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Effect of Technological Change on Economic Growth in the Eastern Economic Corridor: The Case Study of Chonburi Province, Thailand

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ABSTRACT

The purpose of this research is to study the technological changes in Chonburi Province that affect its economic growth and analyze the factors determining those changes. Historical annual data from 1993 to 2022 are used in the quantitative analysis along with an econometric model in the form of a complex multiple regression equation. The findings of this study reveal that technological change has had a positive impact on the economic growth of Chonburi Province, with the total economic sector achieving 0.0142% with differences in each production sector. However, the production sector exhibited the highest rate of technological change, notably within the utilities, mining, and sanitation sectors. This was followed by commerce, the handicraft industry, warehouse transit, and the transportation sectors. The agriculture, forestry, hunting, and fishery sectors, as well as the metal and non-metallic mining sectors, followed respectively. However, the manufacturing sector, along with the public construction-repair and demolition sector experienced change in the negative direction. In terms of the factors affecting the change in growth of the economic sector as a whole and every branch of production, capital factors were found to have a greater effect than labor factors. When analyzing the influence of factors that determine technological change, each production sector experienced different effects. Research and development expenditure at the national level was found to have the most significant relationship in the same direction as the factors promoting investment in Chonburi Province. In contrast, a significant relationship in the opposite direction was revealed with the value of output not only in the economic sector as a whole but also in each sector of production. Therefore, this research provides recommendations to the government and related agencies by highlighting the necessity for workers with a high level of education. Besides technology development, national value of machinery imported from abroad in each production sector should be emphasized to harness benefits and supporting foreign direct investment and domestic entrepreneurs.

Keywords: Growth Model, Technological Changes, EEC

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Background and Significance of the Research Problem

Thailand has a plan for the continuous development of the agricultural, industrial, and service sectors. There is a guideline for driving the country through the agricultural sector and the abundance of natural resources, including biological diversity. There are also guidelines for the development of light industry to replace imports from abroad. This will be followed by the development of heavy industries that focus on production for foreign exports, such as electronics, petrochemicals, automobiles, and their various components. Thailand faces three obstacles that have accumulated over a long period and affect the economic development of the country. These are the Middle-Income Trap, the Inequality Trap, and the Imbalance Trap under the Thailand Development 4.0 framework and the Ministry of Industry by the Office of Industrial Economics. Therefore, the 20-year Industrial Development strategic plan of Industry 4.0 (2017–2036) has been created with the vision "Towards an industry that is driven by intelligence and linked to the global economy". One way to achieve this is to push for the development of the Eastern region by establishing the Eastern Economic Corridor (EEC), which consists of the Chonburi, Rayong, and Chachoengsao Provinces.

The main objective of the EEC project is to further the development of the Eastern Seaboard area, known for over 30 years as the Eastern Seaboard. Certain industries have been targeted for promotion with the aim of creating concrete investment by increasing infrastructure and public utilities to enhance Thailand's potential to support investment and the development of economic activities and facilitate activities in various areas. These include human resource development and systematizing technology accumulation for the country's sustainable future.

This study focuses only on Chonburi Province since it is one of the areas designated for promotion according to the national development framework of the Thailand 4.0 plan. The economy of Chonburi Province is showing continuous growth, with its industrial production index expanding from 2.1% in 2018 to 7% in 2019. After shrinking by -4.3% in 2020 during the COVID-19 crisis, it then increased again by 7.4% and 3.3% in 2021 and 2022, respectively (The Chonburi Province Office of the Comptroller General, 2023). In parallel, the development of modern technology and innovation has increased the management efficiency of Laem Chabang and Sattahip Ports. Infrastructure development, science, technology, and innovation provide support for technology transfer both domestically and abroad. Furthermore, the development of personnel in science, education, technology, and innovation helps to increase the output value of the industrial sector. Therefore, the researcher has chosen the period from 1993 to 2022 to study changes in technology and the factors determining such changes in Chonburi Province.

Research Objectives

1. To study the changes in technology in Chonburi Province affecting the economic growth of Chonburi Province.

2. To analyze the factors determining the changes in technology in Chonburi Province.

Scope of Research

Study Period: To determine and analyze the factors affecting technology changes in Chonburi Province, secondary data were used in this study, namely annual data from 1993 to 2022 (30 years). These data included the value of gross provincial product of Chonburi Province (GPP) according to annual prices (Y), capital resources used in the production of national products (K) (obtained from the Office of the National Economic and Social Development Council), and the total number of workers in Chonburi Province (L) (obtained from Chonburi Provincial Statistical Office). The economic system and each sector of production were included in the analysis. The data gathered for this study included the number of workers with a high school education or higher in Chonburi Province (EDU) (Chonburi Provincial Statistical Office), Cost National Research and Development Payment (R&D) (National Research Council of Thailand), National Technology and Patent Fee (PATENT), National Foreign Direct Investment (FDI), national inflation rate (IR) (Bank of Thailand), National Foreign Machinery Import Value (MACHINE) (Department of Trade Negotiations), Chonburi Province Investment Promotion (BOI), and the trade value of Chonburi Province (TRADE) (The Chonburi Provincial Office of the Comptroller General).

Scope of the Study: The changes in technology were analyzed from Solow's production function, defined in the form of a natural logarithm equation by analyzing the results of the growth rate in various factors affecting the production process, the number of workers, supplies, and technology. In addition, the effects of changes in technology and the relationship between output and production factors used in the production process in Chonburi Province were also emphasized. As for the factors that determine technology in Chonburi Province, the overall economic sector and each branch of the production sector have been analyzed using complex multiple regression equations. These factors include the number of workers with a high school education or higher in Chonburi Province (EDU), Cost of National Research and Development Payment (R&D), National Technology and Patent Fee (PATENT), National Foreign Machinery Import Value (MACHINE), Chonburi Province Investment Promotion (BOI), National Foreign Direct Investment (FDI), the trade value of Chonburi Province (TRADE), and national inflation rate (IR), to examine the relationships among various factors affecting technological change in Chonburi Province.

In this study, it is assumed that the variable capital resources used in the production of national products (K), Cost of National Research and Development Payment (R&D), National Technology and Patent Fee (PATENT), National Foreign Machinery Import Value (MACHINE), National Foreign Direct Investment (FDI), and national inflation rate (IR) are equal to the Chonburi provincial data because such data has not yet been collected for each province. Upon reviewing the related concepts, theories, and research, various factors were found to affect economic growth and technological change in Chonburi Province.

Theoretical Background and Literature Review

Economic growth through Keynes' Macroeconomics model. Factors affecting economic growth include world oil prices, interest rates, inflation rate, and unemployment rate. Under the assumption that there is no labor supply limit, output can be increased without a rise in price, and the marginal productivity of capital factors is constant. Therefore, each additional unit of capital increases output by the same amount since labor keeps the capital/labor ratio constant (Mali, 2015).

Harrod-Domar stated that the rate of productivity growth is directly proportional to savings, and the capital-output ratio remains constant. This shows that the change in output is proportional to the change in the amount of capital inputs and gives importance to savings and capital accumulation. This is considered an important factor since it results in an increase in the country's total output and pushes the economic system to grow. (Santipholwut, 2015).

Robert Solow (1957) improved the Harrod-Domar model by adding labor factors and technology considerations to the growth equation. Although Solow's model describes developed countries better than developing countries, it still paints a clear picture of economic growth and development. The model suggests that different economies can reach the same level of income by specifying that savings, depreciation, labor growth rate, and the growth in productivity are all the same. Therefore, the Solow model is the main basis for explaining the interaction of two different economies (Santipholwut, 2015; Wangsukij, 1996).

Ayres (1883) proposed that the key factor in the economic development of developed and developing countries depends on technology and social pattern system. This is because technology comes from the collaboration between people and tools. The tools that people use in technological progress emanate from invention and human discoveries. Therefore, Ayres believes that technological progress and economic development are one and the same; if there is no technological progress, economic development cannot occur. (Tohsa, 2005)

Schumpeter (1934), an authority on innovative business strategy, created the theory of Creative Destruction with the idea that entrepreneurs must find ways to use innovative technology in the production process, service, or the innovation of a new product to create business benefits for an organization. Specifically, innovation can make the organization profitable as a monopoly and gain a competitive advantage, but there may also be investors who try to copy other people's technology or modify and develop it further, creating new innovations all the time. (Aujirapongpan et al., 2010; Santipholwut, 2015).

Romer (1986) and Lucas (1988) emphasised that technological progress is not an external factor but an internal factor that affects economic growth. It is necessary to spend on research and development to acquire new knowledge because it is an important driver of growth and helps raise the level of production (Wangsukij, 1996).

The rate at which technology is catching up is influenced by external factors, such as foreign direct investment and research and development expenses. Additionally, social capability factors act as policy determinants, while educational factors foster the development of skilled workers' expertise, facilitating their learning of the production process. As a result, each factor contributes to an increase in total output and the development of technology (Wangsukij, 1996). Promoting investment in establishments has a very important effect on increasing productivity. This is an incentive for private investors, both domestic and foreign, to be interested in investing and moving production bases. Imports of modern machinery and large amounts of money flow into the country, causing its GDP to increase (Rattanakiyont, 2015).

Macroeconomic factors include the exchange rate, basic GDP, and Lao trade value, which determines the direct investment from Thailand to the Lao People's Democratic Republic. The government of the Lao People's Democratic Republic should reduce barriers to international trade. There are measures to stimulate strong economic development and reduce investment barriers for Thai investors in exchange for assistance in improving production efficiency and training in labor skills from experts in Thailand (Wattanakul and Watchalaanun, 2016).

Technological changes have a positive impact on Thailand's economic growth, not only for the overall economy but also for each production sector. Changes in technology cause output to increase at different rates in various fields of production. For example, the number of workers with a high school education and above has a positive influence on technological change. In contrast, direct investment from abroad and research and development costs have a negative influence on technological change for the overall economic sector as well as most

production sectors. In addition, technological change is measured by the value of machinery and equipment used in research and development. (Tohsa, 2005; as cited in Kasrisom).

Research Methodology

Upon reviewing the concepts, theories, and various related research, the concept applied in this study aligns with the stated objectives, as shown in Figure 1.

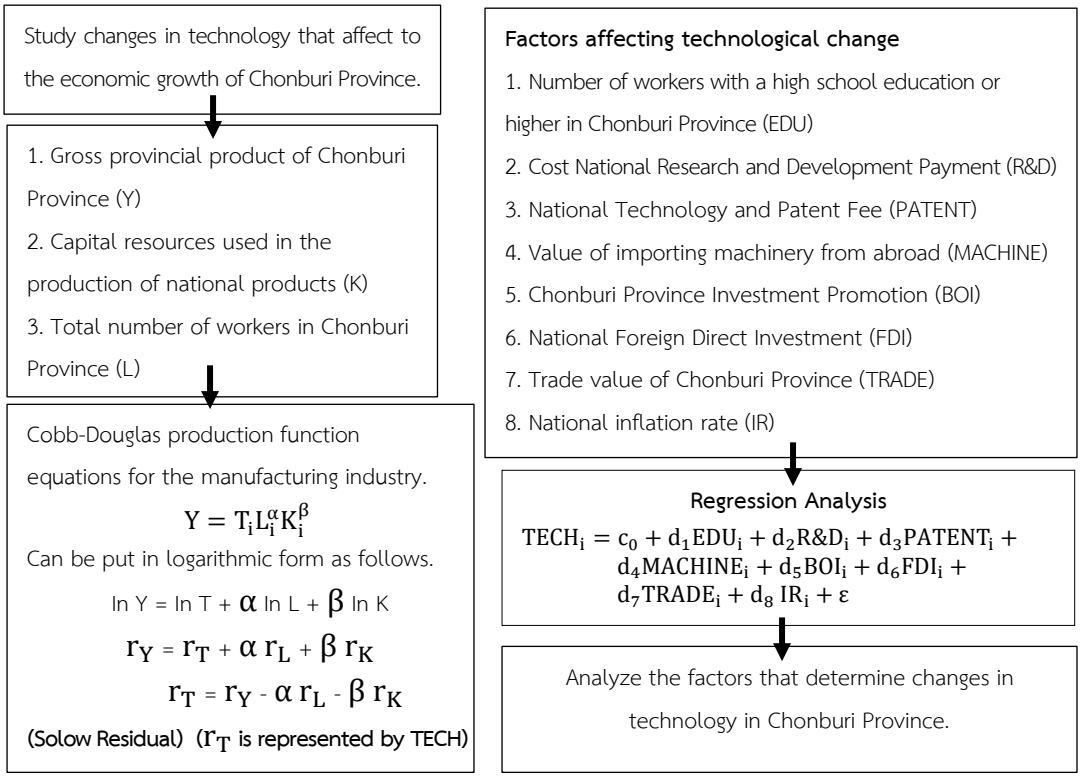

Figure 1 Conceptual Framework

Source: Author's Study

From the research concept, the production function is set in the form of the following natural logarithm:

$$Y = TL^{\alpha}K^{\beta} \quad (1)$$

Where

Y is the gross provincial product of Chonburi Province (million baht)

T is the technology used in production

K is the capital assets used in production in Chonburi Province (million baht)

L is the total labor force used in producing products in Chonburi Province (people)

α is the elasticity of output with respect to labor

β is the elasticity of output with respect to capital

The changes in technology affecting the economic growth of Chonburi Province in the manufacturing industry are for each production sector, as shown in Equation 2.

$$Y_i = T_i L_i^{\alpha} K_i^{\beta} \quad (2)$$

From Equation (2), it can be in logarithmic form as follows.

$$\text{In } Y = \text{In } T + \alpha \text{ In } L + \beta \text{ In } K \quad (3)$$

Find the derivative of Equation (3) with respect to time.

$$\frac{1}{Y}\frac{dY}{dt} = \frac{1}{T}\frac{dT}{dt} + \alpha\frac{1}{L}\frac{dL}{dt} + \beta\frac{1}{K}\frac{dK}{dt} \quad (4)$$

when giving $\frac{dY}{dt} = \dot{Y}$, $\frac{dT}{dt} = \dot{L}$, $\frac{dK}{dt} = \dot{K}$ will get

$$\frac{\dot{Y}}{Y} = \frac{\dot{T}}{T} + \alpha\frac{\dot{L}}{L} + \beta\frac{\dot{K}}{K} \quad \text{or} \quad \frac{\Delta Y}{Y} = \frac{\Delta T}{T} + \alpha\frac{\Delta L}{L} + \beta\frac{\Delta K}{K} \quad (5)$$

or

$$r_Y = r_T + \alpha\, r_L + \beta\, r_K \quad (6)$$

$$r_T = r_Y - \alpha\, r_L - \beta\, r_K \quad (7)$$

Where

r_Y is the rate of change in output or total income of Chonburi Province ($\Delta Y/Y$)

r_T is the rate of change in technology and other factors besides L and K of Chonburi Province, also known as "Solow's Residual" ($\Delta T/T$)

r_L is the labor change rate ($\Delta L/L$) of Chonburi Province

r_K is the capital change rate ($\Delta K/K$) of Chonburi Province

From Equation (1), when α and β are known through the least squares analysis technique, then substitute the values obtained in Equation (7) to measure the rate of technological change affecting the output of the overall economic sector and output of the production sector. Given the known rate of change in total output or the output in each branch of production (r_Y), the rate of change in the number of workers (r_L), and the rate of change in capital (r_K) in both the overall economic system and each production sector in Chonburi Province, it is possible to calculate the rate of technological change (r_T) for the province. In terms of analyzing the factors determining technological changes in Chonburi Province, econometric models can be used in the complex multiple regressive equations as follows.

In terms of analyzing the factors determining the technological changes in Chonburi Province, econometric models can be used in the complex multiple regressive equation as follows.

To find the rate of technological change in Chonburi Province (TECH), the value from Equation (7) is the rate of change in technology and other factors. In addition to the number of workers (L), capital resources (K) or "Solow's Residual" ($\Delta T/T$) or r_T

$$TECH = a_0 + b_1 EUD + b_2 R\&D + b_3 PATENT + b_4 MACHINE + b_5 BOI + b_6 FDI + b_7 TRADE + b_8 IR + \varepsilon \quad (8)$$

and in the model section for each production industry group in the complex multiple regressive equations

$$TECH_i = c_0 + d_1 EUD_i + d_2 R\&D_i + d_3 PATENT_i + d_4 MACHINE_i + d_5 BOI_i + d_6 FDI_i + d_7 TRADE_i + d_8 IR_i + \varepsilon \quad (9)$$

Where

TECH is the rate of change in technology and other factors or r_T in Equation (7)

EUD is the number of workers with a high school education or higher in Chonburi Province (people)

R&D is the national research and development expenditure (million baht)

PATENT is the national technology and patent fee (million baht)

MACHINE is the national value of machinery imported from abroad (million baht)

BOI is investment promotion in Chonburi Province (million baht)

FDI is foreign direct investment at the national level (million baht)

TRADE is the trade value of Chonburi Province (million baht)

IR is the national inflation rate (IR)

a_0, c_0 are constant values

$b_1, b_2, \ldots, b_8$ are coefficients

$d_1, d_2, \ldots, d_8$ are coefficients

i is each production sector

ε is the error that cannot be explained by the regression equation

Data Collection: Relevant secondary data sources were obtained from various agencies such as the National Economic and Social Development Board, Bank of Thailand, National Statistical Office, Research Policy and Planning Division, National Research Council of Thailand, Trade Economic Information Center, Department of International Trade Negotiations (Department of Commercial Economics), Chonburi Provincial Statistical Office, Chonburi Provincial Treasury Office, Laem Chabang Port Customs, and Map Ta Phut Customs House.

Data Analysis: The analysis was divided into two parts: descriptive analysis and quantitative analysis, with two objectives. The first objective is to study the changes in technology affecting the economic growth of Chonburi Province by determining the production function using a natural logarithm and Ordinary Least Squares (OLS) analysis. The other is to analyze the factors determining the technological changes in Chonburi Province and the function of technology due to various factors in the model using econometrics, the complex multiple regression equation (complex multiple regression), and the data for the period from 1993–2022 to encompass the various crises that occurred during the period under study. The dummy variables in the equation are: Tom Yum Kung crisis, Thailand's Great Flood of 2011, Hamburger Crisis, and COVID-19 pandemic.

Results

1. According to 1st objective: to study the technological changes in Chonburi Province affecting its economy

From Table 1, the complex multiple correlation values ($\mathbf{R^2}$) for the overall economic sector reveal that the capital stock used in the production of goods in Chonburi Province (K) and the total number of labors used in the production of goods in Chonburi Province (L) can explain the change in the GDP of Chonburi Province at 98.8401%, with statistical significance at the 99% confidence level. The section on production explains the change in the GDP in each sector. The best production sector in Chonburi Province is commerce, followed by service, utilities and sanitation, warehouse transit and transportation, handicraft industry, metal and non-metallic mining, agriculture and forestry, hunting and fishery, and finally, construction-repair and demolition, respectively. All these have a statistically significant relationship at the 99% confidence level for all variables. Durbin-Watson (DW) values fall into the range where the tolerance value has no relationship with ego (autocorrelation).

An analysis of the production function in Chonburi Province revealed that the change in output value can be explained by the capital factors used in production. Furthermore, the number of workers used in production in Chonburi Province is more than 90%, demonstrating that the production factors can appropriately explain changes in output. When considering the coefficient of production factors in the application of capital factors for the production of goods and the number of workers used in production, the production of the overall economic sector was found to be affected. The factor of capital resources used in the production of goods in Chonburi Province was higher than the number of labor units used in the production of goods.

Furthermore, the production sector was found to have a coefficient of production factors in the application of capital factors. The capital used in production in Chonburi Province is higher than the number of labor units used in production in Chonburi Province for the following sectors: utilities and sanitation, warehouse transit and transportation, handicraft industry, metal and non-metallic mining, agriculture and forestry, hunting and fishery, and construction-repair and demolition. It follows the Lucas concept (Tohsa, 2005) in that the capital and labor factors result in long-term economic growth and the concept proposed by Adam Smith (Wangsukij, 1996) whereby capital and labor factors are important in allowing the expansion of the economic system. Changes in capital and labor factors were found to have an impact on GDP and the commerce sector, while the number of labor units used in production in Chonburi Province was higher than the factor of capital supplies used in the production of products because the number of workers plays a more important role in increasing the productivity of the commerce sector than capital products.

Table 1 Analysis of Factors Affecting the Growth of the Overall Economic Sector and Each Production Sector in Chonburi Province

Constant/ Independent Variable	Regression Coefficient				
	Overall economic sector	**Agriculture and forestry, hunting and fishery sector**	**Metal and non-metallic mining sector**	**Handicraft industry sector**	**Construction-repair and demolition sector**
Constant	-24.5303	-2.7408	-13.1394	6.9813	-8.3147
	(-4.3891)	(2.1831)	(-7.8930)***	(0.7211)	(-1.8661)*
K	2.0784	0.7528	1.5687	0.5719	1.2835
	(5.2792)*	(7.6524) ***	(12.3268)***	(1.4812)*	(3.8983)***
L	0.1317	0.1029	0.0060	-0.0391	0.0094
	(0.6678)	(0.9220)	(0.1945)	(-0.5014)	(0.0518)
R^2	0.9884	0.9051	0.9440	0.9704	0.9020
Adjusted R^2	0.9848	0.9076	0.9341	0.9668	0.9010
F	710.0939***	51.2272***	95.6135***	273.2630***	31.0379***
D.W.	1.9705	2.0792	2.2371	1.5158	2.1226
N	30	30	30	30	30

Table 1 (Continued)

Constant/ Independent Variable	Regression Coefficient			
	Utilities and sanitation sector	**Warehouse transit and transportation sector**	**Commerce sector**	**Service sector**
Constant	9.0186	-15.5110	11.6339	-3.2637
	(0.6533)	(-3.5191)***	(2.5625)	(-0.4132)
K	0.1465	1.5846	-0.0693	0.9647
	(0.1612)	(5.4904)***	(-0.2548)	(2.0602)*
L	-0.0254	0.1449	0.1086	0.0187
	(-0.5614)	(1.1465)	(1.3686)*	(0.1520)
R^2	0.9732	0.9727	0.9841	0.9808
Adjusted R^2	0.9700	0.9681	0.9822	0.97766
F	303.6588***	213.8019***	517.2623***	306.8981***
D.W.	1.6991	1.6155	1.5770	1.5192
N	30	30	30	30

Note: Numbers in parentheses are t-statistics values.

***, **, * is statistical significance at the 99, 95, and 90 percent confidence levels, respectively.

Source: Author's Calculation

When considering the overall economic sector and most production sectors, it was found that the factor having the greatest influence on the level of output was the capital resources used in the production of goods in Chonburi Province, followed by the number of labor units used in production. In other words, the capital factors used in the production of goods make a greater contribution to the rise in productivity of the overall economic sector and every branch of production than the number of workers used in production. Moreover, an increase in the capital factors used in the production of goods results in a rise in the productivity of Chonburi Province according to the concept of Solow (Tohsa, 2005; Santipholwut, 2015; Wangsukij, 1996) in that the evaluation of the coefficient contributes to economic growth so the value of all output depends on both capital and labor factors.

In Table 2, the rate of technological change is analyzed using Equation (7) with Solow's Residual value of the output from the overall economic sector and each production sector. The rate of technological change in the overall economic sector was revealed to be 0.0142 in the

positive direction, while the production sector exhibited the highest rate of technological change. The rate of change for the utilities and sanitation sector was 0.1229, followed by commerce, handicraft industry, service, warehouse transit and transportation, agriculture and forestry, hunting and fishery and metal and non-metallic mining sectors, technological change rates equal to 0.0831, 0.0575, 0.0394, 0.0289, 0.0180 and 0.0092, respectively. This demonstrates the rate of change in technology in the positive direction, causing the output to increase in different ratios according to the particular production sector (Petprasert, 2003; Aujirapongpan et al., 2010). The construction-repair and demolition sector exhibited a rate of change in the negative direction equal to -0.0264. This shows that changes in technology or its continued use affected the output of each production sector.

Table 2 Analysis Results Showing the Rate of Change in Technology and Its Effect on the Output of the Overall Economic Sector and Each Production Sector from 1993 to 2022.

Production Sectors	Rate of change in labor	Rate of change in capital	Rate of change in technology
Overall economic sector	0.0792	0.0233	0.0142
Agriculture and forestry, hunting and fishery sector	-0.0081	0.0431	0.0180
Metal and non-metallic mining sector	0.4165	0.0493	0.0092
Handicraft industry sector	0.0717	0.0494	0.0575
Construction-repair and demolition sector	0.0322	0.0498	-0.0264
Utilities and sanitation sector	0.2674	0.0459	0.1229
Warehouse transit and transportation sector	0.0375	0.0430	0.0289
Commerce sector	0.0803	0.0068	0.0831
Service sector	0.0253	0.0304	0.0394

Note: Equation (7) the rate of change in technology and other factors besides L and K of Chonburi Province, also known as “Solow’s Residual” ($\Delta T/T$)

Source: Author’s Calculation

2. According to 2nd objective: to analyze the factors determining the technological changes in Chonburi Province

From Table 3, the analysis results for the factors determining the technological change in Chonburi Province as a whole revealed that it had a positive influence on the following: the number of workers with an upper and lower secondary school education, national research and development expenses and national direct foreign investment. Factors with a negative influence

on technological change included the value of machinery imported from abroad at the national level, investment promotion of Chonburi Province, national technology and patent fees, trade value of Chonburi Province and the national inflation rate. As for the factors having both a positive and negative influence on technological change in each production sector, the findings reveal that the number of workers with lower and upper levels of secondary school education in Chonburi Province experienced technological change in a positive direction in the metal and non-metallic mining, handicraft industry, and warehouse transit and transportation. In other words, if the number of workers with a high school or higher education level increases, this results in a corresponding rise in the rate of technological change, according to Robert Solow (1957) (Santipholwut, 2015; Wangsukij, 1996). Furthermore, a rise in the level of education results in an increase in the level of technological development and an expansion of production both in the economic sector overall and the production sector (Tohsa, 2005). In contrast, the following sectors experienced a negative effect from technological change: construction- repair and demolition, utilities and sanitation and service. And the sectors that do not analyze number of workers with a high school education or higher in Chonburi Province in the model: agriculture and forestry, hunting and fishery, and commerce.

The national research and development expenses exhibiting technological change in a positive direction included agriculture and forestry, hunting and fishery, metal and non-metallic mining, handicraft industry, and utilities and sanitation. In other words, increased research and development costs cause a rise in the rate of technological change according to the idea proposed by Joseph Schumpeter (1934) (Aujirapongpan et al., 2010; Santipholwut, 2015) that technological progress occurs continuously with investment in research and development. The findings of this current study reveal that technology is determined by the internal factors arising from research and development expenditure (Wangsukij, 1996). The sectors negatively affected by technological change include construction-repair and demolition, warehouse transit and transportation, commerce, and service.

The national technology and patent fees were positively affected by technological change in the following sectors: agriculture and forestry, hunting and fishery, utilities and sanitation, warehouse transit and transportation, and service. In other words, as the number of patents increases, so does the rate of technological change according to the concept of Clarence Ayres (1883) (Tohsa, 2005), who found that technological change results from scientific discovery, research, experimentation, and innovation. The sectors negatively affected by technological change include construction- repair and demolition. And the sectors that do not analyze

national technology and patent fees in the model: metal and non-metallic mining, handicraft industry, and commerce.

The value of machinery imported from abroad at the national level is positively affected by technological change in the following sectors: service sectors. In other words, as the value of machinery imported from abroad increases so does the rate of technological change. The application of technology in other areas relies on the ability to bring technological knowledge, innovation, machinery, and production techniques from foreign countries and apply them to local conditions, according to the research conducted by Janya Tohsa (2005). In contrast, the utilities and sanitation sectors, are negatively affected by technological change. And the sectors that do not analyze value of machinery imported from abroad at the national level in the model: agriculture and forestry, as well as hunting and fishery, metal and non-metallic mining, handicraft industry, construction-repair and demolition, warehouse transit and transportation, commerce, and service.

The promotion of investment in Chonburi Province is positively affected by technological change in the following sectors: construction- repair and demolition, utilities and sanitation, commerce, and service. In other words, increasing investment in promotion results in an increase in the rate of technological change. Thawatchai Rattanakiyont (2015) found that investment promotion is a very important incentive for private sector investors both nationally and internationally, especially with the movement of production bases. Importing modern machine tools causes a rise in GDP (Rattanakiyont, 2015). The sectors negatively affected by technological change include agriculture and forestry, hunting and fishery, metal and non-metallic mining, and Handicraft industry. And the sectors that do not analyze promotion of investment in Chonburi Province in the model: warehouse transit and transportation sector.

Foreign direct investment at the national level is positively affected by technological change in the following sectors: handicraft industry, construction-repair and destruction, and Utilities and sanitation. In other words, an increase in foreign direct investment at the national level results in a rise in the rate of technological change. According to Joseph Schumpeter (1934) (Aujirapongpan et al., 2010; Santipholwut, 2015), international research, development, and the diffusion of technology takes the form of trade and foreign direct investment. New innovations are being invented and developed all the time by entrepreneurs, according to the research by Chaiyawut Wangsukij (1996). Sectors negatively affected by technological change include metal and non-metallic mining, warehouse transit and transportation, and commerce. And the sectors

that do not analyze foreign direct investment at the national level in the model: Agriculture and forestry, hunting and fishery and Service.

The trade value of Chonburi Province is positively affected by technological change in the following sectors: construction- repair and demolition, utilities and sanitation, commerce, and service. According to the concept of Joseph Schumpeter (1934) (Aujirapongpan et al., 2010; Santipholwut, 2015), international trade increases technological development. Copying occurs in order to modify and invent new innovations, including their application in the production process. This accords with the research by Thanet Wattanakul and Thanawat Watchalaanun (2016), who found that trade value has an effect on domestic investment and the development of technology within the country (Wattanakul and Watchalaanun, 2016). The sectors negatively affected by technological change direction include the handicraft industry sector. And the sectors that do not analyze trade value of Chonburi Province in the model: agriculture and forestry, hunting and fishery, metal and non-metallic mining, and warehouse transit and transportation.

The national inflation rates are positively affected by technological change in the following sectors: agriculture and forestry, hunting and fishery, utilities and sanitation, warehouse transit and transportation, and commerce. In contrast, the sectors negatively affected by technological change include metal and non-metallic mining, handicraft industry, utilities and sanitation, and construction- repair and demolition. In other words, inflation affects economic growth through Keynes' Macroeconomics model as well as technological changes. When inflation decreases, the rate of technological changes increases, resulting in increased productivity as well (Mali, 2015). And the sectors that do not analyze national inflation rates in the model: Service sector.

Table 3 Analysis of Factors that Determine Technological Change in the Overall Economic Sector and Each Production Sector in Chonburi Province.

Constant/ Independent Variables	Regression Coefficient				
	Overall economic sector	Agriculture and forestry, hunting and fishery sector	Metal and non-metallic mining sector	Handicraft industry sector	Construction-repair and demolition sector
Constant	58.0058	-9.4150	24.4084	-2.0535	41.830
	(2.2946)*	(-0.8196)	(2.2264)*	(-0.3914)	(1.9220)
EDU	1.1757	N/A	0.0858	1.7595	-5.9082
	(1.3901)	(N/A)	(0.4047)	(2.7648)**	(-3.4469)**
R&D	2.1668	0.0042	0.9893	0.2867	-0.4538
	(2.9135)**	(0.0145)	(2.6537)**	(1.3081)	(-0.6646)
PATENT	-2.2602	1.1423	N/A	N/A	-3.0658
	(-2.1555)*	(1.7672)*	(N/A)	(N/A)	(-1.5833)
MACHINE	-2.2620	N/A	N/A	N/A	N/A
	(-0.9791)	(N/A)	(N/A)	(N/A)	(N/A)
BOI	-2.2699	-0.5497	-2.1633	-0.8669	3.0787
	(-2.5366)**	(-0.6654)	(-2.6610)	(-3.0181)***	(2.1995)*
FDI	0.9191	N/A	-1.1284	0.0564	1.7074
	(1.1996)	(N/A)	(-2.1609)*	(0.1921)	(2.7789)**
TRADE	-2.1013	N/A	N/A	-1.0489	0.0716
	(-3.3670)**	(N/A)	(N/A)	(-4.4543)***	(0.1284)
IR	-0.8896	0.2810	-0.6485	-0.3542	-0.1110
	(-2.7436)**	(1.3572)	(-2.1408)*	(-1.9989)*	(-0.2098)
R^2	0.8285	0.5263	0.7220	0.7751	0.8472
Adjusted R^2	0.5713	0.3109	0.3885	0.6178	0.6027
F	3.2216***	2.4443***	2.1652***	4.9257***	3.4657***
D.W.	2.2928	2.4953	2.2147	2.4722	2.3692
N	30	30	30	30	30

Table 3 (Continued)

Constant/ Independent Variables	Regression Coefficient			
	Utilities and sanitation sector	Warehouse transit and transportation sector	Commerce sector	Service sector
Constant	-10.1938	-60.8292	-7.4829	-2.1456
	(-1.0265)	(-2.1983)*	(-2.0294)*	(-2.5814)**
EDU	-1.1544	2.9548	N/A	-0.0257
	(-2.0055)*	(-1.8888)	(N/A)	(-0.4064)
R&D	0.0164	-1.7162*	-0.4729	-0.0985
	(0.0422)	(-2.1704)	(-2.7963)***	(-4.1386)***
PATENT	0.6245	5.4794	N/A	0.0989
	(0.7764)	(2.3646)**	(N/A)	(1.7743)*
MACHINE	-1.5720	N/A	N/A	0.0617
	(-2.3244)**	(N/A)	(N/A)	(1.0946)
BOI	1.3879	N/A	0.5686	0.0474
	(2.6631)**	(N/A)	(1.9340)*	(1.3041)
FDI	0.8123	-1.9356	-0.1258	N/A
	(2.5927)**	(-2.2692)**	(-7.096)	(N/A)
TRADE	0.4015	N/A	0.3576	0.0791
	(1.0945)	(N/A)	(1.5996)*	(2.2418)**
IR	0.0583	0.7040	0.2881	N/A
	(0.2205)	(1.9706)*	(1.7813)*	(N/A)
R^2	0.7517	0.6376	0.6817	0.5336
Adjusted R^2	0.5655	0.3658	0.5543	0.35970
F	4.0347***	2.3460***	5.3544***	3.5970***
D.W.	2.4092	2.1580	2.3041	2.4461
N	30	30	30	30

Note: 1. Numbers in parentheses are t-statistics values.

2. ***, **, * is statistical significance at the 99, 95, and 90 percent confidence levels, respectively.

3. N/A means that the variable is not included in the model.

Source: Author's Calculation

Discussion

When analyzing the rate of technological change with Solow's Residual output value of the overall economic sector and each production sector, the rate of technological change in the overall economic sector was found to be in the positive direction, with the production branch having the highest rate of technological change. The utilities and sanitation sector exhibited the highest rate of change, followed by commerce, handicraft industry, service, warehouse transit and transportation, agriculture and forestry, hunting and fishery, and metal and non-metallic mining sectors, respectively. This results in the rate of change in technology being in a positive direction, causing output to increase in different ratios according to the production sector. The construction-repair and demolition sector experienced a rate of change in the negative direction. This demonstrates that changes in technology or its continued use decrease the output of each production branch.

The results of the study revealed that changes in technology affected the economic growth of Chonburi Province. The whole economic sector and each production sector tend to have the greatest influence on the level of output. Capital resources used in the production of goods were found to have the greatest influence, followed by the number of labor units used in the production of goods. In addition, the overall economic sector and each production sector use more resources in producing goods than the labor units used in production.

The analysis of factors determining technological change revealed that the effects of technological change were different for each production branch, but the overall economic sector and most production sectors used national research and development expenditure at the national level, demonstrating a relationship mostly in the same direction. Since Chonburi Province has numerous establishments and industrial estates, it is a significant production base for export and trade within the country. The national research and development expenditure has increased, resulting in Chonburi Province receiving modern technology to improve and develop production techniques, including the ability to produce. Therefore, this results in the level of technology increasing and investment promotion in Chonburi Province having the most negative relationship with both the overall economic sector and production sector. In other words, as investment promotion in Chonburi Province increases, the rate of technological change is likely to decrease. This shows that the investment promotion of Chonburi Province does not covertly come in the form of technology. Chonburi is one of three provinces that have been developed in the Eastern Special Development Zone. It has therefore been determined that the automotive, electronic, construction, logistics, food processing, and petrochemical and plastics industries in the area of Amata Nakorn Industrial Estate, Laem Chabang Industry, and

Amata City Chonburi Industrial Estate have the highest growth potential for becoming the main industrial center of the country.

Suggestions

Suggestions for Application of the Research Results: The analysis of technological change in Chonburi Province shows that the lowest rate of change was experienced by the construction-repair and destruction sector in a negative direction. This sector was found to have had no development in technology, innovation, or new inventions to help increase its productivity. Instead, capital and labor factors were used as the main determinants. The government should support the development, innovation, and research or study the technology from abroad. To enhance productivity, reduce time, and increase efficiency in the industrial sector, financial support, tax assistance, or investment promotion should be provided.

Analysis of the factors involved in technological change revealed that greater attention should be paid to workers with higher education since this is important for improving and developing production techniques. Improving the production process and inventing new technology would increase the value of products in the overall economic sector and each production sector. In addition, technological changes in the agriculture and forestry, hunting, and fishery sectors have helped to improve production techniques. Greater attention should be paid to developing these sectors because they represent the original production base of Chonburi Province. Moreover, Chonburi Province is also a coastal city with abundant natural resources and an environment of plants and fruits. Consequently, there are more workers in agriculture, forestry, hunting, and fishing than in all production sectors. In addition, the handicraft industry is the most important for adding to the production value of Chonburi Province. Benefits should be provided to encourage foreign direct investment and support domestic entrepreneurs in Chonburi Province through strong investment promotion. Such investment should include the provision of facilities for doing business, various infrastructure and utilities for doing business, and pushing investment in the area, allowing it to spread into other sections of the original production base to drive the economic mechanism to improve the future of Chonburi Province.

Suggestions for Further Research: Further research should include the study of technological changes and their effect on the overall economic growth of the Eastern region, including the factors determining such change. These could include research and development costs, technology and patent fees, the value of importing machinery from abroad, foreign direct investment, and inflation. Since some of these factors involve national data, if the information is stored at the provincial level, the analysis results would be more comprehensive.

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