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Two-Stage Inequality Decomposition Analysis of Thailand's Spatial Economy, 1995 - 2015

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ABSTRACT

This study analyzed spatial economic inequality in Thailand over period from1995 to 2015 using two-stage inequality decomposition analysis to divide the levels of spatial inequality into between-region inequality, between-provincial cluster inequality and within-provincial cluster inequality. The analysis showed that overall inequality decreased, particularly since 2007, which was performed by the declination of between-region inequality. On the other hand, between-provincial cluster inequality increased, meaning inequality also occurs when the trend of overall inequality moves downward. This situation reflects the spatial agglomeration of economic activities, which is also found in the level of within-provincial cluster inequality. For these reasons, future spatial economic development policies should deeply emphasize development at the levels of provincial clusters and provinces as well as integrate with other perspectives of development.

Keywords: Economic inequality, Spatial development, Two-stage inequality decomposition analysis
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Introduction

Economic inequality is one of the crucial issues mentioned in the 20-Year National Strategy (2017-2036), which has been due to continuous Thai economic development usually giving priority to rapid growth over appropriate distribution. However, growth alone is incapable of diffusing economic welfare for the efficient elevation of quality of life for all people, resulting in unbalanced development and economic inequality. This also directly affects economic problems and other social issues.

Inequality is often represented as the disparity between groups of people and production factors. However, there is another major issue in terms of the inequality of spatial economy, which focuses on the difference between economic return in different areas. Studies in Thailand have demonstrated this issue in the aspect of inequality between urban and rural areas, provinces, and other regions (Sarntisart, 2000; Tinakorn, 2002; Wisaweisun, 2009; Limpanonda, 2012; Preechametta, 2016).

In considering the decomposition system of Thailand's spatial structure, it was also found thatthe Royal Decree on Integrated Provincial and Clustering Development B.E. 2551 (2008) has divided the country into 18 provincial clusters since 2008. Research on spatial inequality would be more interesting, especially in terms of in-depth analysis of provincial clusters. Therefore, this study focused on a two-stage inequality decomposition analysis that divides areas into regions, further divides regions into provincial clusters, and clusters divided into provinces. As a consequence, 3 inequality levels can be detailed as follows: between-region inequality, between-provincial cluster inequality, and within-provincial cluster inequality.

Data and Analysis

Analysis: Regional Two-Stage Inequality Decomposition Analysis

In this analysis, the structure of Thailand's regional system divides the country into regions, with regions divided into provincial clusters, and provincial clusters into provinces. To accomplish this, Two-Stage Theil Decomposition Analysis was selected (Akita, 2000, p. 4) as its equation can evaluate overall regional inequality, expressed as follows:

$$T_d = \sum_i \sum_j \sum_k \left(\frac{y_{ijk}}{Y}\right) \log\left(\frac{y_{ijk}/Y}{n_{ijk}/N}\right) \qquad (1)$$

Where
- T_d = the whole nation inequality index
- y_{ijk} = income of province k in provincial cluster j and region i
- Y = total income of all provinces
- n_{ijk} = population of province k in provincial cluster j and region i
- N = total population of all provinces

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T_{di} is the indicator of provincial inequality in region i with the equation as follows:

$$T_{di} = \sum_j \sum_k \left(\frac{y_{ijk}}{Y_i}\right) \log \left(\frac{y_{ijk}/Y}{n_{ijk}/N}\right) \qquad (2)$$

Therefore, T_d in Equation (1) can be separated as follows:

$$\begin{aligned} T_d &= \sum_i \left(\frac{Y_i}{Y}\right) T_{di} + \sum_i \left(\frac{Y_i}{Y}\right) \log \left(\frac{Y_i/Y}{N_i/N}\right) \\ &= \sum_i \left(\frac{Y_i}{Y}\right) T_{di} + T_{BR} \qquad (3) \\ &= T_{WR} + T_{BR} \end{aligned}$$

Where
$\quad Y_i \quad = \quad$ total income of region i
$\quad N_i \quad = \quad$ population of region i
$\quad T_{WR} = \quad$ within-region inequality index
$\quad T_{BR} = \quad$ between-region inequality index

From Equation (3), it is possible to observe that within-country inequality index (T_d) is the sum of within-region inequality index (T_{WR}) and between-region inequality index (T_{BR}). This equation is called a One-stage Inequality Decomposition equation.

Set T_{ij} as within-provincial cluster inequality of provincial cluster j in region i as follows:

$$T_{ij} = \sum_k \left(\frac{y_{ijk}}{Y_{ij}}\right) \log \left(\frac{y_{ijk}/Y_{ij}}{n_{ijk}/N_{ij}}\right) \qquad (4)$$

Therefore, T_{di} in Equation (2) can be divided into:

$$\begin{aligned} T_{di} &= \sum_j \left(\frac{Y_{ij}}{Y_i}\right) T_{ij} + \sum_j \left(\frac{Y_{ij}}{Y_i}\right) \log \left(\frac{Y_{ij}/Y_i}{N_{ij}/N_i}\right) \\ &= \sum_j \left(\frac{Y_{ij}}{Y_i}\right) T_{ij} + T_{pi} \qquad (5) \end{aligned}$$

Where
$\quad Y_{ij} \quad = \quad$ total income of provincial cluster j in region i
$\quad N_i \quad = \quad$ population in provincial cluster j in region i
$\quad T_{pi} \quad = \quad$ between-provincial cluster inequality index

Replace T_{di} from Equation (5) in Equation (3) as follows:

$$
\begin{aligned}
T_d &= \sum_i \left(\frac{Y_i}{Y}\right) \left[\sum_j \left(\frac{Y_{ij}}{Y_i}\right) T_{ij} + T_{pi} \right] + \sum_i \left(\frac{Y_i}{Y}\right) \log \left(\frac{Y_i/Y}{N_i/N} \right) \\
&= \sum_i \sum_j \left(\frac{Y_{ij}}{Y}\right) T_{ij} + \sum_i \left(\frac{Y_i}{Y}\right) T_{pi} + \sum_i \left(\frac{Y_i}{Y}\right) \log \left(\frac{Y_i/Y}{N_i/N} \right) \\
&= T_{WS} + T_{BS} + T_{BR}
\end{aligned} \tag{6}
$$

Equation (6) is a two-stage inequality decomposition equation, whereas, within-country inequality can be divided into within-provincial cluster inequality (T_{WS}), between-provincial cluster inequality (T_{BS}), and between-region inequality (T_{BR}).

For the range of Theil index, it can be considered from 2 cases including (1) perfect equity, when every province and every region has perfectly equal populations and incomes that $Y_{ij} = Y_i = Y$ และ$N_{ij} = N_i = N$, resulting in the term log of every equation remaining zero and $T_d = T_{WS} = T_{BS} = T_{BR} = 0$. In this case, it means the inexistence of inequality. For the second case, (2) perfect inequality is when income shows a cluster in some specific areas of any region ($Y_i = Y$), while other areas or other regions have no revenue sharing, resulting in $T_d = T_{BR} = \log(1/(N_i/N))$. However, it is nearly impossible after the evidence-based analysis for this case. According to the Theil index, it demonstrates inequality when the result is greater than zero. This value means an increase of inequality.

Data for Analysis

Spatial Data

The structure of Thailand's regional system in this study is in accordance with the Royal Decree on Integrated Provincial and Clustering Development B.E. 2551 (2008). Details are provided in Table 1.

Table 1. *Structure of Thailand's Regional System*

Region	Provincial Cluster	Province
North eastern region	Upper provincial cluster 1	Udon Thani, Nong Bua Lam Phu, Nong Khai, Loei, and Bueng Kan
	Upper provincial cluster 2	Mukdahan, Nakhon Phanom, and Sakon Nakhon,
	Central provincial cluster	Khon Kaen, Kalasin, Roi Et, and Maha Sarakham
	Lower provincial cluster 1	Nakhon Ratchasima, Chaiyaphum, Burirum, and Surin
	Lower provincial cluster 2	Ubon Ratchathani, Si Sa Ket, Amnat Charoen, and Yasothon
Northern region	Upper provincial cluster 1	Chiang Mai, Lampang, Mae Hong Son, and Lamphun
	Upper provincial cluster 2	Chiang Rai, Prae, Nan, and Phayao
	Lower provincial cluster 1	Uttaradit, Phitsanulok, Sukhothai, Tak, and Petchabun
	Lower provincial cluster 2	Nakhon Sawan, Kamphaeng Pet, Uthai Thani, and Phichit
Southern region	Gulf of Thailand cluster	Surat Thani, Ranong, Chumphon, Nakhon Si Thammarat, and Phatthalung
	Andaman cluster	Phuket, Ranong, Phang-Nga, Krabi and Trang
	Border cluster	Songkhla, Satun, Yala, Narathiwat, and Pattani
Central region	Upper provincial cluster 1	Nonthaburi, Pathum Thani, Ayutthaya, and Saraburi
	Upper provincial cluster 2	Chai Nat, Lop Buri, Sing Buri, and Ang Thong
	Central provincial cluster	Chachoengsao, Nakhon Nayok, Prachin Buri, Samut Prakan, and Sa Kaeo
	Lower provincial cluster 1	Kanchanaburi, Nakhon Prathom, Ratchaburi, and Suphanburi
	Lower provincial cluster 2	Prachuap Khiri Khan, Petchburi, Samut Songkhram, and Samut Khon
	Eastern provincial cluster	Chantaburi, Chonburi, Trat, and Rayong

Note: The eastern provincial cluster needs to be contained in the central region because the eastern region has no division that does not allow two-stage inequality decomposition analysis.

Economic and Demographic Data

For the income data of every province, provincial cluster, and region, the study used Gross Provincial Product, Gross Provincial Cluster Product, and Gross Regional Product from the Office of National Economic and Social Development Board from 1995 to 2015, or 20 years, to examine long-term spatial inequality.

For demographic data, the study used the annual demographic data of every province from the Department Of Provincial Administration, Ministry of Interior, during the same period.

## Regional Economic Inequality of Thailand

Overview of Inequality

The overview of Thailand's inequality (Table 2 and Figure 1) shows unstable characteristics and shifts according to changing in the economy. Nonetheless, inequality can be grouped into 4 major durations, which are: (1) the decrease during 1995-1998, from 0.2036 to 0.1913; (2) the increase during 1998-2007, from 0.1913 to 0.2345; (3) the decrease during 2007-2013, from 0.2345 to 0.1843; (4) the increase during 2013-2015, from 0.1843 to 0.1937. It is obvious that, when inequality tends to decrease, it is the same as that of the economic regression at the time. When the economy recovers, inequality tends to increase accordingly. On the other hand, spatial inequality in Thailand according to the overview generally tends to decrease.

With regards to the 3 levels of inequality including between-region inequality, between-provincial cluster inequality, and within-provincial cluster inequality, it was found that (1) between-region inequality is still a crucial problem in Thailand at 55%. However, the tendency of this problem seems to decrease due to the fact that the expansion of economic development to other regions is more apparent. Meanwhile, (2) between-provincial cluster inequality is the inequality level with the least ratio, but is also the only one that tends to increase. This could be explained by the expansion of economic development to other regions causing a reduction of between-region inequality, which affects between-provincial cluster inequality and means some provincial clusters receive returns from economic development. Within-provincial cluster inequality (3) demonstrates that there are several provinces that receive returns from economic development; this has the second most important spatial inequality. Nevertheless, this type tends to decrease.

Table 2. *Overview of Inequality, 1995-2015*

Inequality	1995		2003		2005		2013		2015	
	Index	Cont.	Index	Cont.	Index	Cont.	Index	Cont.	Index	Cont.
between-Region	0.1214	59.63	0.1269	59.39	0.1310	59.82	0.1205	57.47	0.1118	57.73
between-provincial cluster	0.0286	14.04	0.0310	14.50	0.0350	15.98	0.0380	18.14	0.0330	17.02
within-provincial cluster	0.0536	26.33	0.0558	26.11	0.0530	24.20	0.0511	24.39	0.0489	25.25
Overall	**0.2036**	**100.00**	**0.2137**	**100.00**	**0.2190**	**100.00**	**0.2096**	**100.00**	**0.1937**	**100.00**

Figure 1. *Illustration of Inequality, 1995-2015*
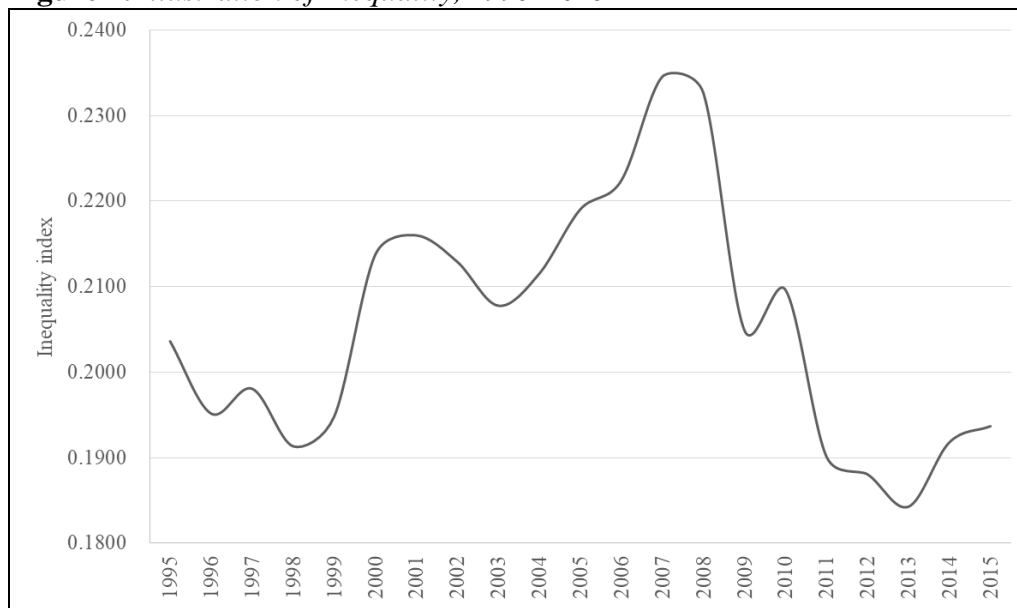
Between-Region Inequality

According to Table 2, it is evident that between-region inequality was crucial for Thailand, but was inclined to reduce, especially after 2007 (Figure 2). However, regarding the increase during 2013-2015, further analysis is required because it is possible that this might be too short a period.

The main force to reduce between-region inequality is the expansion of economic development to other regions. Table 3 represents GRP per capita and GDP per capita, which finds that the region with GRP per capita higher than GDP per capita is the central region. Meanwhile, the northeastern region has a number at the bottom rank during the years of study with five times the amount of data. On the other hand, it is clear when considering the growth rate that the northeastern region has a higher rate at 11.44% than the domestic growth rate per year. Conversely, the northern region has the lowest GRP per capita, with growth rate that is higher than the domestic growth, or 11.47% per year. In contrast, the central and southern regions are the first and second at the top of GRP per capita, with growth rates lower than the domestic level at 10.01% and 7.27%, respectively.

For this reason, between-region inequality remains a major problem for Thailand, though it does tend to decline over time.

Table 3. *GRP per Capita and GDP per Capita, 1995-2015*

Region	GRP per capita (USD/person)					Growth Rate (yearly average)
	1995	**2003**	**2005**	**2013**	**2015**	
Northeastern Region	589	688	976	1,562	1,936	11.44
North Region	859	1,005	1,582	2,330	2,828	11.47
Southern Region	1,680	1,843	2,698	3,841	4,124	7.27
Central Region	3,583	4,340	6,622	9,472	10,755	10.01
GDP per capita	**1,562**	**1,866**	**2,856**	**4,231**	**4,915**	**10.74**

Note: 1USD=31.3 THB, April 2018.

Figure 2. *Between-Region Inequality, 1995-2015*
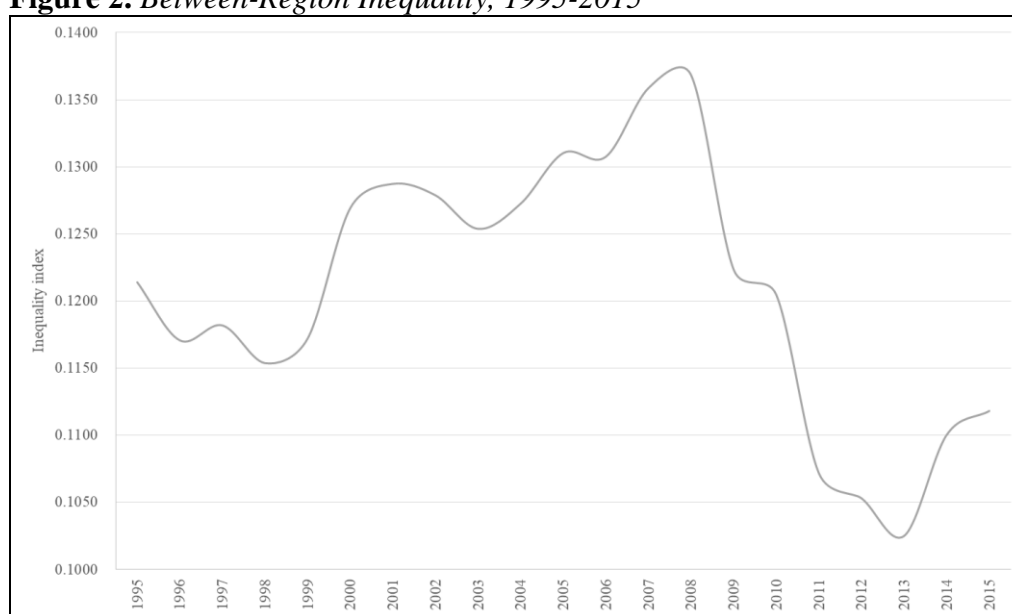
Between-Provincial Cluster Inequality

From Table 4 and Figure 3, it is observable that between-provincial cluster inequality tends to increase significantly from 0.0286 in 1995 to 0.0330 in 2015. Thus, this type of inequality has the tendency to increase. The reason is from the inequality between the southern provincial cluster and the central provincial cluster, which has average growth rates at 2.43 and 0.98 per year, respectively.

The increase of inequality between the southern provincial cluster and the central provincial cluster can be analyzed as stemming from economic development that obviously outperforms other clusters, resulting in a gap between economic return that is different from each other, specifically the growth of the Andaman cluster in the southern region and eastern cluster in the central region. In contrast, the growth rates of inequality in the northern region and northeastern region are influenced by the decrease of growth in other provincial clusters: the

Upper Northern Provincial Cluster 2, the lower northeastern provincial cluster 1, and the lower northeastern provincial cluster 2.

Table 4. *Between-Provincial Cluster Inequality, 1995-2015*

Region	Between-provincial cluster inequality					Growth Rate (yearly average)
	1995	2003	2005	2013	2015	
Northeastern Region	0.0007	0.0006	0.0006	0.0006	0.0006	-0.54
North Region	0.0018	0.0014	0.0013	0.0011	0.0008	-2.72
Southern Region	0.0012	0.0010	0.0005	0.0008	0.0018	2.43
Central Region	0.0249	0.0280	0.0327	0.0355	0.0298	0.98
Total	**0.0286**	**0.0310**	**0.0350**	**0.0380**	**0.0330**	**0.76**

Figure 3. *Between-Provincial Cluster Inequality, 1995-2015*
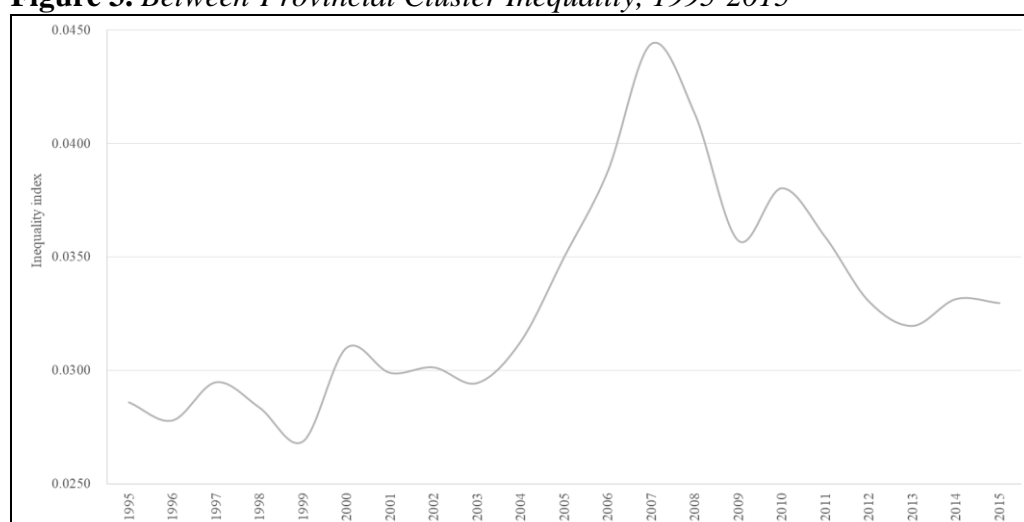
Within-Provincial Cluster Inequality

From Table 5 and Figure 4, it is clear that within-provincial cluster inequality tended to decrease from 0.0536 in 1995 to 0.0489 in 2015, while the central region had the highest within-provincial cluster inequality due to within-provincial cluster inequality in the eastern region and central provincial cluster.

Considering the provincial cluster, it was found that the group that had the highest inequality in the country was the eastern provincial cluster (Chantaburi, Chonburi, Trat, and Rayong), at 0.0151 in 1995. It was impacted from unequal economic development. In this case, Rayong was the province of leading industry in the country and had the highest GPP per capita. Its economy was more outstanding than other provinces in the same cluster, especially Chantaburi and Trat, which comprised provinces with agricultural-based economies.

Basically, the provincial cluster that has the highest growth rate of inequality is the upper northern provincial province 2 (Chiang Rai, Prae, Nan, and Phayao) at 241.33% per year. This is the effect of Chiang Rai's rapid development, an important border trading city for the country. Meanwhile, the economic foundation of other provinces is the agricultural sector. In contrast, the provincial cluster that has the least growth rate of inequality is upper central provincial cluster 1 (Nonthaburi, Pathum Thani, Ayutthaya, and Saraburi) at -3.71%. Every province in this cluster hasdeveloped its economy continuously, especially for industrial development in Pathum Thani, Ayutthaya, and Saraburi. Moreover, trading and property development in Nonthaburi affect the reduction of between-provincial cluster inequality.

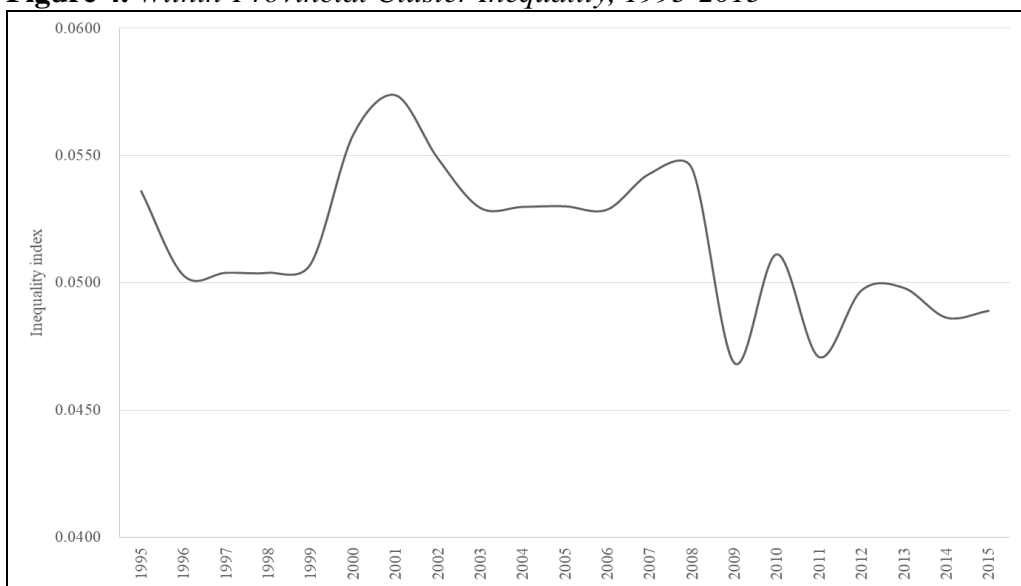**Figure 4.** *Within-Provincial Cluster Inequality, 1995-2015*

Table 5. *Within-Provincial Cluster Inequality,1995-2015*

Region/Provincial Clusters	Within-provincial cluster inequality			Growth Rate (Yearly Average)
	1995	2005	2015	
North Eastern Region	**0.0032**	**0.0026**	**0.0033**	**0.17**
Upper provincial cluster 1	0.0001	0.0000	0.0001	2.58
Upper provincial cluster 2	0.0000	0.0000	0.0001	5.71
Central provincial cluster	0.0014	0.0009	0.0012	-0.53
Lower provincial cluster 1	0.0015	0.0016	0.0016	0.38
Lower provincial cluster 2	0.0001	0.0004	0.0002	2.72
Northern Region	**0.0007**	**0.0014**	**0.0012**	**3.66**
Upper provincial cluster 1	0.0004	0.0008	0.0007	3.78
Upper provincial cluster 2	0.0000	0.0000	0.0000	241.33
Lower provincial cluster 1	0.0002	0.0002	0.0002	-0.99
Lower provincial cluster 2	0.0001	0.0004	0.0004	8.40
Southern Region	**0.0041**	**0.0033**	**0.0066**	**3.05**
Gulf of Thailandcluster	0.0011	0.0008	0.0015	1.98
Andaman cluster	0.0013	0.0008	0.0030	6.12
Border cluster	0.0017	0.0017	0.0021	1.30
Central Region	**0.0456**	**0.0457**	**0.0378**	**-0.86**
Upper provincial cluster 1	0.0092	0.0033	0.0024	-3.71
Upper provincial cluster 2	0.0000	0.0001	0.0002	37.77
Central provincial cluster	0.0131	0.0120	0.0088	-1.64
Lower provincial cluster 1	0.0035	0.0030	0.0043	1.02
Lower provincial cluster 2	0.0117	0.0095	0.0070	-2.00
Eastern provincial cluster	0.0080	0.0178	0.0151	4.39
Total	**0.0536**	**0.0530**	**0.0489**	**-0.44**

Conclusions

According to the inequality analysis, it was discovered that the spatial inequality of Thailand tended to decrease, specifically after the year 2007. The increasing number during 2013-2015 could be attributable to momentary lapses, which must be reassessed at a later time. The reduction of inequality is greatly affected by the reduction of between-region inequality, which is a result of the expansion of economic development, especially growth in the central region.

On the other hand, Thailand has encountered more spatial inequality in between-provincial cluster inequality, which means that various types of inequality exist behind closed doors despite the overview of the country tending to point to a positive trend. Particularly, between-provincial cluster inequality in the provincial cluster and region that has the highest economic growth reflects the concentration of spatial development. For this situation, it can be found that within-provincial cluster inequality is the significant factor. Although its overview tends to decrease, consideration of the provincial cluster with high inequality or the provincial cluster

with high growth rate of inequality shows that provincial development is different and unequal compared to other provinces in the same cluster.

As a consequence, future spatial economic development policies of Thailand, besides focusing on overall economic development in other regions according to spatial competence, should be required to emphasize in-depth development of the provincial and provincial cluster levels with policies that will specifically develop their capacity and connect spatial development with other developments.

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