In addition to this study (2011), Yue and Hongyu (2004) also found that in China, the first factor of provincial economic development is a home purchase. If people choose to rent a house or dormitory, this may indicate a decision to wait for possible migration, but buying real estate indicates a longer-term plan to stay and work locally. Furthermore, the decision to build or buy a house is an important labor force factor affecting economic expansion. The people in the area will choose the location with an

emphasis on convenience. This can lead to greater urbanization, which provides more centers for higher-level services that affect a person's lifestyle.

The results of the research reveal that labor factors affect economic growth in the same direction. The greater the number of workers as a proportion of the overall population, the greater the increase in the growth rate of provincial income per capita. In other words, the size of the labor force of the economy will affect income generation. In a cross-sectional analysis by Barro and Lee (1994), population growth resulting from labor migration to find jobs in an economic system, tend to have a positive effect on economic growth. This research does not analyze the cross-sectional data on labor migration, nor does it cover the analysis of the population of provinces with lower population numbers. However, it is noted that the generation of higher provincial income per capita can demonstrate the more efficient use of technology by the labor force or population in producing goods and services in that province compared with other provinces.

In this study, the effect of tourism on income growth per capita in the nine selected provinces in the lower northern region of Thailand was low and not found to be statistically significant. Although in the national economy, tourism factors can have a major impact on a country's GDP, this does not seem to be the case at the local level. A study by Wattanakuljarus and Coxhead (2008) of the linkages between the manufacturing and service industries in Thailand and the benefits of tourism found that these sectors have a major impact on each other and can lead to the creation of a large number of jobs across the country. Nevertheless, in the area of these nine provinces of the lower northern part of Thailand, tourism is still unable to generate significant economic activity. This is likely because this region overall is not a major tourist area nor do these provinces offer the same leisure activities throughout the year as do other more tourism-focused locations. As a result, tourism only slightly affects the growth in provincial income per capita in this study.

Analysis of provincial government budgets and their effects on the local economies and expansion of per capita income in the nine selected provinces show that these are low and not statistically significant. These findings are similar to those in the study by Zhang and Zou (1998) into the effect of local budgets according to decentralization and provincial budget guidelines, which similarly found they had no significant effect on economic growth in China. Furthermore, a study by Jin and Zou (2005) reached similar conclusions: that provincial budget spending has less of an effect on economic growth than federal action.

Government budgets in provincial areas tend to focus on providing public services and basic utilities to the people, such as primary public health, primary education, and sanitary utilities, which only indirectly affect the change in income per capita. This is different from the effect of the state budget, which tends to focus on building utilities (i.e., infrastructure), especially transport

and communication routes, which in turn affect economic expansion by reducing costs for producers in the agricultural sector and service industries, for example.

Moreover, the effect of creating speed of communication and being able to allocate resources such as raw materials for production help to improve the efficiency of the provincial economic system. This makes it easier for companies to make investment decisions and expand their business. In this respect, an empirical data study on the effects of building infrastructure in China on economic growth : Ansar, Flyvbjerg, Budzier, and Lunn (2016) found that investment in utilities does not always have a major direct effect on economic growth. In addition, high investment in utilities can be compared with the low benefits received, thus the fiscal burden on the budget results in the loss of investment opportunities in other projects that may have a more direct influence on economic growth.

Recommendations

Long-term economic development of a province must focus on concentrating capital investment in all production sectors. This must be pursued in parallel with developing the skills of the labor force across all sectors, because both factors are important in tandem. The government can create labor development projects within chosen sectors to use new technologies in production, such as the use of precision agriculture, drones, and closed production greenhouses in the agriculture sector. This will require farmers who understand the application of technology to focus on improving productivity, using less resources, but also getting more output.

The linkage of production is important in the development of clusters. This is indicated by the results of the analysis that show a convergence of the growth rate of income per population in the nine selected provinces in the lower northern region of Thailand. This indicates that the linkage of production factors and labor inputs is high. For this reason, it is important that the government implements a policy to guide the development of production clusters, although it is crucial for the private sector and manufacturers to invest in this process as well to ensure change.

Cluster production in a province involves the production of goods and services that are connected. Typically this happens with technologically sophisticated goods and services with high added value. Generally, when mass production does not produce all parts of a finished product, some types of raw materials can be outsourced to subcontractors to produce final goods and services. For example, among the provinces with intense agricultural production, such as Uthai Thani, Uttaradit, Phichit, Nakhon Sawan, Sukhothai, and Phetchabun, one recommendation is to focus on the cluster development of agricultural machinery for use in farming.

The government can act as a starting point for supporting such projects, including gathering producers who have marketing connections into the same agricultural product group, developing prototypes with educational institutions to solve problems, and conducting market surveys of demand for machinery

or other products. The private sector and entrepreneurs can then seek channels for further investment and product development both within the province and in other areas as well.

Given that the Phitsanulok, Tak, Nakhon Sawan, and Phetchabun provinces are outstanding in providing value-added services in the service sector, a cluster should be developed around services such as tourism, medical services, transportation, retail, warehousing, and border trade, in order to create a link to other provinces in the surrounding area and thus increase the value of service production. Moreover, Kamphaeng Phet and Tak provinces are dominant in industry and mining, which with further research and development in geological product inventions, including marketing mechanisms, could create a variety of clusters that are appropriate and in line with the development advantages of each province.

Lastly, the development of clusters can also occur with similar products but with multiple manufacturers. This usually happens for reasons of specificity in production factors, such as suitable soil for agriculture, or the popularity of certain consumer products in a particular area. Demand for those goods and services can be encouraged through the formation of an industry cluster, though first there must be a broad survey of interest in consumption of those goods and services not only in the country but also abroad. A study by Xiangfeng (2007) describes the government's support for SMEs and the development of manufacturing clusters in China. It found that China has production areas set aside for many manufacturers who otherwise produce similar products. The process of copying, imitating, and developing variations on the same product, that creates an expertise of labor and helps to build a production hub for this kind of product. The government encourages the foundation of SME businesses by providing training in production and marketing, offering consulting by experts to create a competitive product, and offering financial support.

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